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THE

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INDEX TO VOLUME XIII.

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Street Railway Journal.

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THE SYSTEM OF THE WASHINGTON, ALEXANDRIA & MT. VERNON RAILWAY.

Nearly every visitor to the city of Washington, whether he be from America or from abroad feels that his first trip to the national capital, at any event, is not complete without a pilgrimage to the tomb and former home of George Washington. The house and grounds at Mt. Vernon are preserved as a national park and situated as they are, about seventeen miles below Washington on the high banks of the Potomac River, they form a very pleasant objective point for a trip from the city. Up to within a recent time the only practicable means of transportation between Washington and Mt. Vernon involved a long and tedious trip from Washington to Alexandria, distant some seven miles, by steam boats running at infrequent intervals. A trip to Washington's former home required, therefore, on the part of the visitor, the expenditure of the greater part of a day. All this is now changed. Visitors can travel the entire distance by high speed electric cars, the city terminus of the electric road being at the corner of Thirteenth Street and Pennsylvania Avenue.

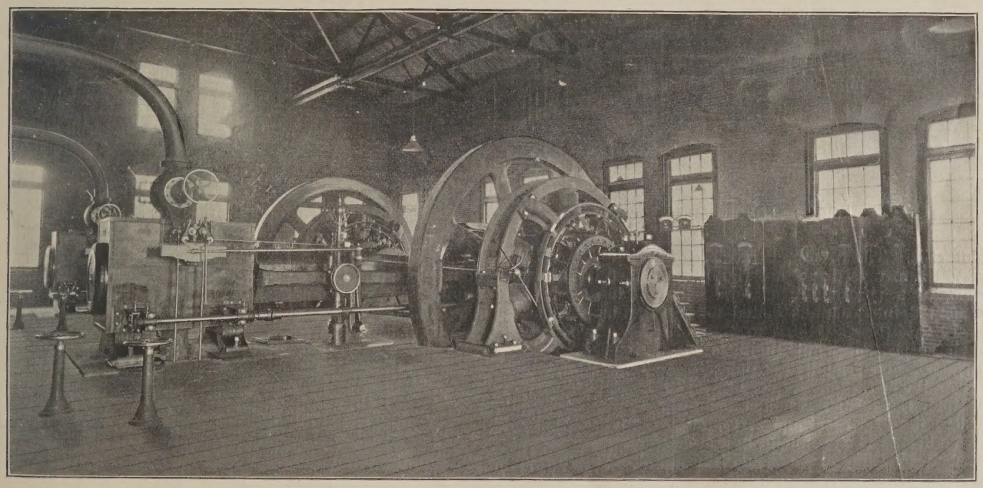

FIG. 1.—INTERIOR OF POWER STATION.

The portion of the line between Alexandria and Mt. Vernon, of the Washington, Alexandria & Mt. Vernon Railway, was built in 1892, and operated purely as an excursion road until June of last year, when the entire line from Washington to Mt. Vernon was opened. For a number of years following the first construction, those interested attempted to secure the passage of a bill by Congress authorizing the railway company to construct a bridge across the Potomac River for the extension of the road to Washington. Failing in this they succeeded in obtaining the right to occupy certain streets in Washington, and operate a ferry for the transfer of cars. The real intent of this bill was to secure the opportunity of making a junction with the tracks of the Pennsylvania Railroad Company, and thereby cross the Potomac by its tracks over Long Bridge. The electric railway company was then able to make a traffic arrangement with the Pennsylvania Railroad Company which, it is generally known, took a large part of the bond issue for the extension. With the recent opening of the completed line, the large interurban traffic expected between the two cities was realized at once, while the excursion traffic to Mt. Vernon has been greatly augmented by the attraction of a through rail route to the home and tomb of Washington.

The conditions outlined above demanded following steam practice in the construction of the line through the country while in Washington, some form of conduit system was obligatory, owing to the law forbidding overhead trolley wires in the city limits. The entire length of conduit construction in the city is one mile of double track, and of overhead trolley construction outside approximately twenty-five miles, taking in Alexandria, Mt. Vernon and Arlington Cemetery.

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CONDUIT SYSTEM.

The section in Washington operated by the electric conduit system consists of about one mile of double track with a loop at the terminus. The conduit illustrated in Figs. 2, 3 and 4 is patterned after that of the Metropolitan Railroad, of Washington. It is twenty-five inches deep, built of Portland cement concrete. Cast iron yokes, weighing about 280 lbs. and similar to those commonly employed in cable roads, spaced four feet six inches apart, support the rails (eighty-three pounds per yard) and also carry the slot rails. The conductor rails are of T section, weighing 23½ lbs. per yard and are rigidly suspended in the conduit from porcelain insulators. These insulators are cemented into castings bolted to cast iron boxes located every 13½ ft. and bolted to the slot rails and yoke. At each suspension point there is a large box and a smaller one opposite across the slot. The former has no bottom, the insulator holder being bolted in the corner, and serves as a manhole. The conductor rails are bonded by Chicago bonds and form a complete metallic circuit, one side being positive, the opposite being the negative return.

The cost of this underground construction per mile of straight single track with stone paving blocks relaid, was $35,000, exclusive of gas and water pipe changes and paving outside of track. The cost with asphalt paving was about $1600 per mile additional.

The contractors for the conduit construction were: general contractor—Edmund Saxton. Rails and special work—Pennsylvania Steel Company. Cast iron, small wrought iron and steel details—Diamond State Iron Company. Malleable iron and steel castings—Baltimore Malleable Iron & Steel Company. Electrical apparatus—General Electric Company. Electric plows and contact boxes—Detrick & Harvey Machine Company.

Inasmuch as a speed of eight miles an hour is the greatest allowable in Washington, the adoption of the above electrical equipment precluded the use of a 500 volt circuit in the city, as the motors taking current at the lowest point of the controller, after all resistance is cut-out, cause the car to run beyond the allowable speed. It was also thought inadvisable, of course, to operate the motors for any length of time through the resistances. Accordingly the city division is run on a separate circuit, and it was considered more expedient to purchase current at 220 volts from a local company, than to install some form of transformer system, at least for the present. This change of voltage complicated to no little extent the car wiring, and required a second controller. The various positions of the handle of this controller allow operation by the 500 volt circuit, or 220 volt circuit. The lamp circuits were made independent for each voltage. This required double the number of outlets and lamp fixtures, but simplified the wiring.

The change from overhead to underground contact is made as the cars, on entering the city limits, leave the tracks of the Pennsylvania Railroad. The chief object sought by the engineers at this point was to devise a method by which this change could be made quickly, and so well has

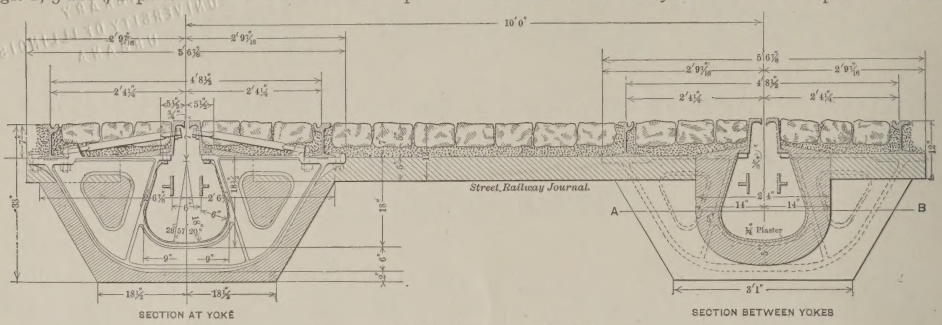


FIG. 2.—CROSS SECTION OF CONDUIT.

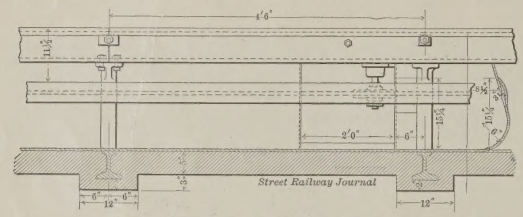


FIG. 3.—LONGITUDINAL SECTION.

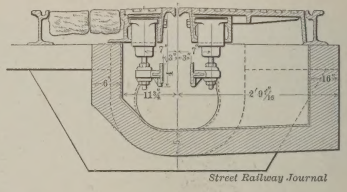


FIG. 4.—CROSS SECTION AT MANHOLE.

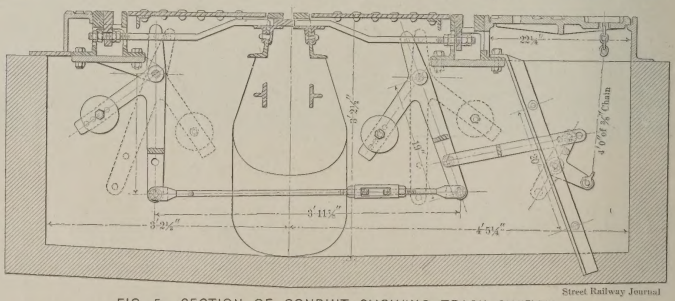


FIG. 5.—SECTION OF CONDUIT SHOWING TRACK SWITCH.

this been accomplished that the change from underground to overhead conductor is made without bringing the car to a stop, the electric plow being automatically detached from the truck.

This is accomplished as follows: the plow when in position is suspended from the car truck as shown by Figs. 6 and 7. The current is taken from the conductors by the spring contacts, *B B*, is carried up through the shank of the plow and is transmitted to the car by the conductors, *e e*, through the junction boxes, *E E*. The plow is supported on the truck by the brackets, *C C*, upon which it can slide sideways, but which hold it rigidly in the direction of the car movement.

When the car approaches the change pit where the plow is to be removed, as shown in Figs. 6 and 8, the plow is guided sideways by means of the curved offset in the slot rails till disengaged from the carriers or hangers, *C C*. The rollers on the lower sides of the plow, *A A*, have previously entered the channel rails, *H H*, below the street surface. These rails carry and guide the plow down through the trap, *N*, and into the pit as shown. The plow is then pushed around to the proper position in which it can be attached to the truck of the next car going back. The trap is opened and closed by means of levers, operated by the man tending the pit. The contact boxes break the electrical connections automatically.

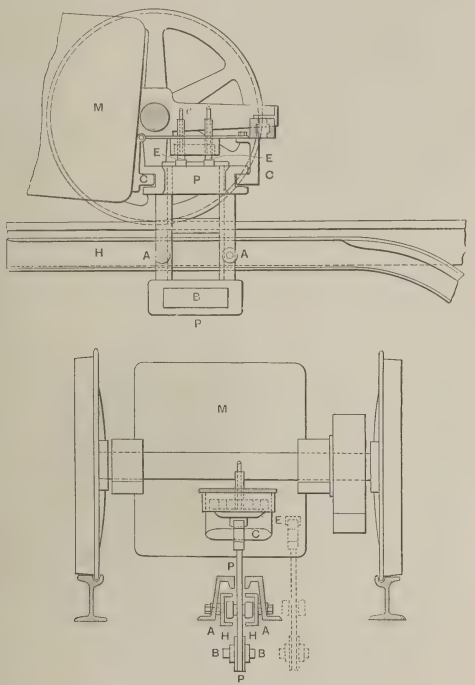


FIG. 6.—METHOD OF HANGING PLOW—SIDE AND END ELEVATIONS.

This method of carrying the plow provides a perfect safeguard against injury to plow and electrical apparatus in case of misplaced track and slot switches, or the derailment of motor car. The plow under such conditions would drop out from its hangers automatically on the same principle as at the curved offset and change pit, but with this difference that the head of the plow would rest on top of the slot-rails. The car and plow could then be pushed back to the nearest slot hatch and the plow returned to its place with but a few minutes' delay.

OVERHEAD SYSTEM.

After making the junction with the Pennsylvania Railroad the electric railway uses the tracks of the former for about a mile in crossing Long Bridge, and its approaches on the Virginia side the single track of the electric railway branches from the Pennsylvania Railroad and runs practically parallel to the latter to Alexandria, about six miles distant. A branch runs from an intermediate point to Arlington Cemetery. There are turnouts at frequent intervals.

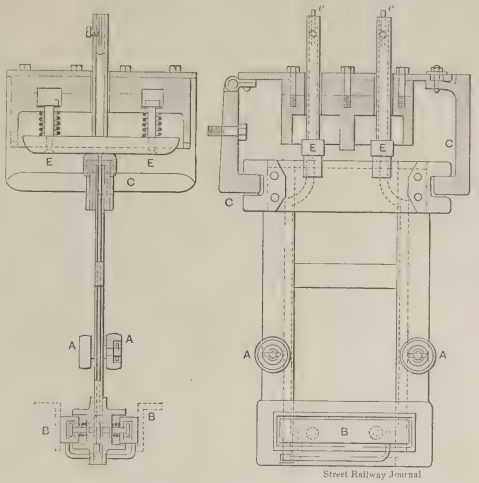


FIG. 7.—PLOW—ELEVATION AND SECTION.

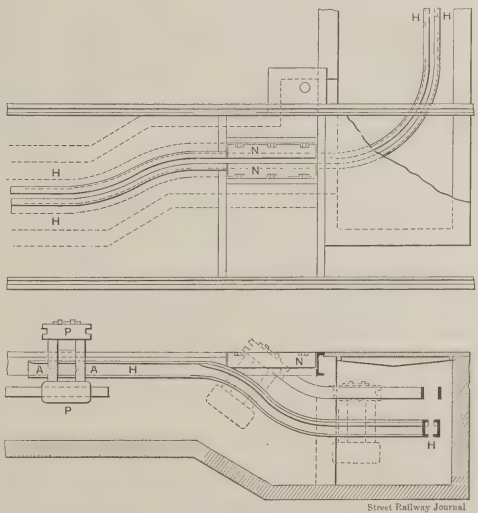


FIG. 8.—METHOD OF DISENGAGING PLOW—ELEVATION AND PLAN.

With regard to this part of the line, in roadway, bridges and track, the practice of the Pennsylvania Railroad was followed as closely as consistent; ties 6 ins. × 8 ins. × 8 ft. 6 ins., rails 60 lbs. per yard, No. 8 frogs at turnouts, rock ballast.

From the traffic reports of the Pennsylvania Railroad it was a matter of figures to show that three car trains at

such intervals as it was considered possible to sandwich them in among the trains of the Southern, Cheseapeake & Ohio, and Pennsylvania Railways, all using Long Bridge, would accommodate the interurban travel that might be expected. From this followed the equipment of the motor cars with 100 nominal horse power motors, for a train having two 150 k. w. belted units. This plant being inadequate, of course, for the loads of the interurban service, a new station was erected on an inlet of the Potomac, midway between Washington and Alexandria. The plant is designed to operate six trains of three cars each with one unit, with a spare unit for reserve, and space for a third.

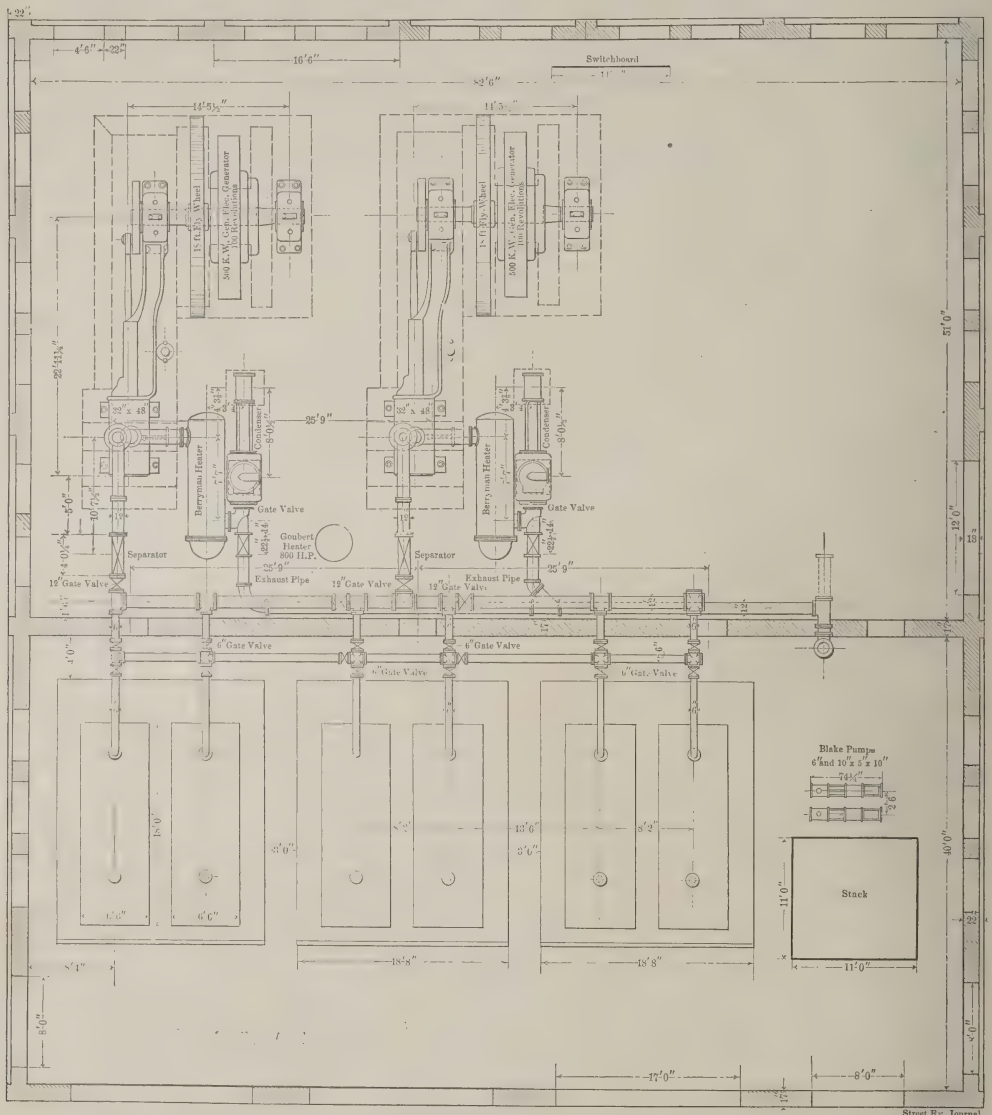


FIG 9.—PLAN OF STATION.

weighing 40 tons empty. It should be noted that the road, for one operated electrically, is unusually free from steep gradients, the most severe being 1.4 per cent for about 1500 ft. The motors are G. E. 2000 with single turn armatures.

POWER STATION.

The portion of the line first built was operated by a small condensing station, a few miles below Alexandria. It will be noticed that this was the first step toward providing the capacity it was expected would finally be required, and toward the ideal layout of apparatus (namely, three equal units, two of which are equal to the maximum load), involving the least outlay of idle capital and the maximum flexibility and economy of operation. Fig. 9 shows a plan view of the building with location of boilers, engines, etc. In determining upon the class of

engines to be used, Mr. Flint, the expert engineer of the railway company, went very fully into the question of simple *vs.* compound, and decided in favor of the former, the correctness of which later operation proved. However, the possibility of compounding becoming sometime desirable was kept in mind, and the contract having been let to the Providence Steam Engine Company for two 32 in. × 48 in. improved Greene engines, to be direct coupled to two 500 k. w. multipolar General Electric railway generators, the foundations were so constructed as to admit of the future installation of the high pressure cylinder, producing a machinery that when the high pressure cylinder was coupled on there would be a passageway between the head and the wall, the opening allowing room for taking out the piston and piston rod. This arrangement resulted in a compact engine room with, however, ample room around the machinery.

The engines are of heavy design, adapted to the severe and sudden strains of railway service. The flywheels weigh 60,000 lbs. each. The generators are of the well known style of the General Electric Company, and were required to fulfill the following conditions: each gener-

PLATE BRIDGE.

CURVE CONSTRUCTION. STRAIGHT TRACK, PARALLEL TO PENNSYLVANIA RAILROAD.

FIG. 10.—VIEWS OF LINE.

tandem compound engine. The load conditions that a year's operation brought out would determine the size of the high pressure cylinder that would result in an engine adapted to meet these conditions most economically. The possibility of such an engine had, of course, to be taken very carefully into account in the design of the engine house; for a tandem compound engine of 1000 h. p. is a fairly long machine, and it seemed an unjustifiable expense to lay out the engine room accordingly, on a mere probability.

This matter was disposed of by the simple expedient of providing openings in the wall between the boilers and engines directly behind the latter, and so locating the ator to be capable of delivering at its terminals 833 amperes at a pressure of 600 volts for a continuous run of ten hours without any part of the machine being heated more than 100 degs. F. above the atmosphere; each machine to be overcompounded ten per cent and to operate with an overload of twenty-five per cent without injurious sparking; the insulation resistance between armature and ground, series winding and ground, shunt winding and ground, and between shunt and series windings, to be not less than one megohm.

An important feature of the apparatus is the heavy flange cast with the hub of the wheel, and flaring to a diameter of about four feet, and faced for bolting to the

spider or arms of the armature. This, of course, is a great aid in relieving the strain on the keys in case of short circuits.

As shown in Fig. 9 the boilers are back to the engines. There are six horizontal tubular boilers in three batteries, each 72 ins. diameter × 18 ft. long, built by

FIG. 11.—EXTERIOR OF STATION.

the Bigelow Company. The horizontal seams are treble riveted butt-joints with double cover plates. The gases from the boilers pass to the brick stack base by a wrought iron flue. The steel portion of the stack is 78 ins. diameter, 90 ft. high, resting on a brick base 30 ft. high. The stack is self-supporting.

FIG. 12.—ENTRANCE TO LONG BRIDGE.

Fig. 9 shows the main steam piping, which is novel. Every precaution has been taken to prevent the plant having to shut down from failure of steam pipes. To effect this, Mr. Flint put in a six inch header as auxiliary to the main twelve inch, with controlling stop valves at suitable points. Though only six inches, whereas the main header is twelve inches, the auxiliary is sufficient for emergencies to tide over any temporary failure of the main piping. By this arrangement in case of accident to the twelve inch, by shutting down one unit and starting up the other, operation may be kept up without the delay of firing up other boilers. The feed is drawn from the river by two feed pumps, one being a reserve. They are of the single compound type, having a six inch high on a ten inch low pressure cylinder, five inch water cylinder, ten inch stroke, furnished by The Geo. F. Blake Manufacturing Company. The cold feed drawn from the river is forced through an intermediate horizontal Berryman heater located between the engine and condenser, as shown in the plan. From the intermediate it passes to a supplementary upright Goubert heater, of 800 h. p. capacity, taking the exhaust from the feed and air pumps. It should be said that each engine is provided with its own intermediate heater and independent condensing apparatus, the two units being duplicates in every respect. There is a bye-pass for the feed around each heater. Stratton separators on the main steam pipes to the engine catch the condensation which is returned to the boilers by a receiver and automatic pump in the basement.

The switchboard (Fig. 14) is worthy of special mention. In it a departure was made from the standard General Electric Company railway board in which the positive and negative bus bars are but a short distance apart. Everything on each generator panel carrying current is negative, there being but one dynamo switch on a panel. One panel carries the three main dynamo switches, the extra, or third switch, being for the future unit. This layout effects a minimum distance of about eighteen inches between the positive and negative conductors nearest together.

On the switchboard there are three feeder panels. One controls the line between a circuit breaker before the station and Alexandria, where there is a circuit breaker dividing the old line from the new. At this latter point there is located a switch, by throwing which the whole line may be operated from the new station during light travel on the lower end, making it not worth while to start the lower station or when the travel on the lower end is too heavy for the old station to carry alone. The

FIG. 13.—DEEP CUT AND FILL.

second feeder panel controls the line between the new station and Long Bridge, and also the Arlington branch. The third panel covers the part of the electric system over the tracks of the Pennsylvania Railroad, that is on Long Bridge and its approaches. The feeders to this part of the line serve it alone.

The power station is an exceedingly substantial and

practically fireproof building. The walls are of brick laid in cement mortar of one part of cement and two parts river sand, and are reinforced by pilasters. This work on the station was done by day under careful supervision, the bricks being laid solid in cement jointed through and through. No grouting was permitted. There are five flat

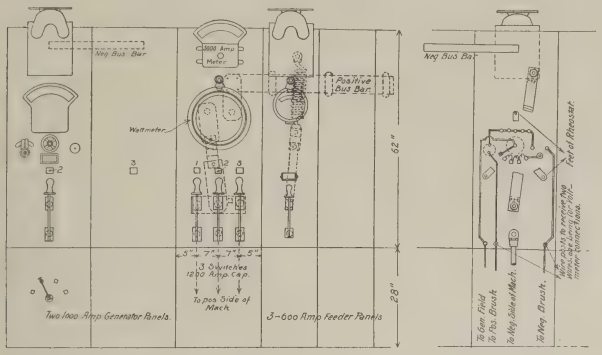


FIG. 14.—SWITCHBOARD.

steel trusses over the boiler house and four over the engine room. The latter trusses are designed to carry 10,000 lbs. at any point. There is no traveling crane, but vertically over the engine shafts suspended from the roof trusses there is a continuous line of I beams, making it an easy matter to lift off the caps of the bearings, etc. The engine room floor is supported by steel beams on brick columns. The flooring is double, the under layer being three inch pine. All the erection work was done on this and the top of edge grain Georgia pine, afterward laid when all the dirty work was over.

The commercial tests of the plant were very satisfactory. A load was put on the generators by carrying

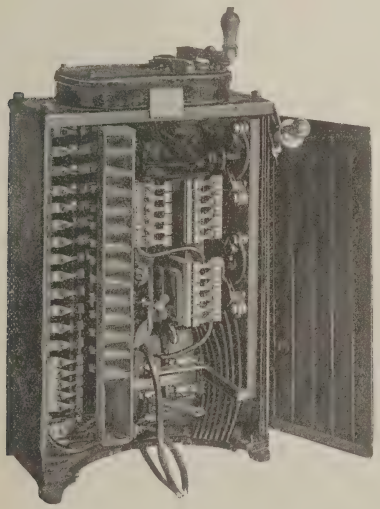


FIG. 15.—CONTROLLER.

loads from the switchboard to two wrought iron plates each about 2 ft. × 2½ ft. suspended vertically in a brine tank into which a stream of water was constantly kept running. Each unit was run five hours, the engines running smoothly, the generators not sparking, and not showing a maximum temperature of over 120 degs. F. after the run. The voltage being 600, the generators developed 500 k w. each, or about 671 h. p. Adding ten per cent for friction of engine and generator makes a total of about 750 h. p. Now the steam piping, which afterwards was covered with magnesia, was at this time uncovered so that the losses from condensation must have been considerable, so that the total horse power developed by the boilers could not have been far from 800, on the Centennial basis. Four boilers furnished steam easily during the tests—an excellent showing.

OVERHEAD SYSTEM.

The main considerations governing the electric overhead system were: 1. Provision

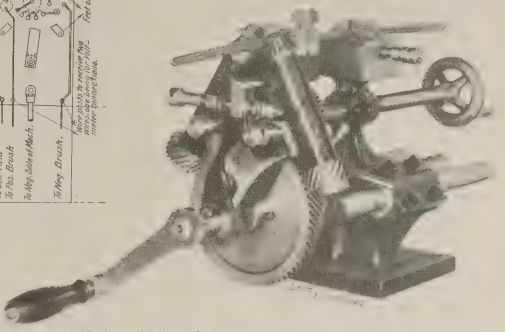


FIG. 16.—MILLING MACHINE FOR TROLLEY WIRE.

for successful operation at a speed of forty miles or more per hour. 2. Provision for operating independently that part of the line using the Pennsylvania Railroad tracks. 3. Substantialness, implied in the first consideration above.

The form of trolley, choice of conductor for the trolley, method of its suspension and feeder capacity, enter into No. 1. Regarding design of trolley, Nan-

FIG. 17.—VIEW SHOWING DOUBLE TROLLEY WIRE.

tasket experience demonstrated that the form of groove customary in street railways was not adapted to high speed service. The usual contracted groove designed to follow the contour of the wire was found to cause the trolley to bind on curves and so leave the wire. Experiment showed that the narrow groove is unnecessary for taking off current and led to the adoption of the open groove,

shown in Fig. 21. This wheel also has a larger diameter than is customary.

On the other hand the engineers decided not to use the form of conductor installed at Nantasket. While straight, this wire was all right, but once kinked, it was thought liable to throw the trolley off. After careful consideration they decided to put up a No. 0000 hard drawn copper wire. This, of course, necessitated a different method of suspension from that usually employed. A chief advantage of the Nantasket trolley conductor is that that form can be so held by the clamp or car, that the latter is well clear of the course of the trolley wheel. To accomplish this same result with the No. 0000 wire the General Electric Company got up a special suspension clamp, shown in Fig. 20, designed to grasp the trolley wire by grooves milled in the sides. The milling of the wire was accomplished by a special tool (Fig. 16). This milling tool was mounted on the tower wagon, and driven to the high speed necessary for working copper, about 1700 r. p. m. Two men turning cranks below supplied power transmitted by belting to the milling machine. With this outfit about five suspensions could be milled hourly under the best conditions. A tight and permanent hold is made on the wire by the screws in the clamp, and by afterward beading over the ends of the screws to prevent their working loose.

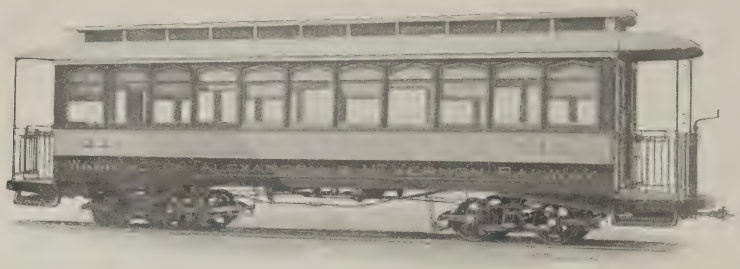


FIG. 18.—TRAIL CAR.

This method of suspension permits of a smooth underrunning trolley at practically any speed, and, though the clamps have lost their hold in a few cases, they are very satisfactory on the whole.

High speed at turnouts is impracticable with any form of overhead frog or switch yet devised. Two trolley wires got rid of this difficulty. They are as near together as the hangers permit. This construction involved very little extra first cost in this case, as the extra trolley wire could be furnished and strung nearly as cheaply as if it had been in the form of feeder to which it is really equivalent, owing to the location of the line circuit breakers.

The line everywhere was put up in the most substantial manner. Though the road is single track, cross suspension was used as offering greater security. Poles are located 100 ft. apart on straight track, much nearer on curves. On Long Bridge span wires were stretched at intervals of 40 ft. from one truss to its opposite in preference to using a rigid suspension from the top lateral bracing of the bridge. The overhead line work as well as the construction of roadbed and track was done by Trask, Burns & Company.

CARS.

The cars are run in trains consisting of one motor car and two trail cars. The motor and trail cars are 40 ft. long,

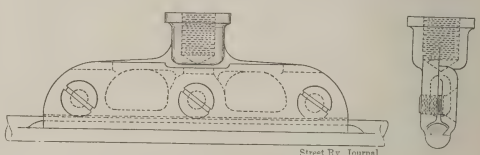


FIG. 20 —TROLLEY WIRE CLIP.

seating forty-four, have double trucks, reversible seats, lavatory, water cooler and all latest improvements, including the Standard Air-Brake Company's brakes, geared type, which are giving very good satisfaction. The motor cars are vestibuled, have maximum traction trucks, and weigh unloaded about twenty tons. The trailers weigh unloaded about twelve tons. All the cars were furnished by the J. G. Brill Company.

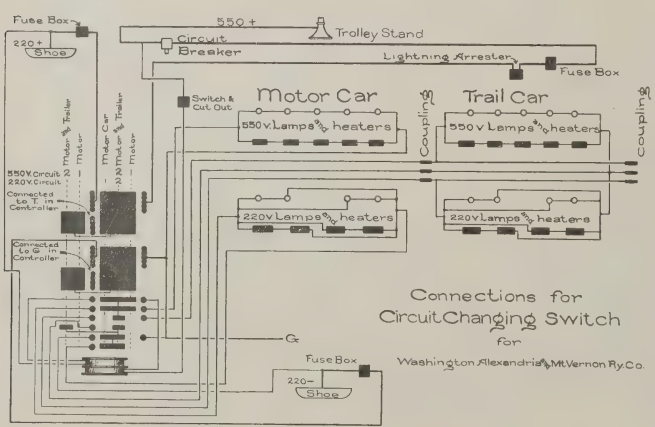


FIG. 19.—DIAGRAM OF CIRCUIT CHANGING SWITCH CONNECTIONS.

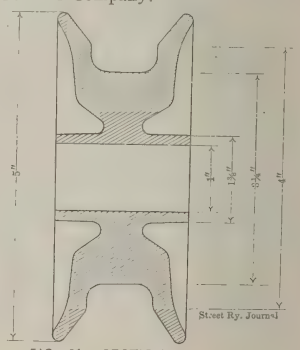


FIG. 21.—SECTION OF TROLLEY WHEEL.

CAR HOUSE.

The cars are housed in a fireproof building (Fig. 22) near the power house, 75 ft. × 160 ft. and of steel construction throughout. The trusses are the Fink design covered with corrugated steel roofing, and supported by eight inch steel I beams. The use of I beams for posts allows of

cheap fireproof construction by running up an eight inch brick wall between the posts, held by the flanges. The tracks in the barn were laid with a grade of about two per cent to insure the motor cars starting by releasing the brakes.

OPERATION.

The operation of a road of this character requires organization and operating rules, modeled closely on railroad practice, which were the more necessary on account of the joint operation with the Pennsylvania Railroad. Over the latter's tracks the employes are subject to the same rules, as are the steam road's employes. The trains are run on the block system of safety signals and all switches are interlocking on this division; on the rest of the road trains run by rule. There is a train despatcher in Washington, an operator at south end of Long Bridge, one at the junction of the Arlington branch, one at the new power house, one at Alexandria and one at Mt. Vernon. The movements of all trains are recorded. The operating rules adopted are those in use on the Pennsylvania Railroad modified to suit the electric railway.

FIG. 22.—CAR HOUSE.

The operating officers of the company are: president and general manager, G. E. Abbott; general freight and passenger agent, G. R. Phillips; superintendent of motive power, J. Colvin, to whom the successful working of the complicated car mechanism is due.

The constructing engineer for this trolley system and power station was B. P. Flint, of New York, to whose personal attention to details the successful solution of the many problems in the construction of the system is due. He was assisted by W. B. Upton, consulting engineer in charge of the electric conduit construction.

The Plant of the Toledo Traction Company.

The Toledo Traction Company now owns and operates all of the street railways in the city of Toledo, comprising in all about 120 miles of single track, and completely covering the entire city. In some cases the lines extend beyond the city limits into suburban localities. The company was incorporated on July 1, 1896. The capital stock amounts to $6,000,000, of which $2,000,000 is preferred stock and $4,000,000 common stock. The company has acquired by consolidation and merger all of the assets, property, rights and franchises formerly belong-

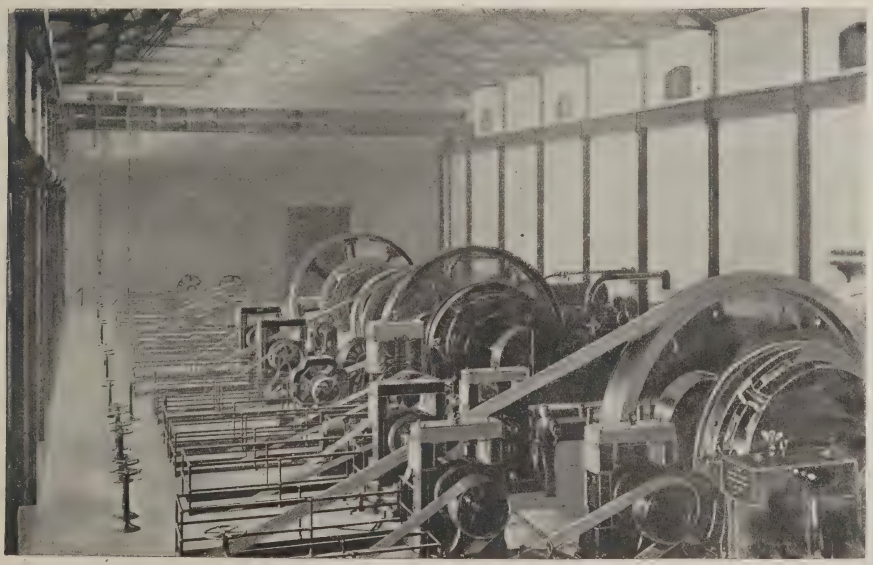


FIG. 1—.EXTERIOR OF POWER STATION, TOLEDO.

ing to the Toledo Consolidated Street Railway Company, the Metropolitan Street Railway Company, the Central Street Railway Company, the Ironville Street Railway Company, the Toledo Electric Railway Company and the Toledo Electric Street Railway Company.

The entire system is operated by electricity. The various lines composing it have been completely equipped for mechanical traction during the past few years. The present car equipment consists of 119 closed cars, 100 open cars, 29 trailers, 284 motors, 5 snow plows, and about 147 trucks, all of modern construction.

The street construction is entirely modern, as all of

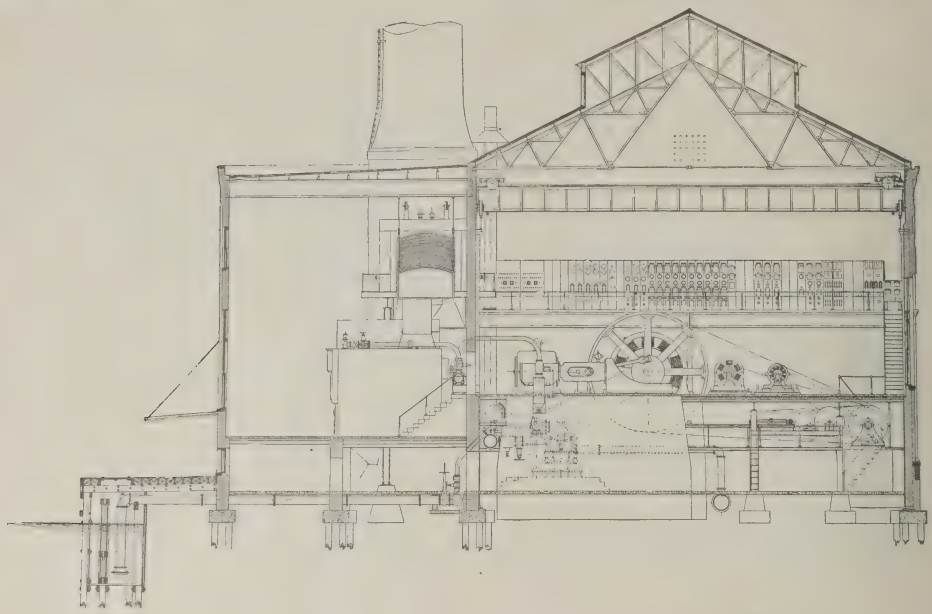


FIG. 2.—CROSS SECTION OF POWER STATION, LOOKING TOWARD SWITCHBOARD.

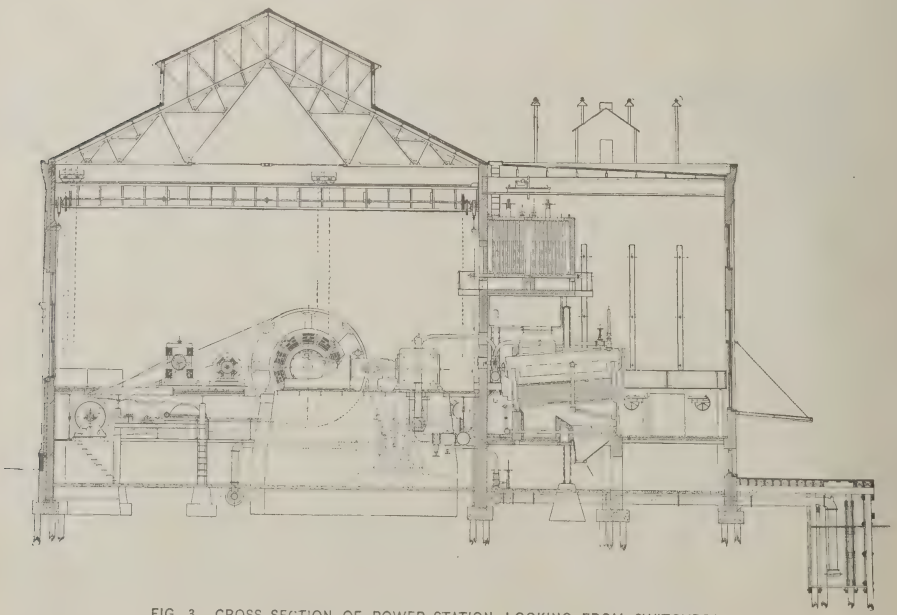


FIG. 3.—CROSS SECTION OF POWER STATION, LOOKING FROM SWITCHBOARD.

the track has been rebuilt within the past five years with heavy girder and T rails and with the best quality of oak ties, averaging about 2600 to the mile. The streets on which the tracks are located are for the most part substantially paved with stone, brick, asphalt and wood paving.

The new fireproof power station, which has just been completed, is located on the Maumee River in the center of the city. It is modern in all its appointments and will be, if the estimates of its builders and owners are true, exceedingly economical in operation. The accompanying illustrations show the general design and construction of the plant.

Fig. 1 is a general view of the dynamo room showing the generators which are used for the lighting business conducted by the company as well as those for street railway service. Fig. 2 is a cross section looking toward the switchboard. Fig. 3 is a cross section of the station looking from the switchboard. Fig. 4 is a sectional side elevation showing the boiler room side of the plant. Fig. 5 is a plan view of the station, showing the boiler room, engine room and generator room arrangement. Fig. 6 is a general view of the boiler room. Fig. 7 is an exterior view of the station, and Fig. 8 is an interior view of the station, showing the switchboard.

The over-all dimensions of the station are 212 ft. × 116 ft., and the frontage on Water Street being 212 ft. and on Monroe Street, 116 ft. The building extends to the river from which water is taken for condensing purposes. Adjoining the station there is ample room for future extensions. The building is of steel frame with brick walls and slate and tile roof, and is set on a foundation of piling, concrete and brick.

The engine room, shown in Figs. 1 and 8, and in plan in Fig. 5, measures 208 ft. × 70 ft. Its equipment consists of six engines. Four of these were built by the American Wheelock Engine Company, and are of the cross compound type, running at a speed of ninety revolutions per minute. The high pressure cylinders on each of these four engines are eighteen inches in diameter, the low pressure cylinders forty-eight inches in diameter, and the stroke is forty-eight inches. These four engines are connected by rope drive to a hammered and turned wrought iron shaft 6½ ins. in diameter and 172 ft. long. This shaft is located in the basement as shown in Figs. 2 and 3. Provision is made for connecting the generators with this shaft by means of three friction clutch couplings and three flange couplings all built by the Hill Clutch Company. Leather belts are used for connecting the generators with the pulleys on the countershaft.

In addition to this engine equipment there are two Porter-Allen engines of the tandem compound type, running normally at 150 r. p. m. The low pressure cylinders are fifteen inches in diameter, the high pressure cylinders thirty-six inches in diameter, and the stroke is thirty inches.

The boiler room, shown in Fig. 6, and also in plan in Fig. 5, measures 208 ft. × 38 ft. The equipment consists of four 500 h. p. Heine Safety water tube boilers, and four 300 h. p. Stirling boilers. These are fitted with two Hawley down draft furnaces and six McKenzie furnaces. The feedwater heaters were furnished by the Fuel Economizer Company,

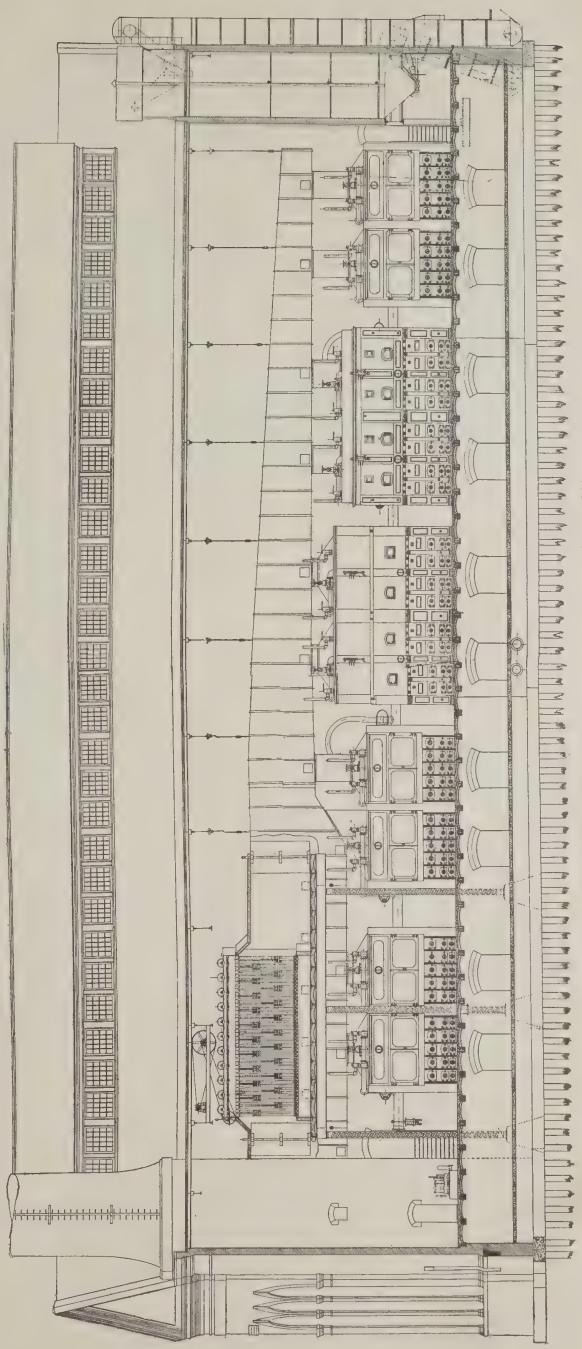


FIG. 4.—LONGITUDINAL SECTION OF BOILER ROOM.

The separators are of the American Wheelock and Porter-Allen types. The coal handling machinery was furnished by the John A. Mead Manufacturing Company. The crane used has a capacity of twenty tons, is operated by hand power and was supplied by the Brown Hoisting & Conveying Machine Company. No mechanical stokers are used. The pumping outfit consists of four direct belted Cramp pumps, and two Blake steam pumps. Jet condensers are used of the American Wheelock and Blake types.

The piping of the plant is lap welded with cast steel flanges and is covered throughout with Magnesia sectional covering. The gate valves used are of the Chapman type.

The boiler room stack is 230 ft. high, thirteen feet inside diameter, and is built of steel lined with firebrick and tile. Its position and exterior form are shown in Fig. 7 and also in the sectional plan, Fig. 5.

The electrical equipment of the power station consists of both lighting and railway generators. The machines used are General Electric direct connected generators for railway and power service; Fort Wayne generators for arc lighting; Westinghouse generators for alternating current lighting, and Edison generators for power and lighting where the distribution is made by the three-wire system in underground conduits. These generators are connected with the engines and with the countershaft, as shown in the plan view, Fig. 5.

The switchboard, shown at the end of the generator room in Fig. 8, is constructed entirely of white Italian marble, two inches in thickness, polished on the front face and smooth on the back. It is of the panel type with a separate panel for each dynamo, excepting in the three-wire system where one panel contains the necessary switches and instruments for four machines. Each feeder has a separate panel, except that the three-wire system provides for eight feeders on each panel, and the railway panels are fitted for two feeders each. The entire board is 100 ins. in height. The panels are attached to an iron framework made of T bars. The iron of each section of the board is insulated from every other section and from the ground. The entire length of the board is about sixty

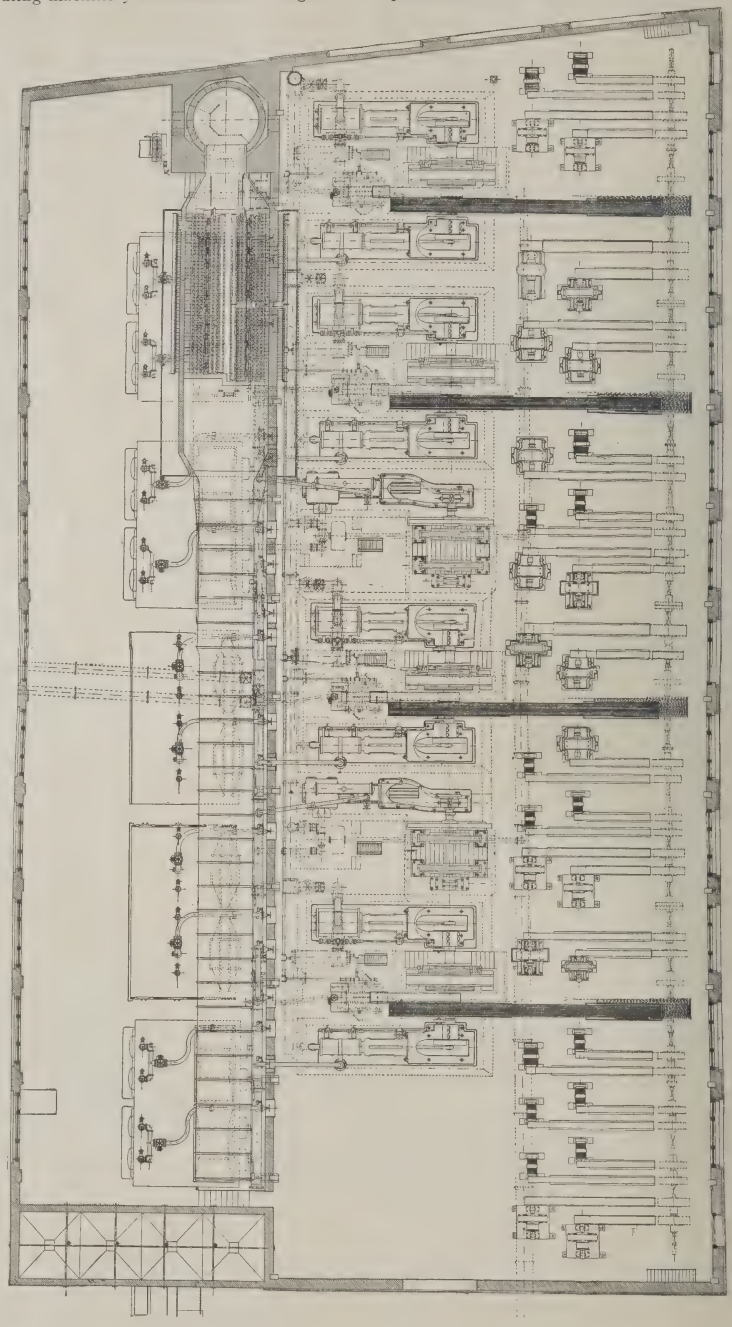


FIG. 5.—PLAN OF POWER STATION.

feet. The instruments used are of the General Electric and Weston types.

The Toledo Traction Company, through the Toledo Consolidated Street Railway Company and the Western Electric Light & Power Company, controls, with the exception of the business of one small company, all of the electric lighting, public and private, and the power business in the city of Toledo. The franchises are perpetual and the Toledo Consolidated Electric Company has also a perpetual franchise for subways and conduits extending over the entire city which it has installed throughout the business district. Into these conduits are placed the feeders for the railway and lighting circuits, and with them are connected the entire underground system for the lighting of the central portion of the city and for the distribution of power. During the coming year all the poles in the business district now used for supporting wires for the transmission of power for lighting and otherwise, except for the support of the trolley wires, will be removed. The companies have a contract with the city of Toledo for lighting the streets which does not expire until January, 1900. The lighting and power business of the company is as follows: city arc lights, 719; commercial arc lights, 304; incandescent lights, 30,578; motors, 923 h. p.

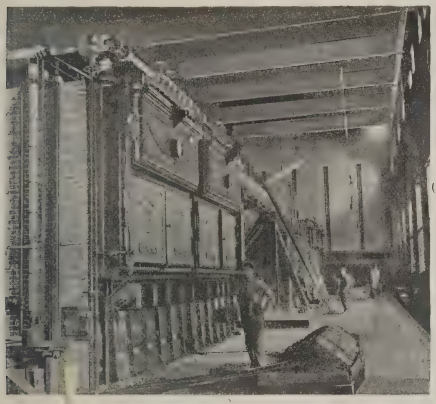


FIG. 6.—BOILER ROOM.

The combined earnings of the railway companies forming the Toledo Traction Company and the electric light companies now controlled by it, for the year ending June 30, 1896, previous to the consolidation, were: gross,$910,414; net earning after deducting taxes and all other charges $342,921. The present annual fixed charges are $254,100.

The earnings of the companies for several years past have shown marked and continuous increases, notwithstanding the general business depression. This is largely due to the prosperity of Toledo, and its constant increase in population. As shown by the census of 1890, the city had a population of 81,434. The registration in 1896 amounted to 27,145, indicating a population by a most conservative estimate of at least 120,000. It is reasonable to expect that the railway business will continue to have a steady and substantial growth. The power and light business is said to be capable of rapid expansion, as up to the present it has been impossible for the light companies to supply the increasing demand for service. On this account the large additions which have been made to the plant during the present year will, it is thought, insure largely increased earnings from this department. It is estimated that the gross earnings for the coming year will exceed $1,000,000. The proportionate increase in the net earnings should be much larger, for by the consolidation of the properties and by abandoning three power houses and operating the entire railway system and electric lighting from the central power station, the percentage of operating expenses to gross earnings ought to be substantially reduced. It is believed the combined operating expenses should not exceed fifty-five per cent of the gross receipts, and it is more than probable that they will be reduced below this sum. The company has no leases, guarantees or fixed charges other than the interest of the bonds and no floating debt except current liabilities incurred in the regular operation.

A word about the city of Toledo itself will serve as an indication of the possibilities of the development of the railway system. The city has had a gradual and substantial

FIG. 7.—EXTERIOR OF STATION.

growth in the past and its diversified manufacturing interests have steadily increased for many years. The large registration shows how great has been the advance in population, and its wealth and the improvements in the city have increased proportionately. It enjoys exceptional natural advantages. There are eleven systems of steam railroads with twenty-three lines centering in the city. The harbor on the Maumee River is one of the best on the

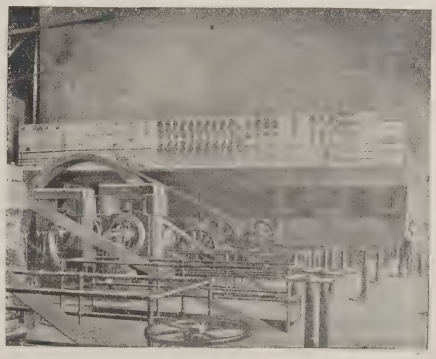


FIG. 8.—SWITCHBOARD.

great chain of lakes. It is a large manufacturing and distributing center. Its close proximity to the soft coal fields, to the oil and natural gas regions, together with its facilities for transportation and distribution in this central locality, afford exceptional opportunities for manufacture and trade.

The photographs illustrating this article were taken by Mr. Geo. A. Cooke, assistant to the general manager of the Toledo Traction Company.

IT IS stated that the Hanover (Mass.) Street Railway may be extended to Whitman.

An Interurban Electric Passenger and Freight Railway.

The Norfolk & Ocean View Railroad, of Norfolk, Va., was one of the first if not the first, steam railway in the country to give up steam and adopt electricity as a motive power. This line was operated seventeen years by steam, and has been an electric line for eighteen months. Standard steam railroad practice is followed in every detail except in the motive power equipment. The line is 9½ miles long, single track with sidings at convenient intervals. Seventy pound T rail is used exclusively and 2500 sawed ties are employed to the mile. The company owns its right of way and the roadbed is high and well graded. The overhead construction is supported by iron brackets on octagon sawed pine poles and is built to stand heavy current and high speed. The trolley wire is No. 00 hard drawn copper and the feeders are 500,000 c. m. cable and No. 0000 solid wire. The feeders are tapped every eighth pole for trolley wire and a lightning arrester is connected in the line at the same distances.

FIG. 1.—MOTOR CAR DRAWING FOUR LOADED FREIGHT CARS.

The track is well bonded with No. 00 copper wire and rails are cross bonded every eighth of a mile. Ground plates are connected to the tracks at two streams of water which the line crosses.

The power station and car house are located at Oak Wood, midway between Norfolk and Ocean View. The power house is a handsome, fireproof building, of brick with iron girder roof. It is well lighted by numerous windows as well as by ventilators and skylights in the roof. The engine and boiler room are divided by a heavy fireproof wall, the doors of which are protected by iron plates.

The boiler room is 90 ft. × 50 ft., and is equipped with four Wood water tube boilers, of 225 h. p. each. The safety valves on these boilers are set to blow off at 125 lbs. steam pressure. The floor is of stone. There is a side track at the side of the fire room and coal is unloaded directly in front of the boiler door. Fig. 1 shows a motor car shifting a coal train at power house. The total weight of the motor car and four loaded coal cars shown was 368,000 lbs. The radius of the curve is 22 degs.

The engine room is 90 ft. × 60 ft. The engine equipment consists of two tandem compound Frick-Corliss engines, with cylinders 14 ins. and 28 ins. × 42 ins. stroke, and two tandem compound Ball engines, with cylinders 10 ins. and 18 ins. × 12 ins. stroke. The Frick engines take steam at 100 lbs. pressure and make 80 r. p. m. They are direct belt connected to two 200 k. w. Walker multipolar generators. The Ball engines are connected to two 75 k. w. Westinghouse, alternating current lighting machines. The current from these dynamos is transmitted 4½ miles to Ocean View at 1100 volts, and there stepped down to 100 volts for lighting the Ocean View Hotel and grounds of the hotel and railway company.

The switchboard is of Tennessee marble, on a steel frame, which stands four feet out from the wall. The board is finished in highly polished quartered oak. One main panel contains circuit breakers and section switches for the six feeder sections of the road. The center panel carries six indoor type lightning arresters, the main station ammeter and switches for the various lighting circuits. The end panel supports the rheostats, circuit breakers, voltmeters and other instruments for the regulation of the four generators.

Fig. 2 gives a view of the interior of the power station, and shows the arrangement of the lighting plant. The alternators and their engines are set in such a manner that the belts can instantly be shifted from one engine or alternator to the other, should occasion require. If one engine and generator were completely disabled, the other set could take on the load, and thus a shutdown could be avoided. The engines are run condensing. Water for this purpose is drawn by an independent pump from twenty-four driven wells.

FIG. 2.—INTERIOR OF POWER STATION.

The northeastern terminus of the Norfolk & Ocean View Railroad is at Ocean View, which has for many years been one of Virginia's most famous seaside resorts. The magnificent Ocean View Hotel is owned by the railway company, but leased and operated by other parties. The beach for miles is lined with cottages belonging to residents of Norfolk, Richmond, Washington and other cities.

Being largely a summer road, the rolling stock of the company consists chiefly of open cars. The company

owns four closed motor cars, which are used during the winter season. These cars are vestibuled at each end, are mounted on double trucks, and are equipped with two fifty horse power motors and Hunt air brakes. In addition, the company has two open motor cars and one parlor car. The open motor cars are equipped with four fifty horse power Walker motors to the car. The Hunt independent electric compressor supplies air for the brakes. The trucks are the heaviest used in electric railway practice, being the McGuire "L" trucks, duplicates of the trucks used on the Metropolitan & Lake Street Elevated Railroads, of Chicago. The additional rolling stock consists of twenty-four excursion coaches and seventeen freight and flat cars.

FIG. 3.—CAR.

Fig. 3 shows one of the standard motor cars, and Fig. 4, a thirty-two ton motor car hauling six coaches loaded with 670 people. This is considered by the management to be the heaviest electric train in the South. The coaches are built by the Wason Manufacturing Company, and are unusually strong and heavy. They have automatic Colwell couplings, solid thirty-three inch wheels, straight sides and standard steam coach roofs. The entire train is lighted by ten lights to the car, snap couplings connecting the rear of the train to the motor car. These coaches have fifteen seats, and seat six people to the seat, making ninety the seating capacity of each car.

FIG. 4.—MOTOR CAR DRAWING SIX LOADED TRAIL CARS.

These cars are so long that one trolley pole will not reach from the center of the car to the end, so they are equipped with two trolley poles. In addition to the air whistles with which the train is equipped, a sixteen inch steel gong is mounted on each end of the motor car. The rest of the rolling stock is from the shops of the Jackson & Sharp Company, and are well built, attractive cars.

Despite the fact that the past year has been one of uncertainty, and that many interests have felt the effect of lack of trade, the Norfolk & Ocean View Railroad Company reports 1896 to have been the most successful season the road has ever experienced. The passenger business has increased nearly fifty per cent, and a very profitable freight business has been developed, which was never catered to before. This is the hauling of truck and other farm products, an account of which appeared in a late issue of the STREET RAILWAY JOURNAL. A recent extension of the company's line to Willoughby Spit, and the purchase of a new ferry boat, gave the company on Dec. 24 a through line to Old Point Comfort, Hampton and Newport News.

The officers of the company are O. E. Smith, receiver, L. D. Mathes, superintendent, to whom we are indebted for the photographs accompanying this article.

Large Power Station at Berlin, Conn.

The plans for the electrical equipment by the New York, New Haven & Hartford Railroad for an extensive interurban system near Berlin, Conn., have been completed. These plans contemplate: the electrical equipment of two tracks between New Britain and Hartford (these tracks are now operated by steam as part of the system of the New York & New England Railroad); the electrical equipment of the steam line now operating between Berlin and New Britain, and the electrical equipiment of the steam line between Berlin and Middletown. The third rail system similar to that in use on the latest section of the Nantasket Beach Electric Railway will be used.

Power will be supplied from a large station at Berlin, for which contracts have already been given and construction commenced. Two 850 k. w. General Electric generators directly connected to Greene engines will be employed, and the first equipment of rolling stock will consist of fifteen cars. These will be similar in every respect to the Nantasket Beach cars, and it is possible that some of the latter cars will be put in operation on these lines during the winter months, the Nantasket Beach line being essentially a summer road.

The power station will be large enough to supply power for the equipment of a line from Middletown to Waterbury by way of Meriden, and it is possible that the steam tracks now extending between these places will be equipped with electric power shortly.

THE Cincinnati, Hamilton & Dayton Railway Company (Cincinnati, O.), has decided to equip its lines between Middletown and Hamilton with an electric system similar to that on the Nantasket Beach line of the New York, New Haven & Hartford Railroad Company, and to this purpose it is securing estimates from the principal manufacturers of electric railway apparatus. C. A. Wilson, Carew Building, Vine and Fifth Streets, Cincinnati, is the chief engineer.

The Street Railway System of Paris.—I.

By M. Lavalard.

It is a well known fact that the operation of city passenger transportation systems is of relatively recent origin. Without wishing to go too far into past history, which is not the purpose of the article, it was about 1855 that there was organized in Paris a stock company under the title of the General Omnibus Company. This was the consolidation of several small omnibus companies, whose vehicles were poorly built and as poorly equipped. At about the same time a M. Loubat was authorized by the city to commence the construction of a system of omnibuses on rails which was being operated with success, it was said, in the United States. This concession soon passed into the hands of the General Omnibus Company, which thus became the grantee of all the transportation franchises. The monopoly thus established was hampered, however, with certain conditions which were very arduous. The municipality

SERPOLLET STEAM MOTOR—PARIS.

could insist upon the operation of certain unprofitable lines and could thus cut down the profits on the well paying divisions. But if qualified in certain ways it proved extremely advantageous for the city in facilitating the opening and development of certain quarters of Paris which up to this time were without means of communication. An idea of the growth of the transportation business can be gained from the statement that the number of horses used at first was 4000, while to-day it is more than 15,000, and that the number of passengers transported has increased from 34,000,000 to more than 210,000,000.

It is not necessary to detail the changes which were made to the omnibuses in increasing their carrying capacity from fourteen to thirty and forty passengers, but it is interesting to note that it was in 1872 and 1873 after the German War that the installation of tramways proper was commenced. They were operated by animal power, the Government not wishing to permit mechanical traction in the central part of the city.

The General Omnibus Company had the concession for all tramways within the city limits, but for reasons too numerous to enumerate and after much discussion, two other tramway companies were authorized to enter the city. In this way were formed the Northern Tramway Company (now that of Paris and of the Seine Department) and the Southern Tramway Company (now the General Parisian Tramway Company). But it ought to be well understood that these companies were not permitted in Paris except under certain conditions and at certain royalties which were paid to the General Omnibus Company which has the monopoly of street transportation up to 1910.

Other suburban companies have since been allowed entrance into the city, always complying with conditions laid down by the General Omnibus Company. Among these were the Paris & St. Germain Steam Tramway Company, the Arpajon Company, the Cable Railway Company, of Belleville, and the Electric Tramway on the Claret system. The latter commenced operations on June 1, and serves Romainville.

Mechanical Traction in Paris.

For many years mechanical traction has been the order of the day; but it has encountered opposition from the Government and municipality. To-day everything is changed and everyone talks only of the replacement of horses by mechanical power. We will speak briefly of the actual situation:

The General Omnibus Company operates by mechanical traction from twenty to twenty-five miles, divided into four divisions, employing respectively compressed air cars (Mekarski system), electric accumulator cars, steam motor cars (Serpollet system) and steam motor cars (Rowan system).

Recently the municipal government has authorized a general investigation of the subject of the application of mechanical traction to all the street railway lines of the city, which aggregate more than 120 miles in length. A study will be made of all the systems known, electricity, gas, stored steam, compressed air, etc. If the street railway companies should give up the use of horses entirely the total number on the streets would not be greatly diminished, since the cars employ only 4000 horses against 12,000 in use for busses. The city of Paris will not permit the introduction of car rails on certain prominent thoroughfares and on very narrow streets.

The Tramway Company of Paris and of the Department of the Seine (Tramways Nord) operates several lines by accumulators and by Serpollet steam motors. The company is anxious to give up entirely the use of animal power. This company operates also stored steam motors (Francq system).

The General Parisian Tramways Company has not yet employed any system of mechanical traction, but I learn that it is going to place a contract with the Thomson-Houston Company if the municipality will permit an installation of the system of that company. It has forbidden it up to this time.

The Paris & St. Germain Steam Tramways Company employs steam dummies on the greater part of its suburban system, and within the city operates with stored steam (Francq system).

The Arpajon Company employs outside of the city limits ordinary steam motors, and within the city compressed air motor cars.

The cable railway of Belleville employs a system similar to that in America and England. It was installed by the builders of the line at Highgate Hill, London.

The last street railway company organized in Paris is that at Romainville. This company within the city limits uses an electric conduit on what is called the Claret system, similar to that in Buda-Pesth. Without the city limits the overhead system is used. It is the only installation of its kind which exists at the present time near Paris.

The Brooklyn Heights Railway Company has inaugurated a feature on its newly-opened Flushing line—a parlor car service between Flushing and Brooklyn. Seats are assigned passengers in a manner similar to that now done on parlor cars on steam roads. A porter is in attendance to look after the wants of passengers. The regular fare between Brooklyn and Flushing is ten cents and the special charge for seats on the parlor car is fifteen cents additional.

Electric Plant at Owosso, Mich.

An interesting plant has just been completed for the Caledonia Electric Light & Power Company, at Owosso, Mich. This plant will operate an electric railway and will also furnish light and power. The railway connects Owosso with Corunna which is the county seat, and is about three miles distant from Owosso. The road may possibly be extended to Durand and to Trenton and Flint, and from there will connect direct to Detroit. Owosso is a city of about 12,000 inhabitants, with many manufacturing

FIG. 1.—EXTERIOR OF POWER STATION.

plants, while the inhabitants of Corunna number about 3000. Midway between the two cities and on Caledonia River, is Caledonia Park, which is owned by the president of the railway company, I. D. H. Ralph. This park was opened to the public last May, with concerts by Gilmore's band. At the park is a casino seating 1500 people, where opera and vaudeville shows are given every evening. Next summer many new amusements will be added.

The street railway line was originally operated with Healy motors, two in number, with four trail cars. This equipment was installed in 1891, and operated for a period of two years. At the end of that time, the Healy motors were replaced by two Baldwin motors, with combination cars, and these were in constant service until Feb. 22, 1896, when the first electric cars were put in service. The entire electrical equipment for the power house was installed by the Triumph Electric Company under the supervision of A. W. Foster, of the firm of Foster & Lewis. The exterior of the power house is shown in Fig. 1.

FIG. 2.—VIEW OF OPEN CAR.

The equipment consists of one 150 k. w. multipolar street railway generator (Fig. 4) direct connected to a 250 h. p. Fisher center crank, self oiling engine; two 65 k. w., 550 r. p. m. generators, belted to a 150 h. p. engine. The lighting apparatus consists of three 65 k. w. General Electric alternators, and five Thomson-Houston 2000 c. p. arc

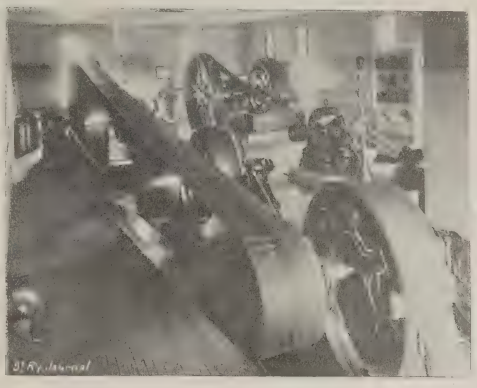


FIG. 3.—INTERIOR OF POWER STATION.

dynamos. These dynamos are run direct from a jackshaft situated in the basement, and operated by friction clutches.

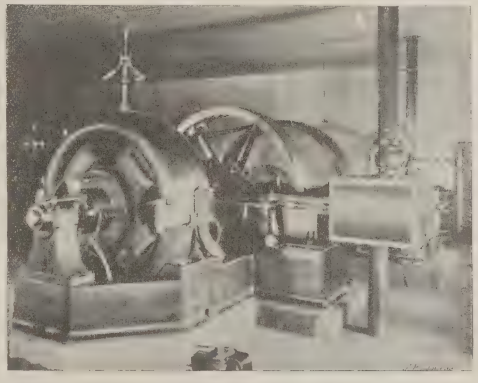


FIG. 4.—RAILWAY UNIT.

Belted direct to the jackshaft are two 14 in. and 22 in. × 26 in. side crank, compound condensing engines, operated by independent condensers. The arrangement of the units is shown in Fig. 3. This plant furnishes current for both Owosso and Corunna, as the company owns franchises from both cities for a number of years.

The line, overhead construction and track work have been well done. Forty-five pound and fifty-five pound rails are used.

There are at present two thirty-eight foot Brill combination cars which are in constant service, equipped with G. E. 800 motors. There is also one open car, (Fig. 2) made by the Wells & French Company, which does service in summer, running to the park.

THE stored steam system of Leon Franq is being tried in Paris on the Saint Germain and Poissy line.

Electric Railway Power Stations in America and the Economic Results of their Operation.

By L. D. Tandy.

The question of expenses and economies in the production of electric power is naturally one of vast interest to readers of the Street Railway Journal and one that has justly claimed a large share of thought and attention. It hardly seems necessary, therefore, for me to enlarge upon the difficulty experienced in obtaining comparable data, owing to the variety of methods practiced by different roads in keeping their records.

The first question to be decided in providing for the construction of a road, is: "What kind of a power station is the most suitable for the conditions under which the railway has to operate and which in the most economical?" There are six kinds of stations; namely, the expensive, moderate and cheap *theoretical* stations, and the expensive, moderate and cheap *practical* stations. If the owner of the proposed line is not a man overburdened with theories, he naturally directs his attention to the last three, and confines his investigations thereto.

In Table I will be found in detail the operation of a number of stations of various types, including the triple expansion and compound (cross and tandem) engines, direct connected and belt driven generators, condensing and non-condensing.

Stations A, B, C and E are large stations, containing the most expensive machinery, No expense has been spared in their construction and, in consequence, fixed charges are exceedingly high. These stations have a normal load as compared with their rated capacity and are comparable with any of the large metropolitan stations.

In station A, I would call special attention to the figures relating to evaporation, wherein the water per pound of coal is shown to be below normal; namely, 7.6 lbs. while the coal per kilowatt hour is also very low. The results obtained at this station are remarkable, inasmuch as the consumption of water is less than 15 lbs. per h.p. hour; a record which many claim to make, but few achieve, and this it not indicated horse power, but an electric horse power at the switchboard, which includes engine and generator losses. It would appear from this, therefore, that mistakes are made in many stations in crowding the boilers to evaporate too much water per pound of coal, paying but little attention to the quality of steam produced from so high an evaporation. If, in the designing of a station, a trifle more leeway in the boiler room were allowed, it would tend materially toward reducing the cost of producing power. It is also interesting to calculate the thermal units in our coal; assuming a theoretical efficiency of 10 per cent, taking 778 ft. lbs. equal to 1 thermal unit, we find we are obtaining 13,000 thermal units per pound from our coal. This, to say the least, is startling, as this figure is about the maximum of the best Cumberland or Clear Creek bituminous coal, while the coal at the station under observation is anthracite buckwheat, and the horse power, or kilowatt hour taken at the switchboard and not an indicated horse power.

Station B is, if anything, overloaded, and conse-

TABLE I.

Station.	Boilers.	Pressure.	Style of Engines.	Cond. or Non-Cond.	Style of Generators.	Coal.	Cost of Coal per net ton.	Lbs. Coal per K. W. hour.	Lbs. water per lb. coal.	Lbs. water per K. W. hour.	COST PER KILOWATT HOUR.						
											Cost of Coal.	Operating supplies, excl. of coal.	Labor Operation.	Supplies Maintenance.	Labor Maintenance.	Maintenance Buildings.	Total.
"A"	W. T.	160	Cross Comp.	C	Direct	Anth.	$2.40	2.6	7.6	19.9	$.0028	$.0005	$.0024	$.0003	$.0001	$.0001	$.0061
"B"	"	160	Trip. Exp'n	C	Belt	Bit.	3.50	3.5	9.8	34.	.0052	.0008	.0023	.0006	.0005	.0002	.0096
"C"	"	160	Cross Comp.	C	Belt	Anth.	2.40	3.11	7.7	24.1	.0033	.0008	.0044	.0002	.0005	.0001	.0093
"D"	"	160	Tand. Comp.	N C	Belt	Anth.	3.15	3.65	9.3	33.8	.0051	.0009	.0030	.0001	.0001		.0092
"E"	"	160	Cross Comp.	C	Belt	Anth.	2.07	3.5	8.	31.	.0033	.0010	0043	.0003	. 0006	.0001	.0096
"F"	"	140	Cross Comp.	C	Belt	Cumb. Bit.	2.90	3.8	9.3	35.3	.0056						.0100
"G"	"	140	Cross Comp.	C	Belt	Cumb. Bit.	3.23	4.	9.4	37.6	.0065						.0109
"H"	"	150	Cross Comp.	C	Belt	Cumb. Bit.	3.05	4.4	8.5	37.4	.0068						.0112
"I"	"	150	Tand. Comp.	C	Direct	Cumb. Bit.	2.69	4.2			.0050	.0006	.0042	.0002	.0004	.0001	.0105
"J"	"	160	Vert. Comp.	N C	Direct	Bit. Scrn'g	1.40	6.2	6.9	41.3	.0057	.0004	.0033	.0004	.0001		.0098

quently the results obtained therefrom are more favorable than those arrived at in connection with stations A, C and E.

Station D is a representative city station of moderate cost and high efficiency.

Stations F, G and H are city stations of moderate cost. They are not of absolutely modern construction, but, at the time of their erection were as perfect as money could make them.

Station I is a model station, of small size, running an extremely variable load.

Station J is a large city station running under adverse conditions, having been designed as a condensing station, but, owing to difficulty in connection with condensing water, it was operating non-condensing. The load here is also very variable. The same criticisms will apply (perhaps with greater force) to this station as to stations A, B, C and E.

Owing to lack of time in which to satisfactorily prepare it for publication, I am unable to submit data of a representative simple, non-condensing station. This I regret, in view of the fact that the cheapest power produced in the United States, to my knowledge, is in a station of this type. The average cost for a period of one year was $.0058 per kilowatt hour. This station is equipped with single cylinder non-condensing engines, 34 in. × 60 in. cylinders, large units, fire tube boilers, and steam pressure at 110 lbs. The cost for the construction of this station, per kilowatt, was less than for any station of its kind in the United States.

It is, of course, an undisputed fact that there are no two stations operating under exactly similar conditions and the figures which are submitted for the purpose of making as close a general comparison as possible.

TABLE II.

		Station A.	Station C.	Sta'n D.
OPERATION.	Coal	46. %	36.8 %	49. %
	Water	3.92	3.2	5.04
	Cylinder Oil	2.19	1.15	1.144
	Engine "	.437	1.575	.862
	Grease	.109	.147	
	Waste	.175	.118	.1658
	Boilers	.153	.515	.116
	Engines and Pumps	.262	.383	.199
	Miscellaneous	.109	.236	1.245
	Total	53.355	44.124	57.9
	Engineers, Oilers and Wipers	14.65	21.64	15.65
	Firemen and Water Tenders	11.25	11.31	7.47
	Miscellaneous	6.39	2.245	1.89
	Total	32.25	35.2	25.
	Electrical Supplies	.81	1.34	2.24
	Electrical Labor	8.26	10.72	12.05
	Total	9.07	12.05	14.3
	GRAND TOTAL FOR OPERATION,	94.6	91.25	97.4
MAINTENANCE.	Buildings	.153	.074	
	Boilers	.787	.942	.762
	Engines and Pumps		.972	.315
	Coal Pockets and Sundries		.044	.034
	Total	.94	2.025	1.111
	Buildings	.262	.280	
	Boilers	1.4	2.782	.397
	Engines and Pumps	2.038	2.89	.563
	Coal Pockets		.545	.083
	Total	3.7	6.49	1.04
	Electrical Supplies	.284	.029	.445
	Electrical Labor	.458	.118	.397
	Total	.765	.147	.844
	GRAND TOTAL FOR MAINTENANCE,	5.405	8.67	2.995

Taking into consideration first the relative merits of the direct connected and belt driven stations, it will be found:

First. A difference in percentage of coal in favor of station C; also in water. This is due to the fact that the cost of coal does not decline in a direct ratio with the total cost, larger savings being made in other items.

Second. The item of cylinder oil shows also in favor of station C. Engine oil and grease show in favor of station A, due to a lesser number of bearings. Taking the item of lubrication as a whole, it is an offset.

Third. Material for the operation of boilers, engines, and pumps, and miscellaneous material will be found to be in favor of station A.

Fourth. Labor for operation of steam plant. The item of engineers, oilers, and wipers shows 6 per cent in favor of station A, due to less oiling and attendance; firemen and water tenders constitute an offset. Miscellaneous labor shows 4 per cent in favor of station C.

Fifth. Electrical material and labor for operation both show in favor of station A.

Sixth. The grand total of operating expenses shows about 3 per cent in favor of station C.

Seventh. Material for maintenance of building, boilers, engine and pumps, coal pockets, etc., shows about 3 per cent in favor of station A.

Eighth. Labor for maintenance of building, boilers, engines and pumps, coal pockets, etc., shows about 5 per cent in favor of station A.

Ninth. Electrical maintenance, labor and material shows about 5 per cent in favor of station C.

On comparing station D with stations A and C, a loss will, of course, be found in coal and water, but a gain is shown both in engine and cylinder oil and grease, and besides a larger gain in labor of the steam department; a decided gain will also be found in maintenance.

The writer's purpose in making the above comparison is to show the *relation* which each item of expense bears to the whole, not the *percentage of economy*.

Taking the matter of economy into consideration, the figures for the various general items per kilowatt hour will be found in Table III.

In the grand total for operation, a saving of 30 per cent in station A over station C, and 26 per cent over station D, will be found. In maintenance, a saving in station A over station C amounting to 58 per cent is shown, and an increase (or loss) in favor of station C amounting to 36 per cent, which station is also 24.6 per cent less than station D. On total cost, station A is 30.8 per cent less than station C.

Taking station D (a non-condensing belted station) in comparison with station C (a condensing belted station) it will be seen that in cost of operation station D is running 5.5 per cent less than station C; in maintenance, 69 per cent less than station C, and on the total cost station D is 10.8 per cent less than station C. It must be remembered, in making this comparison, that station C is not carrying as heavy an average load, compared to its size, as either stations A or D, and station D is carrying a heavier average

On referring to Table II a percentage comparison of stations A, C and D will be found, showing the percentage of each item of expense to the total cost of the power. This comparison shows forcibly the relative merits of the direct connected, belt driven, condensing and non-condensing stations. For the purpose of making the comparison, the coal used in station D has been computed at the same price as that at stations A and C, it being the same grade of coal, the difference in cost lying in transportation charges. The conditions under which the above stations are operating are about the same, the only difference being in size, A and C being the larger, which would naturally reflect to the disadvantage of station D. This is partly, if not wholly, offset by the fact that station D has a slightly larger average load, in comparison with its rated capacity, than stations A and C, more especially the latter.

load than either stations A or C, but it is also a much smaller station. Some idea can be derived from the foregoing exhibits of the relative economies in the cost of producing power; also that the day of belt driven generators is past, as the economy of direct connected generators is self evident from a careful study of their respective performance. But to get at the dollars and cents actually saved, it is necessary to take up the all-important item of fixed charges, and ascertain whether the increased cost of one type of station over another has resulted in saving

TABLE III.

Comparison in Cost per Kilowatt Hour

		Station A.	Station C.	Station D. *
Operation.	Material, Steam Dept.	$.003245	$.004000	$.004660
	Labor, " "	.001964	.003184	.002014
	Total, Steam Dept.	$.005209	$.007184	$.006674
	Material, Elec. Dept.	$.000049	$.000121	$.000180
	Labor, " "	.000504	.000970	.000970
	Total, Elec. Dept.	$.000553	$.001091	$.001150
	Grand Total for Operation	$.005762	$.008275	$.007824
Maintenance.	Material, Steam Dept.	$.000057	$.000185	$.000089
	Labor, " "	.000225	.000588	.000084
	Total, Steam Dept.	$.000282	$.000773	$.000173
	Material, Elec. Dept.	$.000017	$.000003	$.000036
	Labor, " "	.000028	.000010	.000032
	Total, Elec. Dept.	$.000047	$.000013	$.000068
	Grand Total for Maintenance	$.000329	$.000786	$.000241
		$.006091	$.009041	$.008065

* Coal computed same price as stations A and C.

enough to offset the increased fixed charges, owing to the greater initial investment. In some of our large stations, I found compound condensing engines and water tube boilers operating at a pressure of 110 to 120 lbs. Wherein the economy lies in the use of water tube boilers, and condensing at this pressure, is far from being plain. The cost of operating a station of this character I have not given, owing to the poor showing which it makes.

Power can be (and is now being) produced, with coal at $1.60 per ton, for $31.61 per horse power year of 365 days, with twenty-hour days. The cost will range as high as $70, owing to conditions and price of coal, as there are some small, high speed, belted stations to-day whose power is costing them from $.013 to $.015 per kilowatt hour.

Some British Impressions of American Street Railways.

By Alex. McCallum.

Recently I received a commission from the *Glasgow Herald*, which occupies a foremost place among the great daily provincial newspapers in Britain, to pay a visit to the United States and make a series of inquiries on the spot as to the position now reached in the application of mechanical power to the propulsion of street cars. In Glasgow, as some readers may be aware, the street railways are not only owned, but are operated by the Municipality for the benefit of the citizens and consequently the general interest in methods of traction is much more keen than can be expected in cases where the lines are worked by companies. It is nearly two and a half years since the lease under which the old tramway company operated expired, and since then the Town Council has had the whole business entirely in its own hands. It has been fairly successful so far, and has given a much improved service, but both it and the Glasgow public are very desirous to have some better method of traction than the present horse system which on all hands is felt to be insufficient. Delegations from the Council have in recent years made many excursions for the purpose of inquiry, the last of which was to the United States and at present it seems as if their long investigations and deliberations would soon reach a point and result in action. These things being so, I was asked to get whatever information was available in America, particularly in regard to electric traction, and as its mechanical success is already thoroughly established attention was largely turned to its financial aspect. The latter is a point upon which it has been very difficult to get reliable data in Great Britain, and this is not surprising considering the reticence which until recently characterized so many of the American companies. During my inquiries I visited a number of leading cities in the States, and in due course reported upon what I had seen and learned. From another standpoint however, namely, how it strikes a stranger, a few impressions and comparisons may not be without interest to American street railway men.

Having previously some knowledge of the growth of the trolley wire system, I was not surprised to find it in such wide use. But there was certainly matter of satisfaction in noting how perfectly the cars work, how rapidly they respond to the call to start or stop, and how easily they can be manœuvred through streets of great traffic density. The only place where I considered that little benefit was gained from the use of electricity was in the heart of Boston, for owing to the congestion there horse cars would get along almost as well. I do not overlook the advantage that accrues as soon as quieter and more roomy streets are reached, and no doubt it is impossible to operate the center of Boston with horses and the rest of it with electricity. Generally, I was impressed both with the smoothness and the rapidity of the motion of the electric car. The increased size of the vehicles, also, as compared with those used under the horse regime, is a very valuable consideration, though it must be borne in mind that the British double decker horse car can seat almost as many people as an American eight-wheeled electric car. Another good point is the elegance with which the cars are finished, both externally and internally.

Regarding the poles and overhead wires, this is a matter to which we Britishers as a rule have a rooted objection. We have no telegraph and telephone wires strung from poles along the streets as in American cities. To a large extent the wires are underground, and where they are not they are attached to the roofs of buildings and cross the streets at a considerable altitude. This being so, it will be plain that the appearance of the streets with these telegraph poles and wires in so many American cities is to the British eye positively hideous. The existence of a few more poles and the wires for the electric street lines makes practically no difference. Even the practice of stringing the feeder wires from the poles is not very serious in such circumstances. I was, therefore, glad to learn that in many cities an arrangement is coming into force for putting all wires, except the trolley and span wires of the electric railways, underground. After this work is done people will wonder why they tolerated an avoidable eyesore so long. It was also satisfactory to learn that where energetic steps have been taken to prevent the electrolysis of gas and water pipes success has been achieved. Very alarming reports of this evil have been circulated in Britain, but we have already a code of rules laid down by the Board of Trade, which should make electrolysis impossible.

It was gratifying to learn that the later forms of electric generating machinery and of motors are being found a vast improvement over the older types. It appears that not only is the present mechanism more efficient in its conversion of energy, but it is cheaper to buy, cheaper to work and cheaper to maintain. In some cases sufficient time has elapsed to warrant these affirmations to a large extent,

but one cannot help being reminded of the glowing statements made in favor of the economy of electric traction even in the early days. The difference is that in those days there was no experience to back up the statements, and they turned out to be over sanguine, while now there has been considerable experience showing how material have been the improvements. Apparently two of the greatest advances have been the substitution of large direct connected engines and generators for the small belt connected units formerly employed, and the displacement of the rheostat by the series-parallel controller.

Before glancing at the financial results of electricity, a word may be said on other subjects. I had heard with some surprise and found it was true, that in several cities cable roads have been pulled up and the trolley wire installed. Surprise disappeared, however, when it became apparent that in such cases they were roads that should never have been equipped by cable, owing to small traffic or excessive curvature, or both; or they were worn out, and it was considered better to put in the poles and wires so that the lines could be worked from existing electric power stations instead of from separate cable stations; or the machinery and style of equipment were old and needed improvement; or the companies were actuated by a burning desire to have only one kind of power all over their lines. The latter consideration is of great value under some local conditions; in others it is of less moment. I failed to find any proof that electricity can work so cheaply, even now, on congested thoroughfares where the street railway traffic is excessive, as the cable.

Everywhere the statement was made by street railway managers that nothing is to be expected from storage batteries, compressed air or gas, and little from the conduit electric system except when the local conditions are, as in Washington, peculiarly favorable. My own similar views were confirmed. Still, I was very much struck with the beautitul smoothness of operation and perfection of every detail in the conduit system at Washington. In economy of working the thing promises well, and the climate, the streets and the drainage are all favorable.

On the financial side of trolley wire railways, I was certainly surprised. Large numbers of statements were made to me by managers, who certainly can have no inducement to boom any system except for its merits, which made it plain that at length the electric traction is emerging from its struggles and is getting on a sound financial basis. We were told the same story a good few years ago, but the tellers then were only what I believe I called "the electric men," and the street railway managers were to a large extent silent. They could show few figures then; they were experimenting, and wisely held their tongues till some definite result of experiments could be announced. Now however the managers are as loud in the praises of electricity as the electric men themselves, and only one conclusion can be drawn. Some managers, men who are plagued with crowded streets and a crawling pace through them, admitted to me that they did not find the operating expenses per car mile much less than with horses, but they pointed to the increased size of the cars, the very material addition to the receipts per car mile, and the great increase of the mileage run by the same number of cars. In this way even those men were able to report substantial additions to the net revenue. Their more favorably situated brethren, who had fewer crowded streets to tackle, reported the above favorable features to exist in a still greater degree and also a considerable decrease in operating expenses per mile run. Over and over again I heard the story of roads which paid no dividends under horse traction paying dividends now, and of others that paid small dividends increasing the percentage. It is thus clear that in spite of the increase of capitalization necessitated by making the change from horses to electricity, a large proportion—and I am told the great majority—of the companies have more than recouped themselves.

Evidently one of the greatest, if not the greatest, benefits that electric traction has conferred on the public is the removal of the working classes from crowded city areas to healthy suburban homes. Thus electric traction is one of the greatest social and sanitary reformers that America possesses. Without the system of uniform fares, however, the thing would be impossible. Of this admirable system it seems scarcely possible to speak too highly from a reformer's point of view. No doubt it is a hardship that a man cannot ride a hundred yards without having to pay five cents, but the compensating advantages are immeasurable by comparison. In Great Britain, where almost as much has to be thought of a penny by the poorer classes as in America they think of a nickel, I am afraid we are very far from the uniform fare, no matter what sort of traction we adopt. The tendency in fact is quite the other way, as witness the adoption of half-penny (or one cent) fares for a half mile ride in Glasgow and London. A uniform fare of a penny would probably mean ruin to many British tramway companies. Three half-pence might suit at a pinch in some cases, but it is a very awkward sum, necessitating the payment of two coins of different values, the penny and the half-penny, or else three separate half-pennies, so that there would be endless waste of time, and continual worry for the conductors in finding small change. Two pence might suit, but in relation to wages and prices it is rather a higher figure than the American five cent fare, and would probably lead to a ruinous diminution in the amount of short-distance riding.

While it is the case that in Britain we shall not be allowed to drive electric cars at as high a speed as is common in the United States, I think this will to a great extent be counterbalanced by the lower rates of wages paid to employes as compared with the scale in America.

It is highly probable that within a very few years there will be many electric lines in the old country, and that cable roads also—on a cheaper, and, it is held by some in Britain, a better plan than the American—will extend. There is a field for both, and I have before now explained in this journal the nature of legislative enactment which has hindered progress in the past. Progress has now begun and will continue at an increasing rate. Not stick-in-the-mudism, but statutory enthralment has hindered the forward march.

Altogether I was highly pleased with what I saw of American street railways, as well as deeply sensible of the courtesy of the railway men and their readiness to place large sections of their valuable time at my disposal. Now that they have succeeded in electrifying most of their lines, little further advance in that way can be made, unless new and still more improved methods of operating are discovered. What the future is to bring forth in the way of interurban electric railway development it would be, however, hard to say. The local steam lines, I am afraid, are in for a bad time. What they ought to do in self-defense in the first place is to demand that interurban electric railways should in all cases be compelled to acquire rights of way of their own and not be allowed to use the highroads of the country. That would put both enterprises on a more equal footing as to capital, and then if necessary the local steam lines may become electric lines. One blot—from the aesthetic point of view—will then be removed from many a pretty country side, for the comparatively silent electric car or train will displace the roaring, shrieking, smoking and steaming demon which seems to reside in the steam locomotive. For us in Great Britain such thoughts are mere idle dreams at present. We have a long way to travel before then.

Glasgow, I am inclined to think, in view of the strong opinions of many of the members of the Tramways Committee of the Town Council, will adopt the trolley wire. Prejudice against it is not so keen as a few years ago, and many men now see that it is purely a case of trolley wire or horse. The cable has been declared impossible on the main routes, and even if possible, the greater length of tracks would still cry out for the trolley. A report by the latest delegation of the Council which has been examining the situation in America, will doubtless soon come up for consideration. Then if the trolley is adopted we shall see some stirring times, and doubtless an attempt to make the

mileage of street tracks something like commensurate with population. Thirty-three miles of streets, all double track, to a population of some 700,000, makes the American street railway man gasp with astonishment. But if he remembers his own horse days, and if he knew of the multiplicity of local steam railways in and about Glasgow, he would cease to be surprised.

The Development of the Modern Electric Railway Car Wheel.

By P. H. GRIFFIN.

The development of the electric railway wheel has been based almost entirely on the conditions of service. It has been necessary for the manufacturers to frequently accept specifications which could not be carried out to their satisfaction and with confidence in the result. This was unavoidable because in many instances the electric railway was—and still is—obliged to conform to peculiar local regulations concerning the form of rails and general construction of tracks. To get into operation at all there was no alternative but to comply with these regulations, good or bad as they might be. It was necessary to regulate curves by the width of streets rather than by a correct standard of construction. Crossings over steam railway tracks had to be made before proper agreements for right of way could be secured; in fact it has been necessary for electric railways to accept almost any conditions that would permit operation, no matter how difficult and impracticable they might be; and under such auspices the electric wheel was developed. In general section it first followed the style of the spoke wheel used in horse car service. This was 30 ins. in diameter and weighed about 200 lbs. Owing to the increased weight and speed of electric cars it was soon found that heavier wheels were necessary, as well as those made from the best metal and from patterns designed with the utmost care to avoid undue shrinkage strains. Wheels 33 ins. in diameter soon came into considerable use; and now the total number in service is made up of about an equal proportion of each diameter weighing from 300 lbs. to 360 lbs.

The spoke pattern is still adhered to in general because nothing better has been suggested, and it seems to answer the needs of the present service very well. The spoke wheel indeed possesses several advantages as compared with the plate wheel. In the former the metal can be massed in heavier section than in the latter, and this permits of a deeper chill on the wearing surface. With plate wheels of like weight and ordinary section the plates would run from ½ in. to ⅝ in. thick, and if a heavy chilling mixture was used these plates would be harder and more liable to crack in service.

But there are new conditions arising from day to day, one of the most important of which is brake service on interurban railways, where speed is higher than in cities. The present local traffic brake application is a constant and most important factor in the wear of wheels, but does not as yet involve the excessive friction which occurs in high speed service and which results in the heating and expanding of wheels. This result is sure to come and should be provided for. Whether the spoke wheel will stand it or not is a question.

The subject of brake heating on steam railways is at present in active discussion owing to the proposal of the Pennsylvania Railway Company to apply thermal tests to wheels to prove capacity for resisting expansion strains in brake service. The test proposed is to cast a band of molten iron, 1½ ins. thick and four inches wide, against the face of the tread. Although this test is generally spoken of as something new, it is not really so, as in the writer's experience it has been used for ten or fifteen years, although hot metal bands from ½ in. to ⅝ in. thick were used instead of the heavier ones now proposed.

To apply sudden and intense heat with the heavy band described is not a repetition of conditions of service; and to make wheels to withstand strains which do not arise in service would be a mistake. The test is as well a very dangerous one in wet or wintry weather, when steam or dampness on the surface of the wheel tested would cause an instant explosion of the molten metal. It is, however, possible to make such tests with safety and to graduate them as to temperature with a very simple apparatus burning gas or oil.

In the case of electric spoke wheels the spokes are in general more heavily dished than in any other kind of service, and possibly this departure from the straight line of hub to tread may admit of the giving or bending of the spokes under expansion strains if the latter are not too severe. There can be no question that this subject is of the utmost importance and should have careful attention from electric engineers who now operate or contemplate operation at higher speeds than usual.

In general service the electric wheel receives most severe treatment as the electric car has but four wheels compared with the steam car having eight, and each of the former really carries as great a load as each of the latter. The steam wheel merely revolves under the weight and does not have to have to drive it as a traction wheel. This difference in traction and carrying service means an increase of from fifty to seventy-five per cent of wear. This increased wear must be sustained on less than one-half the width of wearing surface and one-third of the flange dimension possessed by the standard steam car wheel.

On the electric flange falls the brunt of everything in the service. While the steam flange receives wear on the inner face only the electric flange receives it everywhere. It must grind its way through curves where the long rigid wheel base and short curve radius permit only a forced passage. It makes loud complaint, as everybody knows who happens to live near such a spot and hears the shrill screech caused by the friction of flange and rail. For the flange of a steam wheel to strike on its point, much less to do service of this kind, would be deemed so dangerous that no railway engineer would take the responsibility of it for a moment; but the electric flange must constantly do service of this kind.

As yet electric and steam railways are not on such friendly footings as to permit the laying of the usual and proper crossings over the tracks of the latter. Right of way is yet in many cases an open question, and electric cars are only permitted to bump and jolt over the steam tracks as best they can. In such cases the electric flange must carry the entire load, receiving it as a sharp blow delivered by the entire weight of the car and its passengers. It is not practicable to make the flanges heavier or the treads wider as long as the present section of rail is used; there is indeed more likelihood of smaller instead of larger sections being used in the future.

It will be seen that the present electric wheel has to perform a task that is constantly increasing in severity, and there is little possibility of any provision being made to meet it, except in the general quality of the wheel itself. Everything else can be made heavier and stronger—motors, trucks, car bodies, etc.—but the tread and flange of electric wheels are apparently fixed quantities for city traffic.

With the extension of electricity to interurban service the conditions promise to increase in difficulty. When cars run over city tracks into the country, the wheels must conform to the tread and flange section used in the cities, in order to pass over the tracks. Thus a new kind of electric wheel will be required—one that can meet the requirements of both cities and country—of ordinary and high speed service.

The question of the flange appears to be the most difficult of all. It demands a metal containing every quality possessed by chilled iron, wrought iron and steel, and it must have maximum toughness and hardness. Chilled iron gives the best wear, as it is the hardest of all materials. Ordinary steel wears more rapidly, especially on the light flanges. Special qualities of steel, such as manganese steel, are now manufactured into wheels and have been tried by several of the larger companies.

With chilled iron the trouble is chipping or breaking of the flanges, some railways finding trouble of this kind and others not. Local track conditions seem to be principally responsible for the result. If there are steam tracks to be crossed where proper crossings are not provided, chipping is likely to result.

Chilled iron in its wearing capacity varies according to the quality of the material used and the skill and experience in manufacture. When the former is the best and the latter sufficient to control the depth of chill so as to have it proper and uniform, the results are good; but if mixtures are made to produce wheels that can be sold at a low price, then results are certain to be irregular and often very bad.

Solid cast wheels of ordinary steel have not been used at all in this country, and very little elsewhere. Built-up steel wheels have been tried in one or two instances to a considerable extent. Sixty cars on one of the large Pittsburgh lines were equipped with steel wheels some few years ago, but the heavy wear on flanges caused the removal of all of them within a few months. In Europe, where steel tired railway wheels are generally used in most countries, it is natural that a modification of the heavy steel wheel should be tried for electric service; but as local conditions in regard to track construction are, if anything, more stringent than in America, it is likely that the result will in the end be harder on the steel wheel. The rail with the flaring side to the groove, so common in America, is not allowed in Europe, but one with a deep narrow groove not over ⅞ in. wide, and with sharp corners, is used. Necessarily flanges cannot be over ⅝ in. thick. How successfully steel flanges will resist these conditions remains to be seen. The general construction of steel wheels used on electric railways in Europe is thus far also very light, and engineers have still to realize that a light wheel of many parts will not do the work. With the general section in use, not over twenty to twenty-five tons of pressure can be retained by the hub even if double that amount is used in forcing the wheels on the axles. This is because there is no rigid support from the remainder of the wheel as in the case of chilled wheels which are made in one solid piece. The constant starting and stopping is therefore sure to tell heavily on the connecting parts of the light steel wheels. Chilled wheels are also in use to a considerable extent—perhaps half of all in service—and in proper time the question will be decided on its merits.

America's Supremacy in Wood Construction.

By W. E. PARTRIDGE.

Contrary to the general opinion in foreign countries, America's boast that she can produce better woodwork than can be obtained elsewhere in the world, is not the result of simple brag or boasting, but it is founded upon a series of very advantageous natural conditions. These are all of them favorable to woodwork of the highest class, and are not to be found combined in any other part of the civilized world. It is a matter of common note in all parts of the world that American pianos "stand" in all climates, and in a manner superior to instruments made in other countries. American carriages find their way everywhere, and in spite of high price, have driven all other makes out of many Eastern markets. An American at Hong Kong, surprised at seeing the English residents riding in carriages built in the United States, asked the reason, and was told that they were the only vehicles that could stand the climate. In the same way American street cars have gone to the most remote parts of the globe, and have done their work in a way no cars built elsewhere could ever approach. Chapter and verse might be quoted for a hundred different cases where American cars have worn for a generation in foreign countries, while on the same tracks those of European make have disappeared from service after a few years of wear.

The first and one of the most important advantages which the United States possesses over other countries is in the variety and quantity of lumber available for all kinds of cabinet, carriage, car and wood work generally. The list of American woods suitable for car building is a long one. It includes a majority of the most useful woods known to man, all of them of superior quality. First of these is the yellow or Georgia pine for generally employed framing. This wood is indispensable. It has a strength very closely approaching that of oak and often exceeding it. It is the stiffest of all the common woods, far exceeding oak in that respect, while it is durable, light, holds iron perfectly, is straight of grain, obtainable in long length, free from knots and not attacked by white ants in hot countries. It is the ideal wood for car framing. Indeed, weight for weight, it surpasses iron or steel in strength. Next to this wood in its importance in the car frame, are the white oaks. There are probably a dozen different timber trees supplying the wood called "oak" in the United States. Some of them are very highly esteemed. The first wood on the list of those used in finishing as well as framing is the white ash. It is remarkable for its strength, elasticity, and, in the so-called second growth, the whiteness and beauty of its grain. It is almost universally used for the posts of street cars, and for other parts where lightness and strength are required. It is valuable in framing while the white selected "ivory grain" makes a most beautiful interior finish. The white wood, poplar or *liriodendron tulipifera* is one of the most magnificent woods of the country, obtainable in almost any width of board, unlimited in thickness and of great length, sound, straight, free from knots or shapes. It is the wood almost universally used for panel work. It does not split or change its shape materially in seasoning, and hence large panels can be made from it with a certainty of their holding their shape through years of service. White pine is another light, soft wood, easily worked and holding its shape, all things considered, better than any other known wood. Hickory is one of the strongest woods known in the art. The Douglass fir, spruce, cedar, the maples which are reckoned among the most beautiful of our light colored woods, cherry, birch, beech and many others are some of the woods in constant demand by car builders. All of this long list of woods used in car building are abundant and cheap and obtainable everywhere in the United States. The ash and the oak are probably inexhaustible, because the timber now coming into the market is to a large extent "second growth" and is likely to keep up with the demand for years to come.

Next to suitable lumber in relation to perfect wood construction is the seasoning, and here is found the second great advantage of the United States over all other countries. It is one which money can scarcely hope to secure for other regions, and that is its exceedingly dry climate. In general, air seasoned wood is superior to that which has been subjected to the action of heat or currents of air in drying houses. All wood workmen are familiar with the destructive effect of heat upon timber. The dry climate of the United States enables timber, not only to be very perfectly air dried before its final seasoning in the kiln, but it also enables it to be made up in a dry state without it absorbing moisture from the atmosphere.

Seasoned lumber in which the moisture has been reduced to eight per cent or ten per cent by artificial drying, will, in a few hours' exposure to moist atmosphere, absorb from ten per cent to fifteen per cent additional. Hence, the workman who is obliged to handle lumber in a moist climate is never able to get his structure completed without having it absorb a large amount of moisture during the process. The American workman has a great advantage on this account, because when his work is finished it contains less moisture than that of his European brother, no matter how carefully the latter may have seasoned his material before working. It is probably safe to say that an American car, when finished ready for the paint shop, contains less moisture by from ten per cent to fifteen per cent than one built in any of the European countries.

Benjamin Franklin in one of his essays mentions an

interesting illustration of this. The cover of a box of water colors purchased in Paris and brought to this country by him shrank to such an extent that a strip of wood had to be added to it shortly after his return. He noticed the fact on his second visit to Europe the cover regained its original size and retained it during the whole period of his stay and the added strip was necessarily removed. On his final return to America the cover again shrank and the strip had to be replaced. It is a fact of common note that all objects of wood, like writing desks, fancy boxes, etc., which are made abroad, when brought to this country, crack and shrink in a destructive way owing to the extreme dryness of our country. There were hundreds of cases of this kind noticed at the Chicago fair in 1893.

The skill of American workmen, and the ingenuity and perfection of the machinery used in this country, require no comment. They are well known and acknowledged everywhere. This combination of workmen, of climate and the abundant supply of sufficient woods for the purpose, joined with the fact that for years America has been using and building street cars of every description, are the conditions which, naturally, combine to make it possible for the United States to build the strongest, lightest and most durable cars for street railway purposes which can be obtained anywhere.

Mechanical Traction in Europe.

An interesting paper on the subject of mechanical traction was read before the recent meeting at Stockholm of the International Street Railway Association, by E. A. Ziffer, president of the Council of Administration of the Imperial Royal Privileged Lemberg-Czernowitz & Jassy Railway Company. In the paper Mr. Ziffer reviewed the whole field of the present application of mechanical traction in Europe with figures in regard to cost of operation. Some of the statements made upon different motive powers are given below.

STEAM.

The first application in Europe of a steam dummy or car containing motive apparatus and space for passengers in the same vehicle was in 1848, in England, on the Eastern Counties & Bristol-Exeter Railway. The car was 39.3 ft. long, was mounted on three axles and contained space for sixty-two passengers.

Belpaire System.

These cars were first put in operation on street railways in Belgium in 1877, and in 1888 fifty of the type were in operation upon different lines in that country. The cars were mounted on three axles and had a total length of 22.3 ft. The cars carried forty-four passengers and 1100 lbs. baggage, total weight 40,920 lbs. empty, and 48,400 lbs. loaded. The consumption of coal was from 5.3 to 8 lbs. per car mile. The consumption of water was about 7.1 gals. per mile.

Thomas System.

During 1880 Thomas dummies were put in operation on some of the secondary railways in Hesse, and three of them are still in use on the Saxony state railroads. The boiler is of the horizontal type, and the engine has two cylinders and is capable of developing one hundred horse power. The passenger portion contains accommodation for eighty passengers seated. The cars cost $6480 and attain a speed of from 18.6 to 24.8 miles per hour, often drawing two or three ordinary cars. The consumption of coal on lines where the grades are not more than one-half per cent does not exceed 7.1 lbs. per mile.

Rowan System.

Rowan cars are in use on the steam tramway between Copenhagen and Klampenborg, in Tours, Berlin and in one or two other places in Germany. According to an article published in July, 1895, in the *Zeitschrift für Kleinbahnen*, the dimensions of two cars in operation on a line 4½ miles in length are given below. The cars contain seats for forty passengers and have vertical boilers.

Diameter of cylinders	9 ins.
Stroke of piston	13 "
Heating surface of boiler	182.9 sq. ft.
Weight empty	26,180 lbs.
Weight ready for operation	27,500 "
Steam pressure	195 "

The car is mounted on bogie trucks, one of which carries the engine so that curves of narrow radius can be passed, and the boiler being much more powerful than that of an ordinary locomotive, and the weight of the passengers being made available for traction, permits the mounting of comparatively steep grades.

On some of the recent types of Rowan motors the motor is of from 50 to 150 h. p. and a speed of 24.8 miles per hour is attained. The exhaust is so arranged that it is invisible from the street, discharging into a nest of tubes. The consumption of coal on a line presenting grades of 1½ per cent has been 9.6 lbs. per train mile. The cars generally are divided into five compartments, one for the motive power, second for mail, third for baggage, fourth for first class and fifth for second class passengers, who number together from forty-five to fifty passengers. The cost of operating per mile of line after seven years of operation has been as follows:

Fuel	2.74 cents.
Oil, grease, waste, lighting, etc.	.94 "
Maintenance and repairs of rolling stock	2.08 "
Total	5.76 "

Serpollet System.

This is a comparatively new system and has been applied very successfully to automobile carriages, as well as to tramway traction. The system was described in the issue of the STREET RAILWAY JOURNAL for March, 1896. Certain improvements which have been recently made are in placing the motor between the two axles, instead of on the front platform, remedying thus the unequal division of the load on the two axles which characterized the first motors. The engine has two cylinders and is connected to the axles by sprocket chains and gears. The system has been adapted to cars seating passengers from fifteen to fifty in number, weighing as follows:

15	passengers,	weight	empty	5500 lbs.,	loaded	7700 lbs.	
20	"	"	"	7700 "	"	13,200	"
40	"	"	"	13,200 "	"	18,040	"
50	"	"	"	17,600 "	"	25,300	"

On the line of the Tramway Company of Paris and Department of the Seine, the cars mount a grade of five per cent. Power is transmitted from the engine axle to the car axle by chains where the speed is not over 15.5 miles per hour, where above that, gearing or direct connection would probably be employed. The official statement of the consumption per horse power hour for a small motor of 4 h. p. is given as follows:

Coal	4.4 lbs.
Water	30.8 "
Oil	0.55 "

These figures would be less for a 20 h. p. motor which is the size usually used on a car of 22,000 lbs. weight.

The system is in use at Havre, Saint-Romain, Marseilles, Thessaly, Vienna, by the General French Tramway Company and on the lines of the General Omnibus Company, of Paris. The experiments on these lines are said to have been satisfactory. The company has also a number of other orders, notably for lines in Paris, Orleans, Lille, Berlin, Vienna and Cherbourg.

FIRELESS LOCOMOTIVES.

Lamm-Francq System.

This is a stored steam system in which the ordinary furnace is dispensed with, the boilers of the motors being charged at central stations with water at a high temperature and under pressure. As the pressure is reduced, the water turns to steam. The latest motors also use a "re-heater," employing coke, by which it is thought some economy is ensured. The expense of the system as compared with the others mentioned, as found by the Tramway Company of Paris and of the Department of the Seine is as follows:

Animal traction, per car mile	33.25 cents.
Fireless locomotives, per train mile	26.63 "
Electric traction by accumulators per car mile	37.35 "

In the above are included expenses common to the three systems figured at 8.356 cents.

A train is composed of two passenger cars containing seats for fifty people and a truck for baggage.

Motors of this type are now being built for the Saint Germain-en-Laye à Poissy line of the following dimensions:

Diameter of cylinders	13 ins.
Stroke of piston	12 "
Volume of hot water	951.12 gals.
Volume of steam	14.12 cu. ft.
Maximum pressure in the reservoir	220 lbs. per sq. ft.
Weight, empty	26,400 lbs.
Weight ready for operation	36,520 "

COMPRESSED AIR MOTORS.

Mekarski System.

The application of compressed air has extended over a number of years in Nantes and in other cities in France, and is now being made by the General Omnibus Company of Paris on three divisions of its system, having a total length of 17.4 miles. Upon two of these lines twenty-three locomotives will be required of which fifteen are intended for regular service. The daily service will be 2201 car miles and it is thought that the cars will take the place of thirty-five horse cars. The cost of traction is estimated at 8.7 cents per mile. On the third line of the General Omnibus Company, twenty-four cars will be used, of which eighteen will be in regular service. The grades on this line are considerably steeper and the cost of operation is estimated at 13.55 cents per motor car mile when operating alone and 3.22 cents per trail car mile or an average of 8.38 cents per car when operated in two-car trains.

The Mekarski system is now in use on the following lines:

(1) Tramways of Nantes, 6.8 miles standard gauge.
(2) Tramways of Nogent, near Paris 2.5 miles, gauge 3.28 ft.
(3) Tramways of Saint-Maur, 8.7 miles, standard gauge.

(4) Tramways from the Louvre to Saint-Cloud and Versailles (General Omnibus Company) 12.4 miles, standard gauge.

(5) Tramways from Vincennes to Paris (General Omnibus Company) 4.3 miles standard gauge.

(6) Tramways of Vichy-Cunet, 2.5 miles, gauge 3.28 ft.

(7) Tramways of Paris-Arpajon, 2.5 miles, standard gauge.

The question of applying the system on a large scale is under consideration by the General Omnibus Company of Paris. If this is done, two central stations of 4000 h. p. will be established according to plans of L. A. Barbet.

In an interesting pamphlet recently published by M. Barbet on the application of compressed air to tramway purposes, it is stated that:

After a test extending over two years, on the motor cars on the tramway from Paris to Ville-Evrard, there is a consumption of 35.5 lbs. of air per mile. On the line from Saint Augustin to Vincennes, on which the grade is quite irregular and which crosses many streets where the cars have to make frequent stops, the consumption of air is 45.35 lbs. and is diminishing constantly as the machines are improved. It can be definitely stated that the cost of air consumption per car mile varies between 6.4 cents to 8 cents. The cost ought to be considerably reduced as the grades are less; for instance, the consumption of air on the Nantes Tramway, calculated over a year, does not reach 25 lbs. per mile, which corresponds to an expense of about 4.5 cents.

The cost of supervision varies according to the wages of the engineer and the amount of work which he is obliged to do. For the same machine the cost of supervision is 1.9 cents on the Nantes tramways, 2.2 cents on the line from Paris to Ville-Evrard and 3.5 cents per car mile on the line from Vincennes to Saint Augustin.

The cost of maintenance of machines, including the expense of the shop, the cost of renewal parts, oil and waste, rose in 1894 on the Nogent tramways for the machines which had been in operation for some time to 2.3 cents per car mile. If the preceding items are added, the total cost per motor car mile is as follows:

Consumption of air 22 lbs. at $6.45 per 2200 lbs.	6.45 cents
Wages of attendants	2.43 "
Maintenance and oil	2.29 "
Total	11.17 "

or in round numbers, 11 cents per mile.

When a motor car draws a trail car of capacity of fifty passengers, the consumption of air increases according to the grade, from 7 lbs. to 18 lbs. per car mile. The trail car does not need any conductor and the expense of maintenance and oil, which are insignificant, are included in the price given above of 2.3 cents.

According to the information furnished by M. Barbet, the cost of operation on the Nogent tramways and on the Nantes tramways in 1894 is as given in the table below:

COST PER CAR MILE IN CENTS.

	Nogent,	Nantes.
Labor at station	2.32	1.45
" on cars	2.26	2.00
Coal	4.71	2.64
Water	0.55	0.52
Oil and waste at station	0.13	0.06
" " for cars	0.36	0.26
Maintenance station	1.00	0.61
" rolling stock	1.61	1.81
" miscellaneous	0.16	0.06
Total	13.10	9.41
Length	2.48 miles	6.82 miles
Gauge	3.28 ft.	4.707 ft.

The difference between the cost of operation in the two cities is on account of the difference in the wages paid, and because in Nogent according to municipal ordinance an extended service is not given.

The average consumption of air in Nogent where the grades are steep and where the cars are larger than at Nantes is 35.5 lbs., while at Nantes the consumption is only 24.8 lbs.

According to the pamphlet of M. Barbet, the production of compressed air at Nogent and Nantes is about 7.7 lbs. per steam horse power, but in an estimate for the extension of the Nogent power station, the Creusot Works have guaranteed a production of 13.2 lbs, of air per steam horse power, which would considerably reduce the cost of operation.

Popp-Conti System.

The characteristic of the Popp-Conti system is the use of compressed air at a low pressure—354 lbs. to 425 lbs. per square inch—while in the Mekarski system the pressure rises to 850 lbs. to 1133 lbs. per square inch. The former system therefore offers the advantages of greater security, of a power station more economical, of a reduced cost of maintenance for compressors and other apparatus, while their output is greater, and finally of an operation more economical. In this system the cars can be built much lighter, since the reservoirs of air, which they carry, have only the dimensions necessary to keep a supply of air for a travel of from 1¼ to 1¾ miles.

The reservoirs are recharged automatically at points along the route, the time for recharging not being more than a few seconds. Pipes containing compressed air are led to these stopping points from the main power station. When a car arrives at one of these stations, a lever, placed inside the rail, is automatically pushed down by the pressure of the wheel flange. This raises between the tracks an ingenious automatic contact valve which charges the reservoirs with compressed air to the original pressure. The pipes leading from the power station are of steel, from two to four inches in diameter, and are laid like gas and water pipes about 2.3 ft. below the pavement. These can be laid in the existing sewers as are the pipes of the Parisian Compressed Air Company, which has an installation of seventy-four miles and which has been in operation for fifteen years.

The advantages claimed for this system are the ease with which the system is operated, no special intelligence being required on the part of the motorman, other than that he can learn in a very short time, the circumstance that this system does not disfigure the streets or public places, the absence of all danger to passengers and others, and finally the reduced amount of fuel consumed, which does not exceed 3.63 lbs. per horse power on average grades, and 4.29 lbs. on steep grades. The cost of installation of conduit varies, according to the length of the line, from $3200 to $4800 per mile, and does not exceed under the most unfavorable conditions $6400 per mile of double track.

The system is now in course of construction on the St. Quentin and d'Angoulème tramways. The steepest grades are 6.6 to 7 per cent and the two lines were expected to have been ready for operation by July and August of the current year. At present, negotiations are under way with the South Paris Traction Company for a line to be in operation by next May.

The total cost of operation is estimated at 22.5 cents per car mile, divided as follows:

Supply of compressed air	3.5
Conductor	3.2
Maintenance	15.8

The following is an estimate of the General Lighting & Power Company of Paris for the establishment of a line, 6.2 miles in length, serving a traffic of 340,000 motor car miles and 66,000 trail car miles, including installation of machinery and conduits:

Power station with three steam engines of a total of 500 h. p., three compressors and six reservoirs, boilers, pumps, etc.	$53,000
17,646 ft. of conduit, with nine re-storage traps, mounted complete	12,000
Eight motor cars and eight trail cars	38,000
Miscellaneous	9,000
Total	$112,000

not including buildings and track which should be about $18,000 per mile.

The General Lighting & Power Company of Paris states that it is ready to guarantee the cost of operation of the Popp-Conti system, as follows:

For the first project, 11.6 cents per motor car mile and 5.8 cents per trail car mile; for the second installation, 7.1 cents per motor car mile, and 3.2 cents per trail car mile.

These items include: 1, the expense of producing the compressed air; 2, the cost of maintenance of the central station, of the compressed air pipes, of the apparatus for taking the air and the rolling stock; 3, the cost of oil and waste for the rolling stock, the wages of attendants, the heating and lighting of the cars; 4, the royalty for the patents.

From the above it seems that as the installation is larger and the service more frequent, the cost of the mechanical installation of the central station and of the conduits is reduced.

CABLE RAILWAYS.

In his paper, M. Ziffer recites the experience in America, and quotes the cost of operation for cable, horse and electric power, as shown by the report of the Chicago City Railway.

The cost of operation of the Edinburgh Northern Tramway, as given by him, are 12.76 cents per car mile, and of the Birmingham Cable Tramway 12.64 cents per car mile.

GAS MOTORS.

Lührig System.

The Lührig system in use in Dessau, is described by M. Ziffer. Full particulars of this system are published in the last issue of the STREET RAILWAY JOURNAL, page 785. The cost at the works of a car with room for fourteen passengers seated and twelve others, and with ten horse power motor is given as $3360 and that of the compressing station apparatus $2400. The German Motor Company of Dessau gives as the cost of operation of a recent road, that at Hirschberg, taking as the basis the cost of .007 cents per cubic foot of gas and an average consumption of 30 to 34 cu. ft. per motor car mile as follows:

First. For the consumption of gas 2.2 to 2.4 cents per car mile.

Second. The cost of traction, that is, the consumption of gas, wages of employes on cars and at station, cost of oil and waste, maintenance of motor 5.64 to 6.45 cents per car mile. On the tramways Rhenans-Westphaliens, the cost of traction averaged for a year's experience 4.84 to 6.04 cents per car mile.

Third. Operating expenses, that is, the above together with cost of administration, maintenance of buildings and cars, cost of insurance of employes, etc., 7.25 to 8.06 cents per car mile.

Fourth. Total cost of operation, that is, including with the above sinking fund for installation, tracks and rolling stock as well as the establishment of a reserve fund, from 9.27 per car mile to 10.08 cents according to the intensity of the service.

Daimler System.

The Wurtemburg state railroads have had in operation since 1893, on the lines near Stuttgart, motor cars operated by benzine. The first cars which were employed have been replaced by others larger and more powerful. One of these present cars weighs 22,000 lbs. empty, and contains space for thirty-two passengers seated, and eight standing, and carries a motor of ten horse power. The other with a motor of the same power and a capacity of twenty-four passengers seated and eight standing, weighs about 17,600 lbs. empty. While the service of these cars has not given completely satisfactory results, they are considered desirable for certain classes of work.

Borsig System.

This is a gas motor built by A. Borsig, of Berlin, and differs from the Lührig gas motors in several particulars. The gas engines can be applied to existing cars, the dead weight is less by 3300 lbs. to 4400 lbs. than those of the Dessau cars. The operation is more silent. The cars when not in operation are not shaken by the moving parts. The gas reservoirs are placed under the car and the time required for storing them from the main station is very short. The motor is kept in continuous operation and transmits its movements to the axles by means of conical gears. No special mechanism is required for reversing as in the Lührig system. The products of combustion are utilized in winter for heating the car, but can be allowed to escape through a stack leading to the roof. The gas is also utilized for lighting the car. The cost of the equipment of a car of this kind is estimated at from $864 to $1080.

In reply to an inquiry addressed to the builders upon the subject of the cost of operation, it was stated under date of Jan. 31, 1896, that the new motor had not been in operation a sufficient length of time to give for publication the figures upon this point.

ELECTRIC TRACTION BY ACCUMULATORS.

In America, as well as in England, there have been several important applications of accumulators to tramway traction, without, however, any very satisfactory results. The first attempt of operating cars by accumulators was made in Paris in 1881, when the Faure accumulators were used. In 1885, experiments were made with the Reckenzaun accumulators in Berlin; then in 1886 at Hamburg, in 1887 and 1890 in Brussels, and in 1890 at Dresden with the Julien accumulators which had obtained at the Antwerp Exposition, in 1885, the diploma of honor; finally in Frankfort, in 1891, a tramway car was put in service equipped with Tudor accumulators. The following are the latest experiments of the accumulators for traction.

Schäfer and Heinemann System.

This accumulator constructed on novel points presents, it is claimed, a number of advantages over other systems in lightness and durability. A car equipped with these accumulators and a motor of thirty horse power was put in operation Jan. 7, 1896, on a section 1.58 miles in length of the tramway between Berlin and Charlottenburg. This car weighs complete with twenty-nine passengers 235,400 lbs. The body is 16 4 ft. in length and 6.56 ft. in width. The consumption of energy is only 4.5 k. w. for an average speed of 7.44 miles an hour, corresponding to a resistance of about 17.6 lbs. per 2200 lbs. of rolling stock which ought to be considered a very favorable result for tramway service.

The battery is carried under the seats and is composed of 124 elements. Each element is composed of five positive and five negative plates weighing only 3.96 lbs. They are .117 in. in thickness, 13.65 ins. in height and 7.8 ins. in length, and are separated a distance of .234 in. from each other in a cell of celluloid protected itself by a wooden casing. The plates, which are of lead in the form of a grill, are filled with the active material. The normal intensity of discharge is 6.5 amperes per square inch, but this can easily be doubled and corresponds then to a discharge of three hours. Under a service with average discharge of eighteen amperes, the capacity in battery is indicated as being 400 ampere hours; with a discharge of thirty amperes, it is not more than 330 ampere hours. The weight of the entire battery is 72,600 lbs. The active material is a glycerate of lead, with which is mixed certain fatty acids. The positive plates are formed by a current of from nineteen to twenty-five amperes per square inch in an acid bath of potassium permanganate. The negative plates are formed somewhat more slowly, and without the addition of the potassium permanganate. The car has been in regular service since Jan. 12, 1896, and has shown that it is able to give a daily service of 68.2 miles without being recharged. The batteries are charged during the night in four or five hours, and the cost of charging for the following day's service and for lighting the cars is from $1.20 to $1.44.

The steepest grade on the line is 3.6 per cent for 1640 ft. in length, and is mounted without difficulty. The speed is limited to 7.44 miles an hour on account of local conditions. According to the experiments which have been made, the car consumes for twenty-one round trips of 3.2 miles, that is to say, 67 miles a day, 144 ampere hours. The average potential is 240 volts.

As a result the consumption per car mile in round numbers is 517 watt hours, which is an extremely favorable figure if account is taken that in this consumption is included as well the lighting by seven incandescent lamps of sixteen candle power each. The capacity of the battery suffices then for operation for from sixteen to eighteen hours, in fact, the car has run 105 miles without recharging. The cost of current, based on the price of four cents per kilowatt hour, paid to the central station at Berlin, and on the consumption of 517 watt hours per car mile, is about two cents per car mile. If to this is added the cost of attendance, oil, waste, maintenance, interest and sinking fund for the entire installation, the total cost of operation is about eight cents per car mile.

According to the figures furnished by the manufacturers of these accumulators, operation by accumulators on the line to Charlottenberg will cost 6.677 cents, although the tramways at Halle, operated by overhead wire, cost 7.47 cents, and at Lubeck, also a trolley road, 5.90 cents per car mile, corresponding on an average to 6.68 cents. Traction by gas motors costs, under the same condition, eight cents, and by horses, 9.7 cents per car mile.

The cost of a car complete is $3840.

Waddell-Entz System.

At Hagen there has been in operation since Jan. 7, 1895, on the Kückelhausen-Hagen line (1.92 miles in length), an electric service by means of copper-zinc accumulators, built by the Accumulatorenfabriks-Actien-Gesellschaft, Hagen i. W., under the Waddell-Entz patents. The copper-zinc element gives an accumulator a large capacity, which requires about three hours for charging. The rolling stock includes ten cars, with space for twelve passengers seated and fourteen standing. The electric equipment was furnished by the Oerlikon Maschinenfabrik and Schuckert & Company, of Nuremberg. The motors are fifteen horse power, and each car contains two groups of accumulators of forty-four elements, or a total of eighty-eight copper-zinc elements, which are carried under the side seats. It is yet impossible in the present state of the trial to form a judgment on the merits of this accumulator, although the experiments of the same accumulator on the Second Avenue line in New York did not give the results which were hoped.

System of the Company for the Transmission of Power by Electricity.

The Tramway Company of Paris and of the Seine Department has, as is well known, applied accumulator traction to two of its lines with a length of 2.8 miles. The cars operated are double decked, containing space for fifty passengers, and surmount without trouble grades of 3.6 per cent. The cars run 33.5 miles, drawing a trail car without recharging. Each car is equipped with two motors, and carries 108 elements, giving 216 volts. The accumulators are of the Laurent-Celly type. Both positive and negative plates are made of a lead grill, the one charged with spongy lead, and the other lead peroxide. The grills are the same as those employed by the Electrical Power Storage Company, and are well known. As under certain conditions of service, the peroxide of the positive plates softens, becomes pasty and in this state falls out of the grill to the bottom of the cell, the efforts of the manufacturers have been directed toward overcoming this difficulty. This has been accomplished by covering each peroxide plate with a sheet of asbestos and introducing a piece of wood in the space separating the two plates so as to press the sheet of asbestos against the surface of the peroxide plates and prevent the material from falling out of it. The introduction of the accumulators into the car takes about ten minutes and the length of the charge is five hours. The experiments made in 1893 having demonstrated that the employment of heavy cars is not to be recommended, the weight of these cars ready for service has been brought down from 30,800 lbs. to 25,740 lbs., in reducing the gauge and the dimensions of the batteries, which are now carried in a single tray situated under the car between the axles. The new car contains room for fifty-two passengers, and the manipulation of the batteries at the charging station requires only two men. These improvements ought to materially reduce the cost of operation.

Chloride Accumulators.

Under this heading, M. Ziffer describes the system of the Electric Storage Battery Company and methods of handling batteries, which are familiar to readers of the STREET RAILWAY JOURNAL through recently published descriptions in these columns.

Engl System.

These accumulators are distinguished from the other systems by the reduction of weight and increase of capacity. With a weight of 37.4 lbs. per element, these accumulators give, at a discharge of 20 amperes, about 440 ampere hours; at a discharge of 100 amperes, 375 ampere hours; 150 amperes, 320 ampere hours; 180 amperes, 300 ampere hours; in each case leaving a reserve of about 10 per cent.

The battery consists of 124 elements weighing about 4400 lbs. per car, and gives about 198 miles on a line without grades, or where the grades do not exceed 1½ per cent as in Berlin, and a service of 105 car miles in cases where the grades are as high as 5 per cent, as in Vienna. In the first case the batteries are able to run two days and in the second case, one day, with single charge. In placing the batteries on the roof of the car, the inconvenience resulting from their location under the seats or on the truck are avoided. The batteries are charged in this position from an overhead conductor. The gas which is disengaged during the charge, escapes directly into the air, preventing any destructive action upon the car body.

COMBINED ELECTRIC SYSTEMS.

For the purpose of avoiding the use of overhead wires in the streets of the city, and the troubles produced by the return of current on the rails, as well as to reduce the first cost of operation, different combinations of electric systems have been suggested of which two only will be described.

Combination of Accumulators and Trolleys.

On the Hanover tramways the cars are operated by overhead wire in the suburbs, and accumulators in the interior of the city. The line operated in this way aggregates 14.9 miles, of which two-thirds are equipped with overhead wire. The accumulators now used are those of the Accumulatoren Actien-Gesellschaft Hagen, to whom the tramway company pays $390 per year, per car, for the accumulators. In return for this sum the Hagen Company guarantees the regular operation of the battery. The weight of the car, including the motor body and battery, is 16,720 lbs. At an average of 74 miles a day and 300 days' service, the amount, $390, corresponds to 1.7 cents per car mile to which must be added, of course, the expense of coal, water, etc., together with the increase in weight of the cars, the disadvantage of the use of heavier cars, the more rapid wear on the rail, etc.

In the Annual Report for 1895 of the Hanover Street Railway Company, it is stated that service by accumulators which had been in use for about six months was giving good results, that the cost of traction was less by 1.41 cents, than the use of horse power, and that the fears expressed at the commencement of the service, on the subject of the durability of the accumulators, had not been realized up to that time. The service has since been increased and the company proposes to employ the system on all its lines.

One point, however, should not be passed in silence. The accumulators employed in a system of this kind remain in service only from 3 to 3½ hours at the most. In Hanover it is shown that they are in service for not more than forty minutes at one time, and they are immediately recharged by the overhead line, circumstances which are evidently favorable to service. The system, however, presents this difficulty, that the car is obliged to carry constantly the dead weight of the accumulators even when they are not in use, and consequently there is a considerable loss as to energy.

ELECTRIC TRACTION BY UNDERGROUND CONDUIT.

This system which has been employed but rarely, up to the present, on account of the high cost of installation and the difficulty presented in laying the conduit on account of gas and water pipes, etc., has yet been installed in certain large cities where it has been impossible to secure a right for overhead wire.

In his paper M. Ziffer does not discuss the most well known systems of underground conduit, such as the Buda-Pest, Love, Lenox Avenue, Hoerde, etc., the general details of which are sufficiently familiar, or the early systems, but confines himself to one or two of the more recent and less known systems.

Klette System.

The application of this system is being discussed for Dresden where the company desires to interfere as little as possible with existing tracks, and where the overhead system is being used to some extent, and where the company desires to change as rapidly as possible from the overhead wire to the underground conduit and vice versa. The plans contemplate the construction of conduits between the tracks with a space not greater than 9.75 ins. in width and 25.35 ins. in depth below the surface of the pavement. The system embodies the general principles at Buda-Pest, except the following particulars:

Instead of providing for the complete metallic circuit, one conductor only is laid in conduit and the return is by the rails. It remains to be seen whether, on this account, there will not be greater leakage and danger from short circuits.

The conduit is closed by plates easy to raise, making the conductor very accessible.

The change from underground conductor to overhead and vice versa is effected quickly, simply and automatically.

The difficulty of possible flooding of the conduit from heavy rains, etc., is avoided by the use of overhead wires in those streets which are practically level, and the installation of the conduit only where the grade is sufficient to keep the street comparatively dry in case of rain.

The first cost of conduit on this system is estimated at $2.56 per running foot, not including paving. At crossings the contact is interrupted for 7.8 ins., the cars passing over these points, by momentum.

CLOSED CONDUIT SYSTEMS.

The two systems discussed by Mr. Ziffer, the Claret & Vuilleumier system and the Krizik system, in general construction are somewhat similar to those familiar to American engineers. No installations other than those which could be considered experimental have as yet been made.

GENERAL CONCLUSIONS.

Upon this subject Mr. Ziffer first quotes a statement made by a committee of the Common Council of Berlin recently appointed to investigate the general subject of tramway systems. This reads as follows:

"First. Advantage of the trolley: its low cost; against it the electrolytic difficulties, the disfigurement produced by overhead wires and the dependence upon a central station.

"Second. The advantages of the Buda-Pest conduit system lie in the use of a return conductor and the fact that the appearance of the streets is not changed in any way. Its disadvantages are in the high cost, the possibility of short circuit when the streets are flooded, and the dependence upon a central station.

"Third. The advantages of the Klette system lie in the low first cost as compared with the Buda-Pest system, the fact that the appearance of the streets is not changed, and the possibility of changing a line from horse to electric power without interrupting the service. Against the system can be urged the return of current by the rails, and the dependence on a central station.

"Fourth. In favor of accumulator traction, the chief advantages are the independence from a central station, the avoidance of the use of overhead wires, and the possibility of immediately utilizing tracks operated by animal power. Against the system is its cost, and the weight of cars and the accumulators.

"Fifth. The advantages of gas cars (Lühig system) lie in the possibility of utilizing a cheap and common production, independence from a central station, and the economy of the system. Against it can be urged its inconveniences, bad odor and vibrations of the car, which as yet have been impossible to suppress.

"Sixth. For the Serpollet system the claims made are the independence from a central station and reduced cost. Against it, the necessity of turntables or of loops at termini, the possibility that passengers may be inconvenienced by the hot air, and the occupation of the front platform by the motor,

"Seventh. For the cable system, the advantages lie in its possibilities for caring for great traffic at a low cost and its independence of grades. Against it, its high first cost and dependence on a central station.

"Eighth. Fireless locomotives (Lamm-Francq) do not appear to present, at least for traction in the interior of the city, any other advantages than those which have been mentioned for other systems. On the other hand the system has the disadvantage of compelling the operation of cars in trains; moreover, it is probable that the cost of operation is considerable, and finally, even if there is no smoke, there is at least an escape of steam relatively considerable.

"Ninth. In favor of compressed air, no special advantage can be cited. On the other hand it presents the disadvantage of compelling the turning of cars at the end of a trip, of high cost, and the occupation of a front platform by the motor."

"In view of the constant improvements which are being made in the electric systems, by which something better than now in use will probably be developed soon, it is difficult to decide upon the definite adoption of any particular system. We will therefore confine ourselves to proposing certain tests."

"The systems mentioned can be divided into two classes; those which owing to their high cost and for other reasons are not well suited, even for testing, to Berlin conditions, and those which could be so tested. Among the latter we include the trolley, Klette system, accumulator system, gas motors and Serpollet motors.

"We recommend, therefore, if possible, the test of these systems on the lines of existing roads at the cost of the city, the different manufacturers furnishing the cars and personnel. In this way the different systems can demonstrate their relative advantages and the public as well as ourselves can also determine how they satisfy their conditions.

"If, however, we should be asked what system we would recommend in any definite installation, we should reply, a combination system of trolley and underground conductor. The trolley would be employed where the character of the street permits it, or where the grade of the streets would seem to make the operation of a conduit difficult or impossible. Is it possible to still modify this system by placing on the cars accumulators which could be utilized, under certain circumstances, for traction? We are not prepared to commit ourselves on this point. From what has been told us by the manager of the Accumulator Works at Hagen, it does not seem impossible to secure such a combination. It might be stated here that an application of overhead conductor by the sliding rod contact seems to be preferable to the trolley on account of the easier first equipment of the line, and the reduced amount of overhead work."

At the meeting of the French Association for the Advancement of Science, which was held in Bordeaux in 1895, the question of mechanical traction for tramways was discussed, and will be resumed at the next meeting of the Congress, held at Tunis. The result of the meeting at Bordeaux was that from a technical standpoint, the cable system is only applicable in special cases, but is especially difficult to install in cities.

The accumulators form an ideal method of traction for the interior of cities, if cars equipped with them can care without difficulty for trail cars, mount grades at a fairly good speed, and respond to the exigencies of the service promptly. Compressed air motors ought to find advantageous application in the interior of cities as they possess more independence than ordinary electric cars and more elasticity than accumulator cars. On the other hand they weigh considerable, and wear out the tracks.

Steam motors ought not to be permitted in the interior of cities. Consequently steam dummies generating their own steam should not be permitted in the interior of cities.

Hot water engines with the fireless locomotives are admissible for city service, providing the exhaust steam is condensed.

The overhead trolley system is equally well adapted for city and suburban service, and is especially economical when water power is available, or when the railway service is combined at the power station with the lighting service.

A report recently submitted by a committee appointed by the Municipal Government of Paris to study the different systems of electric traction states:

"The expense of the installation of the cable railway at Belleville (Paris), which has many curves and a grade of 7½ per cent,

amounted to $226,000 per mile. In England, at Birmingham and at London, the cost of installation of cable railways was somewhat less, being respectively $153,000 and $129,000 per mile.

"It is difficult to give in a general way the first cost of an electric line, either trolley or conduit, on account of the great differences presented by local conditions. The report, however, cites certain examples without giving a definite figure. The comparison of the first cost of installing a line operated by accumulators and by the Serpollet system, based on the experiments made in Paris, show a marked economy for the latter.

"So far as the costs of operation of the different systems of mechanical traction are concerned they are as yet too little known, and from the information which it is possible to gather on the subject, it is difficult to make any comparison, certain items being included in one case and not in another."

However, the report gives certain interesting figures on the consumption of coal per car mile:

For trolley traction at Havre	6.03 lbs.
For accumulation traction in Paris	9.2 "
For compressed air traction on the St. Augustin-Viniennes lines	39.3 "
For the Serpollet motors in Paris (the fuel being coke)	7 to 11 "

Motors.—It is without doubt that the direct utilization of steam power in steam tramway dummies offers certain advantages from an economical standpoint, if the inconvenience were not also presented of combining in the same car the steam engine and the passengers, who are exposed, although the motor is in a separate compartment, to being incommoded by smoke, heat and bad odors from the engine. For this reason steam cars can hardly be considered suitable for tramway service within the center of the city, but the system can be considered as one very convenient and economical for light railways situated in suburbs, or interurban roads where the traffic is not very considerable. The improvements in the system which characterize the Serpollet motor cars have added to the desirability of the system and explain the recent adoption of the system on a number of existing new lines. The principal advantage of the system lies in the complete independence of the cars from a central station, in low operating cost, and from the fact that the existing rails of a tramway can be utilized without important changes.

The fireless locomotives of Lamm and Francq have also been so improved as to permit of their economical operation especially when the cars are run in trains of two or three.

Compressed air systems have been the object of numberless improvements and the system has constantly been applied to new industries. The low pressure system is capable of considerable improvement.

Cable railways have recently been the object of a good deal of attention in Europe in spite of the heavy first cost, for lines having steep grades and great traffic which could not be economically operated by other systems.

The operation of tramways by gas or petroleum motors has also been the subject of a great many improvements during the last few years by which the motors have been made much more suitable for tramway service. There is room, however, for great improvements and the system has not been in operation long enough yet for the giving of a definite opinion as to its value.

Among electric systems the accumulator is evidently the ideal, although the lines to which the system has been applied are still in an experimental stage. We cannot deny, however, that during the last two years advance has been made in this method of traction not only from the standpoint of weight, capacity and durability of the accumulator, but also from the standpoint of handling the batteries on the car and in the station. On the other hand, accumulators are still much too heavy and their operation is too costly. Although the improvements which have already been made in accumulator service cannot be considered yet to have been finished, the condition of the system is nevertheless such that it has been applied successfully in combination with the overhead system, as in Hanover, and it is proposed to install a similar plant at Antwerp.

In view of the difficulties yet surrounding accumulator traction and the mixed system as well as the disadvantages of the trolley system which has been more widely adopted at present than any and the results of which are known, a rational solution of the problem of the situation of underground conduit acquires a growing importance. This is why so many new systems of this kind are being continuously brought out. It will have to be shown that any new systems are better than those which have already been installed and while there are at Buda-Pest and several other cities lines which are in operation, the greater part of these lines, except that at Buda-Pest must still be considered as in an experimental stage.

According to some figures in the December, 1895, issue of the *Railway World*, there had been installed by European firms in Europe at the end of 1895, eighty-five electric lines with a total length of 452.9 miles and operating 1371 motor cars. There were in course of construction, forty-seven electric lines with a total length of 385.3 miles, and operating 1226 motor cars. Different gauges are in use from 23.4 ins. up.

The general details of the trolley lines are so well known as not to require a description, and the results secured by them in America have been excellent. It cannot be predicted that this system will continue in the future to maintain its present front rank. That will depend entirely on the improvements made in the accumulators, in the conduit system, in surface contact systems, as well as in the technical and economical advantages which these systems possess.

RESUME.

If we briefly review our study of mechanical power on tramways, we are impressed with the fact that the different mechanical motors employed have been greatly improved during the last few years and that improvements are constantly being made, so that without doubt their application will become much more general.

The Rowan system is especially adapted for the transportation of passengers on secondary railways situated in the suburbs of large cities or for connecting neighboring towns. Nevertheless during recent times these cars have not been a very large factor in tramway work.

The Serpollet car which is equally adapted to the transportation of passengers is especially suitable for city and suburban work. It is marked by great simplicity and economy in original and operating cost.

The fireless locomotives of Lamm and Francq are particularly adapted for lines of large traffic for the interior and exterior of cities. According to the estimates which have been made the operation by these motors is more economical than by steam dummies.

Compressed air motors, especially those of the Popp-Conti low pressure system, which is however yet in the experimental stage, presents a number of advantages for tramway traffic in the interior of cities. Reliable figures however on the cost of operation and installation of this system derived from experience are yet wanting.

Cable railways have been introduced in Europe on account of their great capacity on lines having heavy grades, although the first expense of installation is very high. On the other hand, for large traffic the operation of the system is more economical than that of any of the others.

Gas motors have not yet been in use for any length of time and certain improvements are still necessary. They respond easily to the exigencies of tramway service in the interior of cities of secondary importance as well as in the suburbs. The cost of installation and operation is not very high.

Electric traction under its different forms has been more extensively developed than any other and is particularly well adapted for the large traffic of passengers at high speed as well as for that in large cities and in their suburbs. Electric traction has a large capacity and the improvements which are being made constantly permit the hope that it will be applied not only to the operation of tramways so called, but also for secondary railways, even those used for the transportation of merchandise, and finally to certain kinds of service on trunk railways. The conviction is being confirmed day by day that electric traction will constantly increase in adoption and will be developed in such a way that in the not far distant future it will occupy a predominant position and be adopted for all tramways. The cost of installation depends upon the system employed.

The Report of the Glasgow Commission.

The report of the committee appointed by the Glasgow corporation tramways, to examine and report on street railway traction and operation in American cities, has just been published. The committee, which consists of John Young, general manager of the Glasgow Corporation, and Wm. Clark, engineer, sailed from Liverpool on Sept. 19, 1896, and spent seven weeks in its work here; visiting in the course of its investigation the cities of New York, Brooklyn, Jersey City, Philadelphia, Baltimore, Washington, Pittsburgh, Cincinnati, Chicago, Detroit, Cleveland, Buffalo, Niagara Falls, Toronto, Montreal and Boston. The gentlemen on the committee desire to express their high appreciation of and their hearty thanks for the courtesy and kindness shown to them by one and all of the many gentlemen interested in the street railway industry, which they met in America. After giving a separate report on each city visited the gentlemen gave the following

GENERAL REMARKS AND CONCLUSIONS.

It is about the lifetime of one generation since tramways or street railways became recognized as a necessity of city life. Ten years ago, with the exception of a few cables in San Francisco and Chicago, horse traction was universal.

Wonderful changes have taken place since then. Many forms of traction have taken the field, and there has been a fierce and continuous struggle for the supremacy. One outcome of all this has been enormous development. In 1890 (not to go further back) there were 9037 miles of street railways in the United States. 5400 miles were operated by horses, 510 miles by cable, 604 miles by steam and 2523 miles by electricity. The return for 1896 shows that they have increased to 15,956 miles, of which 1351 miles were operated by horses, 612 miles by cable, 384 miles by steam, and 13,609 miles by electricity. Within the last five years the number of horses used in operating tramways in America has declined by no less than eighty per cent.

Without waiting to trace the history of the traction struggle, we shall endeavor to refer to and discuss the different forms of traction brought under our notice on this visit. They have practically all been discussed in former reports already in your hands, but we shall speak of them as seen and judged of in America.

Storage Batteries.—This system was tried some years ago in Washington among other places. After a large amount of money had been expended on experiments, the system was given up as a failure.

Oil and Gas Motors.—Mr. Yerkes, of Chicago, was at great trouble and expense testing the Connelly motors, but they proved unsuccessful as well as unpopular, and he threw them aside. This is the system which your sub-committee inspected at Croydon. So far as we could learn, there are no other oil or gas motors in America.

Compressed Air.—Mr. Hardie has been working on compressed air motors for some years and has three of his cars now running in New York. They cannot be said however to be either sufficiently successful or popular to be seriously considered for adoption at present.

The latest compressed air motor which has been brought out—and it has been done with a considerable show of influence—is one patented by Mr. Knight and Mr. Whitney. The former was one of the patentees of the Bentley-Knight conduit system, and the latter is largely interested in street railways. The first of the Knight-Whitney cars was placed on the Lenox Avenue route during our visit, and we had the pleasure of riding on it with Mr. Knight. All we can say is, that the car seemed to run all right throughout the double journey (fully five miles) with the one charge. But it would be rash to express an opinion regarding the future of anything of this kind in its first experimental stage, although it seemed to us to be the best compressed air system yet produced.

Electro-Magnetic Systems.—Closed conduit or magnetic systems have as yet made no headway in America, nor, so far as we could learn, are they looked upon with much favor or hope of practical success. In point of fact, so far as we are aware, no street railway company is at present even experimenting with them.

Electric Open Conduit or Underground Systems.— Electric open conduit installations—modifications of Siemens & Halske's Buda-Pest systems—have recently been put down and are being experimented with in Washington and New York. In both cities the overhead system is forbidden. The two experiments are closely allied, and differ only in details. The slot, instead of being in the side rail as in Buda-Pest, is in a third rail in the center of the track, similar to the ordinary slot for the cable gripper. In Lenox Avenue, New York, the conductors in the conduit are of channel iron for one portion, and 1½ in. steam tubes for another, while in Washington it is a T iron. The cost of construction is spoken of in America as practically prohibitory, and the special work at junctions and crossings is very expensive, one junction in New York having cost £15,000. In Washington the capital outlay for track and equipment is given at about £20,000 per mile of single line and in New York the track alone is said to have cost that amount. And, of course, the horse track and the asset it represents are wiped out. Last winter there was little frost or snow, so that these underground experiments have not been tested through a severe winter. Both in Washington and New York the cars have been stopped for a short time during heavy rains, but while we saw them, in dry weather, they were running very well and seemed nicer to ride in than the cable cars, and were evidently more popular.

One drawback specially spoken of in connection with the operating of the underground system is the great difficulty of locating the defect when anything is wrong. And, of course, apart from snow storms, there is the difficulty in wet weather of efficient insulation through damp and slush. We observed the electric lighting of the cars working on this system was not quite satisfactory. The lights were dim at times, and went out altogether at the junctions.

The streets and climate of Washington are, no doubt, specially favorable for an underground system. Dry weather prevails; the streets are wide, well formed and clean, and on the underground routes there is practically no vehicular traffic heavier than buggies and bicycles. Lenox Avenue, New York, is also specially adapted for the system—long, straight lines, and a clean wide street with only light traffic. The company which owns this line and has been experimenting with the underground electric system is the same which has now begun to experiment with the latest compressed air motor. Evidently it is not so satisfied with the results of the underground experiments as to justify it in proceeding further in that direction at present. It considers the cost of construction prohibitive, and has recently canceled contracts made in connection with proposed extensions of the electric underground system, just as it had done previously with contracts for cable extension.

A short length of the "Love" electric conduit system is still operating in Washington, but a similar experiment has been abandoned in Chicago. As mentioned in our notes under the heading of "Washington," the chief difference between the "Love" and the other underground electric systems is that it has a rolling contact, whereas as the others have a sliding contact.

Were money no object, and financial results not to be reckoned, an underground electric system can, in a dry climate, be operated where there is sufficient depth (over two feet) to construct a conduit. But it seems very doubtful indeed if, for a city and suburban system, even where that depth can be got, it could be made a commercial success, and all the more so in a damp climate like ours. It is well known that the Central Railway construction has made it impracticable to have this system in Argyle Street.

On the merits and demerits of the open conduit, we have learned nothing which casts the slightest doubt on the thorough soundness of Mr. Arnot's views as expressed in your sub-committee's Continental report. And in any case, with our present knowledge, we could not see our way to recommend the spending of money in entirely throwing away the present tramways and the assets represented by them, and constructing an underground system, which is of necessity so expensive to construct, does not admit of general application to all the lines of the system, and is only in the experimental stage, both commercially and from the operating point of view, more especially if there is a proved system which is satisfactory and admits of utilizing the present roadbed and is cheaper in every way. We feel bound always to bear in mind that the Glasgow corporation tramways have no rating powers to fall back upon.

Cable System.—The cable system in the earlier days promised to be largely employed in street railways. However, one cannot pass with open eyes and ears through the cities of America without being thoroughly satisfied that it has been superseded. The American street railway men, one and all, speak of it as a "back number." The practical proof of this is that many miles of cable lines have been thrown out in such cities as Philadelphia, Baltimore, Pittsburgh, St. Louis—and even in San Francisco, the home of the cable system. We ourselves saw miles of cable conduit being taken up, and the tracks being reconstructed in every case for the electric overhead system. We also saw a few first rate cable lines in the United States which are not likely to be disturbed in the meantime. The most notable of these are the trunk lines in New York, Chicago and Washington.

The New York authorities meantime forbid the overhead trolley system, and cables have, at enormous cost, been put down in some of the busiest thoroughfares, including Broadway, which has the very busiest street railway in existence. They are all working satisfactorily and successfully, but the management make no secret of their preference for the overhead electric system—if they could get it.

In like manner, cable lines are running very successfully in Chicago, in such busy thoroughfares as State Street and Wabash Avenue—ideal cable routes—as also in the main arteries of a few other cities.

In all such cases however the cables occupy the trunk lines—corresponding to our Argyle and Renfield Streets—and no fair comparison can be made of the operating of such routes and the outside routes which feed them. On the average routes, the cable system is more expensive than the overhead electric, and is considered rigid and cumbrous by comparison. There is no probability of the cable system being extended in any of the cities. On the contrary, there is a probability that when the construction or equipment requires renewal this system will give place to the more flexible and popular trolley.

Electric Overhead or Trolley System.—This is now undoubtedly, the standard system of tramway traction in America. This is borne out by our notes in the various cities visited, and even more strongly by the actual facts.

The invention of a patentee may, on its first appearance, be more or less successfully launched according to the backing it receives from the interest or influence of men of means and position. But no such influence can permanently affect the survival of the fittest. We cannot and need not say anything about the future. But up to the present time there is no difficulty whatever in making up one's mind as to the best surviving and fittest form of street railway traction in America. Street railway managers and engineers have only one answer to the question, From your experience, and taking both efficiency and economy into account, what is the best form of tramway traction for Glasgow to adopt instead of horses? With unanimous voice they answer, The trolley. Each of the patentees and owners of other systems only claims that his is the best where the trolley is prohibited. And at home we have heard the admission made that the reason why they don't want us to begin with a section of the overhead system is because they are convinced that if we began with it we would have nothing else.

Electricity has undoubtedly played the leading part in developing street railways in America. The trolley system was only introduced some eight or nine years ago, and since then the mileage of the American street railways has been practically doubled, and at the present time no less than eighty-five per cent of the total mileage is operated by the trolley, and the percentage is daily increasing.

The system had undoubtedly a crude beginning. In a new country all railroads and street railways must of necessity be constructed in the readiest and cheapest way possible. When the district traversed comes to be more settled and populous there is, of course, so much more money and traffic as to admit of a more permanent construction. Horse tramways were as a rule in America first laid down in very temporary fashion. Light rails were simply laid on cross ties or sleepers, to which they were spiked, and the ground leveled up or roughly paved as the case might be. These rails carried the small horse cars in a way, but were totally insufficient to carry the heavier electrical cars at the higher rate of speed. When, therefore, electrical cars were introduced, the whole track had to be thrown out and laid with much heavier rails on a much stronger foundation. In early examples of the electric system, the appearance of the overhead construction does not seem to have entered into the minds or calculations of the constructors. This is not to be wondered at. Their chief aim was rapid transit and development. And they were accustomed to seeing the obtrusive wooden telegraph poles on the sides of their streets carrying the telegraph wires, and later, similar poles carrying the telephone wires in rapidly increasing numbers. The side poles necessary to carry the cross wires for the trolley were insignificant and beautiful by comparison. And so they stuck them up as fast as they could. The people got rapid transit and were delighted. Meantime, in some of the leading cities the appearance of the crude telegraph and tele-

phone poles, and the innumerable wires they now carry, roused the municipal authorities. This was especially the case in New York City—the same city which had sanctioned elevated railways over their streets, which for ugliness have no rival. Whatever they may think of their elevated railroads, they were undoubtedly right in abolishing the huge wooden telegraph and telephone poles, which even yet disfigure most American cities. In many cases state or municipal ordinances have been passed requiring that in five years all telephone wires within certain areas shall be placed in ducts underground. Thus the objectionable poles have disappeared in New York, and are disappearing also in Washington, Boston, Chicago, etc. And no doubt all the chief cities will see it to be to their credit to remove these eyesores. New York has evidently gone off to the other extreme, and will allow no overhead wires whatever. Washington has taken the same position, although the Capital has still a good many of the old telegraph poles in her principal avenues. Chicago for a time declined to sanction the trolley system downtown, but on the pressure of her own ratepayers the municipality is relenting, and very soon, according to Mayor Swift, the uptown trolleys will run right into the center of the city. The Commissioners of the District of Columbia have also forbidden the introduction of the trolley system into Washington. We need scarcely refer to Washington in this connection, however, as it is a place by itself, and has little or nothing in common with a busy commercial city. With these exceptions, every city in America has got and is well served by the trolley system, and in no case has the overhead system, when once introduced, ever been abandoned.

After seeing the best overhead construction for the electric overhead system, and considering its vast importance as a means of rapid transit of passengers on city and suburban streets and roads, we are perfectly reconciled to it, and feel that it only wants to be seen in use to be appreciated.

Boston seems second to no city in her wish to guard her amenity, and Boston has the trolley everywhere. Mayor Quincy gave us freely his views on the overhead system from his point of view as representing the citizens, and they are in favor of the trolley, which doing the last few years has done so much to develop the city.

The city of Philadelphia ranks high among American cities. Mayor Warwick of that city was quite as frank and strong in his testimony in favor of the trolley, so general and popular in his city.

It, of course, goes without saying that if a system as good and as cheap can be had without any overhead construction we should prefer it. But there is none such known at present. And we feel sure that if the citizens saw this system of rapid transit in operation on the Springburn route—comfortable cars, propelled, illuminated, and heated by the same power—they would not for a moment object to the appearance of neat poles to carry the wires, especially if the old lamp-posts were done away with, and the trolley poles made use of for electrically lighting the streets. We believe the citizens would soon conclude that it was beautiful as a whole.

Glasgow, as the commercial metropolis of Scotland, must continue to be a city of enterprise and industry. As such, let us make it as artistic as we can. Is not the most beautiful ideal of an industrial city, however, one in which all classes of the citizens have decent houses to live in, as well as plenty of work by which they can earn sufficient money to meet their reasonable wants? These are the necessaries which make it possible for the individual members of an industrial community to live beautiful lives, and build up beautiful characters. They must therefore occupy a foremost place in the city which is to be beautiful in the highest sense. Civilization demands that the æsthetic give place in many instances to the useful.

We never were prouder of Glasgow than when we heard of the high place assigned to her as a municipality by the Americans. But we have not served twenty years in the Health Department, and been acquainted with "life in one room," without knowing Glasgow's blemishes—and they are common to all our older cities. One great city improvement scheme has been carried out in our city, and another is now being favorably considered. In Glasgow as it was five years ago there was a population of 565,714 on an area of 6111 acres, giving ninety-two persons to the acre, or 58,880 to the square mile. In the present Greater Glasgow, apart from the adjoining but still separate burghs, we have a population of 705,000 on an area of 12,311 acres, giving fifty-seven persons to the acre, or 36,480 to the square mile. When the four separate burghs now served by our tramway system are included we have a population of 841,000 persons on an area of 14,661 acres, which also gives fifty-seven to the acre, or 36,480 to the square mile. No American city, with the exception of New York, is half so densely populated. No one wishes our citizens to continue so closely packed together as they now are. How are they to spread out? In our humble opinion, and judging from what we have been privileged to see in America, the most powerful instrument which lies to the hand of the municipality for effecting this purpose is the best and cheapest possible tramway service radiating from the center of the city outwards in every direction.

Such a system must be *safe, rapid* as far as consistent with safety. *elastic* as to speed, *clean, comfortable* and *attractive, flexible* enough to apply to all routes and meet all contingencies of street traffic, and, of course, as *cheap* as possible; and it would be all the better if each route had its suburban attractions in the shape of a park for music, and the usual facilities for amusement and recreation generally. As surely as you give cheap and rapid transit, which will enable all sorts and conditions of people living at a distance to travel comfortably to and from their work in the city, so surely will houses to accommodate them be built on cheaper ground—meaning cheaper rents—and with healthier surroundings.

From all we have seen, we are of opinion that the overhead electric system of tramway traction reasonably fulfills these conditions.

Its safety depends upon reasonable care and judgment as to speed and general working. There is practically no danger from the overhead wires, providing ordinary care is exercised in maintaining them properly. No man, as far as we could learn, has been killed by the current from the trolley wires. We have seen dozens of men who have had 500 to 600 volts without injury. In fact, almost every switchboard man has had it, some over and over again; they don't take it because they like it, but they have had it all the same. The president of the West End Company, of Boston, told us that they had comparatively more accidents with the horse cars than with the electric cars. If this can be said of the system in Boston, there is no reason why it should not apply to Glasgow; for Boston has the overhead system throughout, and downtown the traffic is much more congested than in any part of Glasgow. The Mayor of Chicago expressed his opinion that the lieges in his city suffered more from bicycles than electric cars. Then the question of electrolysis is one which may freely be dismissed. We were well assured that by working to the Board of Trade regulations there can be no trouble in this connection. Under the rough-and-ready way in which, in the early days, the trolley system was installed, it is no wonder that electrolysis resulted. The returns were very imperfect. Where the return is sufficient, electrolysis is unknown. Where there have been indications of electrolytic action on gas or water pipes, engineers have had no difficulty in arresting it.

With regard to speed, the electric cars are under perfect control, and can run at any speed. There is no reason why on the average fifty per cent should not be added to our time-table speed for horse traction.

The electric system is eminently flexible. The cars can be backed when necessary (which is not the case with the cable system), and they can be easily turned on to any route. And it is a system which admits of an easy extension of routes in longer or shorter stages as circumstances require.

That an electrically propelled car can be made clean, comfortable, and attractive by good seating, good lighting, and heating if necessary, is beyond a doubt, and these are very strong points in favor of electric traction.

We believe that the poles, if of neat design and judiciously used for street lighting, can be erected so as not to offend the eye. Where the buildings are continuous the overhead construction is least noticed. If the cross wires were fixed to the buildings, as in Hamburg, no poles would be necessary at such places, but it might look as well to have side poles throughout.

That electric traction is cheap has also been clearly established, and all the more so when all that it fulfills is taken into account. So great and so general have been the changes in operating companies through amalgamation and consolidation that it is now almost impossible in very many cases to get from books or accounts exact figures bearing on the cost of operating by horses prior to the substitution of electric traction.

It may be remarked here that these changes have led in very many cases to overcapitalization, chiefly through watering of stock. In a published table we have seen that, in the case of one large company, it takes no less than fifty-eight per cent of the total earnings to pay interest on capital liabilities. The published returns dealing with 15,425 miles of American street railways show that, over all, the capital stock and funded debt amount to £18,293 per mile of single track. In New York State the average is nearly double, being £36,560 per mile of single track. This may explain the reason why a large proportion of the street railway companies in America are not paying dividends. There is no doubt, however, that the companies who have conducted their business throughout on sound financial lines have, as a rule, very good properties at the present time.

Although there was difficulty in getting comparative costs of operating in as many instances as we should have liked, we have given some good and reliable comparisons under the headings of the various cities. In addition to these, a deal of information regarding costs was given to us on the understanding that it was not for publication. These we have taken with the others to arrive at an average. Taking them on the average, the percentage of operating expenses to receipts with overhead electric traction in America is at least fifteen per cent less than with horse traction. The operating expenses per car mile are, on the average, 2*d* less than with horses.

There are further financial gains to be taken into account. On the average, as compared with horse traction, the speed of the cars in America is accelerated by over fifty per cent, and the additional traffic developed by the substitution of electric traction has not been less on the average than twenty-five per cent.

It is true that the development which has taken place in Glasgow since the first of July, 1894, may have made it impossible to realize such favorable results here, but we are confident that the results will be all in the same direction, even although the cost of conversion doubled our capital as in Boston. No doubt it will be borne in mind that an object lesson of 2½ miles cannot be expected to produce as good results as the operation on a large scale of an entire system. It should also be noted in this connection that Glasgow is much better served by city and suburban railways than are the American cities.

The fare which is universal in America is five cents (2½*d*) for any distance the car travels, and most companies also give free transfers to other routes in certain directions. A few companies sell discount tickets slightly reducing the five cent fare. The

Americans are quite astonished at our one cent fare, and also that their minimum is practically our maximum.

There are no cars—cable, electric, or horse—in America with top seats like ours, the obvious reason being the extremes of the climate. Seats on the roof of the car would be too hot in summer, and too cold in winter. In most cases close cars are used in winter and open cars in summer. The adoption of the trolley does not interfere with the use of the top seats.

In the matter of organization and management generally we did not consider America in advance of the old country. The cars in America do not carry half as many passengers per car mile as ours do in Glasgow. With regard to the permanent way, there are certainly some points in their track construction which we have very carefully noted, and particularly the rail welding, but on the whole there is scarcely a track up to the present time in America equal to what we have recently been putting down in Glasgow, and in very many cases electric cars are running in America on tracks very much inferior to the Glasgow horse tracks.

American managers and engineers, while they smile at our still continuing to operate with horses, at the same time congratulate us on our having been able to wait. The pioneers of the electric overhead system have come through a trying and expensive experience. The first motors, generators, and equipments were crude, and had soon to be thrown aside in favor of newer designs. These also in their turn became obsolete. Even up till within the last two years great improvements were made, but now it is generally believed that engines and generators, motors and line equipments have all been by experience so much improved that now they are practically standardized, and they can undoubtedly be bought at very much less money than at any former time.

The adoption of large units of from 1000 to 2000 h. p. has very considerably cheapened the cost of production and maintenance in the power station. Electric motors are not only immensely improved, but they now cost only about one-fourth of the price charged in the early days of electric traction, and all the latest electrical equipments are much reduced in price. The result of improved motors and equipments is that the cost of maintenance has been reduced from three cents per car mile to one cent. One of the greatest improvements has been in the controller. The series-parallel controller is now almost universally used in America. It not only enables the driver or motorman to regulate the speed to a nicety, but it is also fitted with a reversing arrangement by which he can not only back the car, but can also cause the motors to act as an emergency brake should occasion arise. By its use there is also a great saving in current as compared with the rheostat formerly used.

Under these circumstances we feel that nothing has hitherto been lost by delay. We also believe that the time has now come when it is perfectly safe to make a move on a small scale, and are satisfied that the opportunities that have been given us for studying the whole question, both in Europe and in America, have brought our information so well up to date that we should have no difficulty in taking in hand to give an object lesson on the Springburn route of which the citizens will not be ashamed.

Although the question of alternating currents for longer distances is at present occupying a good deal of attention, we need not enter upon it here, as direct current would, in any event, be used for a short distance like the route to Springburn.

The estimate already given of the cost of equipping the Springburn section on the basis of the present service, apart from any necessary renewal of rails, is £19,575, as detailed in last report by the sub-committee on mechanical traction.

RECOMMENDATION.

We therefore simply confirm the recommendation of the sub-committee, as per their report on mechanical traction in Europe, dated July last, which reads as follows:

"That, having carefully considered the whole question, we recommend that the route from Mitchell Street to Springburn be equipped for overhead electric traction as indicated, and that with a view to providing in this way for the necessary augmentation of the service, which is sure to be required next spring, it be remitted to the Tramways Committee with powers to equip this route accordingly as soon as they conveniently can." And we make the further suggestion that the Corporation remit to the Electric Lighting Committee, acting in co-operation with the Tramways Committee, to light electrically as an experiment a portion of the route with a view to utilizing the traction poles for lighting purposes.

New Road for Chicago.

THE Suburban Railroad Company has filed a mortgage to the Chicago Title & Trust Company for $3,000,000, covering all of its property and franchises. It is given to secure an issue of twenty year five per cent gold, interest bearing bonds. An immediate issue of $1,250,000 of the bonds will be made, with which the company will build a double track road from Harrison and West Forty-eighth Streets west through Cicero and Harlem to Desplaines Avenue. It will also build a double track road in Twenty-second Street in Cicero, and another in Robinson Avenue. It is also to defray the expenses of equipping with electricity its lines in Cicero. The remaining $1,750,000 will be used to purchase additional equipment and right of way. The company's office is 100 Washington Street, Chicago.

Electric Railways in the United Kingdom.

The table given herewith is a complete list of the electric railways in operation or under construction in the United Kingdom at the present time. The list is an abstract from a table published by *The Railway World*, of London.

ELECTRIC RAILWAYS IN THE UNITED KINGDOM.

NAME OF COMPANY.	Length Route.	Total length of track.	Gauge.	Weight and Type of Rail. *	No. of Motor Cars.	No. of Trail Cars.
			Ft. In.	Lbs.		
Bessbrook & Newry Trys. Co.	3.0	3.5	3 0	41¼	2	32
Birmingham Central Trys. Co.	3.0	6.0	3 6	102 G	14	—
Blackpool Corporation	3.0	4.0	4 8½	96 G	14	—
Brighton Beach	1.0	1.0	2 8½	56 V	5	1
Bristol Trys. Co.	6.0	10.0	4 8½	76½ G	21	15
Coventry Elec. Trys. Co.	6.0	6.0	3 6	84 G	8	2
Dublin United Trys. Co.	8.0	15 0	5 3	76½ G	30	30
Dublin United Trys. Co. (under construction)	3.0	5.0	5 3	76 G	15	—
Guernsey Elec. Ry. Co.	3.0	3.0	4 8½	40 V/G	8	5
Hartlepool General Elec. Trys. Co.	2.5	3 0	3 6	65 G	5	—
Isle of Man Trys. Co., Douglas-Laxey	7.0	14.0	3 0	50 V	13	14
Isle of Man Trys. Co., Snaefel Mountain	4.8	9 5	3 0	50 V	6	2
Douglas Southern Elec. Trys.	3.5	3.5	4 8½	65 V	8	8
Leeds Corporation (under construction)	7	14.0	4 8½	——	25	—
No. Staffordshire. Trys Co. (under construction)	6.8	8.0	4 8½	——	20	—
Giant's Causeway Elec. Try. Co.	8.0	8.5	3 0	43 G	4	5
Ryde Pier Co., Isle of Wight,	.8	1.5	——	——	—	—
Southend Corporation	1.3	1.3	3 6	40 V	3	6
So. Staffordshire Try. Co., Walsall	8.0	8.5	3 6	76 G	16	—
Brighton & Rottingdean Seashore Ry. Co.	3.0	3.0	18 0	56 V	3	—
Central London Ry. Co., London (under constr'n)	6.5	13.0	——	——	—	—
†City & South London Ry. Co., London.	3.0	6.0	4 8½	60 V	16	36
Waterloo & City Ry. Co., London (under constr'n)	1.5	3.0	4 8½	——	—	—
Liverpool Overhead Ry. Co.	6.5	13.0	4 8½	56 V	48	—

*G indicates grooved girder rail; V, Vignole rail; T, tee rail.
†An extension of this line is now in progress.

Proposed Road at Joilet.

THE Board of Commissioners of the Illinois & Michigan Canal have granted to Warren C. Riale and Vincent J. Duncan, of Ottawa, Ill., a franchise to construct and operate along the towpath of the canal an electric railway between Joliet and La Salle, a distance of sixty-two miles. A company will be incorporated in a few days by these men with a capital of $1,000,000, to build the line which will run over an almost level roadway, passing through the towns of Utica, Marseilles, Ottawa, Dresden, Morris, Au Sable and Channahon, and entering Joliet and La Salle. At intervals of approximately twelve miles, the operating company will construct power houses. Where it is possible, the water power of the canal will be used for the operation of the electric plants. Where this is not possible steam plants will be erected, and in every case where this is necessary coal is to be had for the digging. It will be possible, therefore, to construct this line at the minimum cost, and to operate it at figures far below those for running any other line in the state.

25th Anniversary of the Stevens Institute.

The Stevens Institute of Technology, at Hoboken, N. J., will celebrate its Twenty-fifty anniversary, on the 18th and 19th of February, 1897. The festivities will consist of a banquet at the Hotel Waldorf, New York, to which representative engineers and technical educators throughout the country will be invited. On the following day the Institute will be open for inspection, and the method of instruction together with the apparatus in the various laboratories will be explained. The festivities also include a reception by Mrs. Stevens, widow of the founder of the Institute, at Castle Point, Hoboken, and a promenade concert and dance in the evening will conclude the celebration. The Stevens Institute has always taken high rank among the institutions devoted to technical education throughout the United States, and its twenty-five years of successful effort is amply exemplified in the work accomplished by its graduates in all departments of mechanical and electrical engineering.

LETTERS AND HINTS FROM PRACTICAL MEN.

Glasgow Corporation Tramways.

Glasgow, Dec. 14, 1896.

Editors Street Railway Journal:

In view of the proposed equipment of the tramway system here the following particulars may be of interest.

The tramways in Glasgow were originally built by the corporation and have always been their property. They were leased to a company for a period of twenty-three years. On the termination of this lease on June 30, 1894, the corporation took the working of the tramways into its own hands, and commenced operation on July 1, 1894, with an entirely new equipment.

The corporation tramways extend to comprise sixty-six miles if measured as single track, and embrace the lines in the adjoining burghs of Partick and Pollokshaws, The lines in the adjoining burgh of Govan, extending to eight miles of single track, are the property of the burgh of Govan. The lease of these, however, has recently been taken over by the Glasgow Corporation, so that the whole of the tramways in Glasgow and district—seventy-four miles—are now operated by the Glasgow Corporation. Meantime, horse traction is used on the entire system.

All the lines pass through that central portion of the city which is practically bounded by the three principal railway stations. The routes are almost all arranged to run from one extremity of the city, through the heart of the city, to the opposite extremity. The result is that in the central or chief business portion of the city, the cars pass in very close succession. This is specially the case in the morning and evening, when the tramway traffic is greatest. The most congested point of the city is at the junction of Jamaica Street and Argyle Street, where at the busy hours there is a car passing every fifteen seconds.

The cars in Glasgow, as in most British cities, have garden seats on the roof. The Glasgow cars, of which there are 380, are seated for eighteen inside and twenty-two outside. They are uniform in design and interchangeable in all their parts.

A service of about eighty workmen's cars begins about 4:30 A. M, and continues until 7 A. M. In addition to this, workmen are allowed to travel at workmen's fares on the outside of all cars going in any direction, between the hours of 5 P. M. and 6:15 P. M. The statutory workmen's fare is 1*d*. for any distance up to two miles. The workmen's fares in actual operation, however, range from about 2½ miles for 1*d*. up to about 5½ miles for 2*d*. The statutory rate for ordinary passengers is 1*d*. per mile. The graded fares in actual operation, however, are well within that limit. Taking the average over the system, fares and distances work out as follows:

Fares.	Miles.
½*d*.	.57
1	1.74
1½	2.30
2	3.45
2½	4.15
3	5.24

Rather over thirty per cent of the total passengers carried only pay ½*d*. fare; about fifty per cent pay 1*d*., the average being .91*d*. The average number of passengers carried per car mile is twelve. The longest distance is 5¾ miles, and the highest fare 3*d*.

The service on the respective routes varies according to the hour of the day, a closer service being required in the morning from 8:30 till 10, and in the afternoon from 4 till about 8. Between these hours a car runs every two minutes on most of the routes.

The "bell punch" system of ticket check is used. Each grade of fare is represented by a distinctive color of ticket, all the tickets being consecutively numbered. The conductor in collecting fares, punches and delivers to each passenger a ticket showing the value received and the station to which the passenger is entitled to travel. The work of the conductors is supervised by ticket inspectors, who board the cars and examine tickets to see that each passenger has been properly charged.

In addition to this check, the punch used by the conductor shows by its inside register, and also by the clippings of the tickets, the number of tickets sold by the conductor during his working day, and their value.

Of course, anyone comparing figures here with those in America, must take into account the rates and values ruling in the respective countries. Wages in this country, for instance, are much lower than in America. It may be mentioned, however, that the hours of the Glasgow conductors and drivers are sixty per week, divided into six days. When a man works on Sunday—which he does by rotation—he is relieved for one day during the week.

In connection with the corporation tramways department there is a friendly society which is in a very flourishing condition. The object is to provide an allowance during sickness, or at the death of a member or member's wife; as also to provide medical attendance and medicines, and admission to infirmaries and convalescent homes. Sixpence per week is the usual scale of subscription. The corporation shows its appreciation of this friendly society by contributing 3*d*. to every 6*d*. paid in by the employes as members.

John Young,
General Manager.

A New Rail Bond.

New York, Dec. 16, 1896.

Editors Street Railway Journal:

Knowing that every step in the evolution of the perfect rail bond is of interest to street railway men, the writer ventures to publish the following solution of a problem in bonding which he was recently called upon to solve:

The conditions of rail and splice bars were such that the regular plastic bond could not be inserted between the splice bars and the web of the rail. Plug bonds were not considered safe on account of the poor support given the rail joints by the splice bars. The usual forms of copper bonds offered for sale did not appeal to the writer as being reliable and durable. As the bonds were to be applied to an existing track (an eighty pound grooved girder of English make) the cost of applying the bonds was also a considerable factor of the problem.

After weighing the merits and demerits of all available existing forms, the design shown was adopted as offering the maximum of chances for success under the conditions. It will be seen that this bond is really a combination of the short heavy copper bond and the plastic.

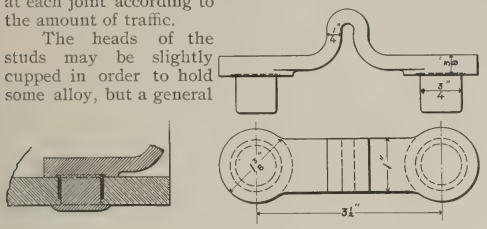
The form and dimensions of the bond are shown in the drawings. It is of a special malleable cast copper with ¾ in. studs. In applying, a ⅞ in. hole is drilled into the flange of the rail, but lacking ⅛ in. of going entirely through, then a ¾ in. (scant) drill is now run through the remaining ⅛ in. leaving the burr on the under side.

The copper studs and the hole in the rail are thoroughly amalgamated with solid alloy and the bond placed in position, the studs being an easy driving fit in the small part of the hole. The space around the studs ($\frac{1}{16}$ in. all around) is now filled with plastic alloy, the

bond is driven home and upset or press riveted by the usual screw press.

It is proposed to place either one or two of these bonds, each having a cross section of ¼ sq. in. of copper, at each joint according to the amount of traffic.

The heads of the studs may be slightly cupped in order to hold some alloy, but a general



RAIL BOND.

hollowing out of the under side of the heads would weaken the head and render it liable to work loose. Also, the hole in the rail flange may be a taper reamed hole instead of counterbored as shown.

This bond is not patented and is given to the fraternity for what it is worth.

E. T. BIRDSALL, M. E.

Electric Traction Under Steam Railway Conditions.

DENVER, COLO., Dec. 10, 1896.

EDITORS STREET RAILWAY JOURNAL:

Some ten years ago, the writer, in the columns of *The Electrical Engineer*, claimed the distinction of being the first to design and construct an electric locomotive that was used to haul standard gauge freight cars. Since that time the problem of "Electric Traction under Steam Railway Conditions," which has been recently discussed by the American Institute of Electrical Engineers, has faced us. The record will show that there have been patented a number of different forms of electric locomotives, the majority of which have been tested. The writer's convictions as to the most desirable mechanical and electrical constructions, being so radically different from those proposed, they may be of interest to some of your readers.

In the present state of the art, I am of the opinion that Mr. Baxter, Dr. Emory, or any one else who figures on the use of the direct current machinery for long distance transmission, is wasting time.

High potentials and the induction motor are here, notwithstanding fears to the contrary. The latter lends itself quite as well, if not better, to regulation than any direct current motor. By using a simple switch to change the number of poles of the field magnets, high efficiency is readily maintained under great changes of speed. I disagree with Dr. Emory as to the desirable mechanical construction of the electric locomotive. He, I understand, proposes to follow the lines of the American steam locomotive, with all of its mechanical monstrosities, which have been necessitated by reciprocating movements and rough track. Although it is a wonderful piece of machinery and particularly suited to wiggle along over a rough and sinuous course, it would be a very difficult problem for a mechanical engineer to design anything (were it desired) as effective for the purpose of throwing the track out of line and knocking down the joints, as is the American locomotive, or even the ordinary electric car. To ensure each wheel to strike hard blows at every low joint, powerful springs are placed behind them. My judgment is (and it is based upon experience with both kinds) that where you have good track to start with, the axles may be supported in rigid frames as is the practice on English locomotives, and that they may be held in a position corresponding to what the track should be, so that when the latter is smooth all of the wheels roll on it; but where low joints, crossings, frogs, etc., are encountered, the wheels pass over without touching the depressions.

I appreciate the advantages of connecting rods, but they should be driven from the center and not from their ends as is the common custom. In brief, I would propose to use a six wheel rigid frame truck, with one pair of flangeless tires, securing the armature of an induction motor to the center axle (either directly or through internal gear) and connecting the other axles thereto by rigid connecting rods, which link the three wheels together. Such a construction having very few loose or wearing parts, could be constructed much cheaper than the common forms, and would be less liable to derangement. I am aware of the stock objections that have been used against mounting railway motors on rigid supports. While they demanded attention in the early days before we learned how to make motors solid, they have but little force to-day. I think, were it desired to place electric motors within steam hammers they would be forthcoming. With the passing of the brushes on dynamos and motor. we will be able to perform mechanical gymnastics that would make the direct current machinery dizzy. The old objections as to the evil effects of shock do not apply with much force to the best forms of induction motors. They have no commutators or brushes to be injured or disarranged. The armature on some of the best forms contains no wire, only a few heavy copper rods, which do not even require insulation. So that all that seems to be necessary is to cushion the field magnet wires, and this can readily be done by adding to their insulation.

In power plants, I think the present much admired, massive, cumbersome, direct connected dynamos are short lived standards, and that they must yield to the more scientific instruments. That mechanical abortion. the sluggish acting centrifugalg overnor and the immense fly wheel, both of which have proved such elements of waste and destruction, are destined to the scrap heap. An electric governor which acts instantaneously is within the reach of any good electro-mechanical engineer. The dynamo of the future, whether needed for long distance transmission with converters, or for extensive city work and rotary transformers, will probably be of the induction type, the output of which can readily be doubled by substituting the field magnet for the flywheel and driving it and the armature in opposite directions with a compound engine. This very desirable construction would be unobjectionable where the dynamos require no brushes, as in the case with inductors.

In conductors and trolleys there seems to be no occasion for improvement except to make the overhead work as trim appearing as possible. Such constructions as that at Baltimore are not liable to be duplicated. Whatever influenced the engineers there to use iron, with its low current conductivity for conductors, and bridge work to support it, is a mystery to me. The third rail, which was tried and abandoned by such celebrated engineers as Siemens, Edison, Field, Daft, Van Depoele and Fisher, appears to be again coming to the front. It, however, has too many objections to compete with the buried feeder and overhead span wire system, which we had the pleasure of introducing less than a dozen years ago. Although many hundreds of thousands of dollars have since been spent, and the genius of the world's best engineers has been devoted to schemes to avoid the overhead trolley wires, none of these so far developed is liable to be duplicated except under special conditions and in a very limited way. They are usually fascinating under favorable conditions, but lack the advantages of the high order of insulation that may be maintained with the exposed overhead wires. The flexibility and smoothness of the trolley's track, the exposed position enabling faults to be readily seen and easily repaired; these are almost essential features, and any designer who ignores them will fail.

Yours truly,

JOHN C. HENRY.

LEGAL NOTES AND COMMENTS.*

Edited by J. Aspinwall Hodge, Jr., and George L. Shearer,
of the New York Bar.

Punitive Damages and Excessive Verdicts.

Among the tendencies and forces which affect recoveries against common carriers of passengers and others for negligence are the court, the legislature and the jury. The first of these is generally to be ranked as a conservative element in the equation. The flexibility of judge-made law renders it possible for the court to correct the excessive tendencies or well known proclivities on the part of either legislature or jury or both. The high standing of the bench in England and in most parts of this country has caused this possibility to become a reality; and the instances where the wishes not only of the jury, but even of the legislature have been more or less thwarted to the benefit of real justice, are numerous and well known to every lawyer.

The very supremacy of the jury, in deciding the questions of fact, leads the court to be jealous of its privileges and to lay down strict rules of law for the guidance of the jury and to upset verdicts upon technicalities which, had the jury been more conservative, might have passed unnoticed. The rule of *respondiat et superior* is now strictly construed and is not allowed to pass beyond its legitimate limits. The best illustration of this is perhaps the theory, now well recognized, which governs the law of punitive damages—that is damages which are allowed to be assessed by a jury over and above the amount which they believe to be in full compensation of the injuries suffered.

A case just decided by the highest court in Wisconsin is illustrative of the rule and is instructive in showing how careful the street railway corporation should be to avoid ratifying a malicious act of an employe. There the defendant was ejected by a conductor of a street car company for not paying his fare. He was immediately allowed to get upon the car again by the conductor, because the conductor became convinced that after all the plaintiff had paid him. The jury awarded $250—$50 as compensatory damages and $200 as punitive damages. The court at the trial charged the jury that, if the conductor maliciously put the plaintiff off the car, the plaintiff was entitled to punitive damages. The appellate court modified the verdict by reducing it to $50, holding, not only that in no case should the jury be instructed that the plaintiff is, as a matter of right, entitled to punitive damages, since in all cases the jury have a right to refuse to give anything but compensatory damages, but also that the charge of the trial court was erroneous, in that it left the question of exemplary damages to turn wholly upon whether the conduct of the conductor was malicious, precisely as if the action had been tried against him. This is held to be bad law under the rule that the malicious character of the tort must be brought to the defendant itself, and the malice of the conductor or agent would fail to support any verdict whatever of a punitive character against the principal, unless the act was instigated or afterwards ratified by the principal.

The accident occured on Sep. 12, and the report was made on the same day to the defendant by the conductor, but that report did not show the defendant that the conductor had acted maliciously. On Sept. 25, the complaint was served. The conductor was in the employ of the defendant from July 28 to Dec. 18, and then left it of his own accord.

After stating these facts the appellate court says, "such retention of the conductor in the employment of "the defendant, with knowledge that such conduct of the "conductor was willful and malicious, *would have been evi-* "*dence tending to prove ratification.*" We doubt if this evidence alone would be sufficient, even in the court delivering this opinion to allow the question of punitive damages to go to the jury. *Cleghorn* v. *R. R. Co. 56 N. Y. 44* is cited by the court as sustaining this *dictum*, but that case only goes to the extent of holding that, where the railroad company knows that its employe is a drunkard or is wholly unsuited to his position and still retains him the company may be held to have ratified his negligent act. (*Robinson's R. R. Co. 68 N. Y. Supp. 961.*)

In ordinary cases we would suggest in view of the impracticability of discharging the conductors and drivers who have been guilty of either negligence or vicious acts, because of the necessity of retaining them within the jurisdiction of the court and the purview of the company as witnesses, that any act of discipline by the company for the malicious or negligent act would be a complete answer to the contention that the company had ratified the act.

The movement in legislative bodies throughout the country towards abolishing the $5000 limit in the acts which allow recovery in death cases, will undoubtedly in many jurisdictions lead the courts to a still more careful definition of what are "pecuniary damages."

In the March, 1896, number of the Journal we discussed the question of six cent verdicts in death cases, and much that we said then is applicable here. In no state of the Union have the courts been more conservative or stricter in their definition of the term "pecuniary damage" than in New Jersey. In a case which we report in the legal comments of this month (*Jackson* v. *Traction Co., 35 At. Rep. 754*), a verdict of $5000 was awarded a father for the loss of his son who was twenty-two years old and earning $12 per week, of which he gave his mother from $5 to $9 a week for his board.

The appellate court reasons that, assuming that the payments to the mother were a benefit to the father, that such benefit was not to be measured by the weekly payments, but by the profit retained out of them after furnishing board. The court then comments adversely upon the failure to show the age of the father, and therefore a failure to show his probable expectancy of life or the joint expectancy of the life of the son and the father; which in any event, was less than the expectancy of either the father or the son. The court goes on to take judicial notice of the fact that $5000 is the present worth of $7 per week for the expectancy of the life of a man twenty-two years of age, and concludes from this reasoning that $5000 plainly exceeds the pecuniary damages to the father whose expectancy of life was less than that, and the court then, after stating that the case had been fairly tried and the verdict of the jury was in other respects unexceptional, holds that $5000 is excessive and decides that if the plaintiff abates the sum of $3000 the verdict may stand for the remainder.

This line of reasoning is not unfamiliar to one conversant with the New Jersey Reports. As far back as 1862 the court indulges in a similar line of reasoning. (*Telfer* v. *R. R., 30 N. J. Law Rep. 188.*)

It seems reasonable to suppose that the tendency of the courts in New York, in view of the increased liberty given to juries in death cases, will be towards a stricter construction of the words "pecuniary damage," even if they do not apply as rigorous a rule as in the cases we have cited from the New Jersey Law Reports.

Under the new constitution of this state we may find a diversity of opinion, since there are now four appellate divisions who will be in most cases the final appellate tribunal in actions for personal injuries resulting in death.

*Communications relating to this department may be addressed to the editors, No. 32 Nassau Street, New York.

Upon the question of the necessity of proving the age of both the deceased and of the next of kin in death cases, and their joint expectation of life, the following citations may be interesting. (*Carpenter* v. *R. R.*, *38 Hun. 116, 120; Hall* v. *R. R. Co.*, *39 Fed. Rep. 18, 20*; *Hooghkirk* v. *Canal Co.*, *92 N. Y. 219; Moskovitz* v. *Lights, 68 Hun. 102.*) H.

EMINENT DOMAIN.

PENNSYLVANIA.—A statutory provision authorizing railway companies to lay their tracks upon or across a turnpike pending an appeal from the award of viewers, merely upon payment into court of the amount of such award, thereby acquiring title to the desired use (Act May 14, 1889, § 17), is invalid, under Const. Pa. art. 16, § 8, which requires that "just compensation" shall be "paid or secured" before private property can be taken, injured, or destroyed by any corporation; since "just compensation" is the amount which may be finally ascertained by a jury upon trial of the case on appeal.—(H. C. & C. Turnpike R. Co. v. H. & M. El. Ry. Co., 35 At. Rep. 850.)

EJECTION OF PASSENGERS.

WISCONSIN.—In an action for expulsion from defendant's street car, it appeared that plaintiff was expelled by the conductor after an altercation as to whether or not he had paid his fare, and was allowed to get on the car again, because the conductor became convinced that the fare had been paid. On the trial, plaintiff testified to the conversation between himself and the conductor, in respect to paying his fare, just after he stepped back into the car. *Held*, that it was admissible as a part of the res gestæ.

In an action for a personal tort, mental suffering resulting from a sense of wrong or insult is an element of compensatory damages.

In an action for a personal tort, plaintiff is not entitled to punitive damages as a matter of legal right, but the awarding of such damages is within the discretion of the jury.—(Hooker v. Newton, 24 Wis. 292, criticised. Robinson. v. Superior R. T. Ry. Co., 68 N. W. Rep. 961.)

LIABILITY FOR NEGLIGENCE.

MASSACHUSETTS.—In an action for the death of plaintiff's intestate, a boy seven years old, it appeared that deceased jumped on one of defendant's street cars and was riding on the step of the rear platform as a trespasser; that the conductor saw him, but did not otherwise notice him; that while the car was in motion he attempted to get off, and was killed by falling on the cobblestones in the street. *Held*, that a verdict was properly directed for defendant.—(Brightman v. Union St. Ry. Co., 44 N. E. Rep. 1091.)

OREGON.—In an action against a street railway, it appeared that plaintiff got off a car going west, walked behind it, and was struck by a car going east. The motorman testified that she stepped from behind the west bound car into the middle of the track on which his car was going. Numerous witnesses who saw the accident, testified as to the circumstances. *Held* that, notwithstanding evidence that she looked for an approaching car before attempting to cross the track, the question as to whether she did in fact do was for the jury.

If plaintiff failed to look to see if a car was approaching before she attempted to cross the track, and by reason of such failure stepped on the track, and was struck by an approaching car, which she could have seen by looking, she was guilty of contributory negligence.

A charge to the effect that if the accident "was caused by the carelessness or negligence of plaintiff," or if she did not "use proper care or caution to ascertain whether a car was approaching" before attempting to cross the track, she could not recover, was insufficient.—(Smith v. City & Suburban Ry. Co.. 40 Pac. Rep. 780.)

TENNESSEE.—Under Act 1883, c. 186 (Mill. & V. Code, § 3134), providing that, where death is caused by the fault of another, the party suing, if entitled to damages, shall have the right to recover for the suffering and loss of time resulting to the deceased, as well as damages resulting to the persons for whose benefit the right of action survived, the right to damages for the death of a married woman, caused by the fault of another, is vested in the surviving husband, to the exclusion of the next of kin. Wilkes, J., dissenting.

An action for damages for the death of a married woman, caused by the negligence of defendant, is properly brought in the name of her administrator.—(Chat. El. Ry. Co., v. Johnson, 37 S. W. Rep. 558.)

NEW JERSEY.—When a father sues as the administrator of his deceased son, who was killed by the neglect of the defendant, the fact that the death was in part occasioned by the contributory carelessness of the father cannot be set up in defense of the action.

The funeral expenses being part of the pecuniary damages resulting from the death of the son, and which had been paid by the father, can be recovered in the action by the father as the administrator under the statute.—(Con. Tr. Co. v. Hone, 35 At. Rep. 899.)

TEXAS.—in an action against a street railway company for injuries alleged to be due to the negligence of the driver of the car, it is not error to charge that negligence on his part is the want of such care as a reasonably skillful and prudent street car driver would observe under similar circumstances, and if by failure to exercise such prudence a passenger is injured the company would be liable.

In view of such construction, it was not error to refuse to further instruct the jury that "it is the duty of a street car driver to be skillful and prudent and cautious, to see that passengers on his car are not injured, and in case a passenger on a car is injured by the negligence of the driver the company is liable for such injury. Negligence in a car driver is the want of such care and prudence as skillful, prudent and careful car drivers observe under similar circumstances."—(Durnett v. Gulf City Ry., 37 S. W. Rep. 336.)

NEW JERSEY.—While juries, in determining the pecuniary injury occasioned by the death of a person to his next of kin, under our statute, may be obliged, to some extent, to form their estimate of damages on conjectures and uncertainties, yet, when the evidence furnishes some standard for the calculation of damages, a verdict disregarding such standard, and awarding damages in excess of any possible calculation based thereon, will not be permitted to stand.—(Jackson v. Con. Tr. Co., 35 At. Rep. 754.)

MASSACHUSETTS.—The drivers of a street car and a vehicle owe reciprocal duties to each other to use reasonable care to avoid a collision, and neither has the right to assume that the other will keep out of the way at his peril; and where a wagon is being driven over the track of a street railroad in passing around an obstruction in the street, and is clearing the track with reasonable celerity, it is the duty of the motorman on an approaching electric car to move slowly, or stop, until the wagon is out of the way.

Where the driver of a wagon, in passing around an obstruction in the street, drives upon the track of a street railroad, he naturally would return to the same side of the street; and the motorman of a car approaching from behind him has no right to act on the assumption that he will cross directly over the track, and remain on the other side.—(White v. Worcester Con. St. Ry. Co., 44 N. E. Rep. 1052.)

TEXAS.—Rev. St. 1879, art. 4245, relating to the liability of railroad companies for stock killed or injured by their locomotives or cars, does not apply to street railroads.—(San Antonio St. Ry. Co. v Wray 37 S. W. Rep. 461.)

CARE OF STREETS, LIABILITY FOR PAVING.

PENNSYLVANIA.—Where a street railway company, in laying its tracks, has failed to conform to the grade of the streets, according to an express condition of the grant of the right to use such streets, the municipality may change such tracks to the proper grade, and recover the cost thereof from the company.

A borough granted to a street railway company the right to use a street, on condition that it would maintain and keep in repair a certain portion thereof, and would join with the borough in any improvement by "repairing or macadamizing," and bear the expense thereof as to such portion. Subsequently, the borough served notice upon the company to join in paving the street with asphaltum, but the company paid no attention thereto. The borough then paved the entire street at its own expense. *Held*, that the company was liable for its share of the preliminary work on the street, but not for the actual laying of the asphaltum, as in using such pavement the borough had exceeded the contract.—(Borough v. Shamokin St. Ry. Co., 35 At Rep. 862.)

IOWA.—Acts 25th Gen. Assem. c. 7, repealing prior acts on the same subject matter, and providing (section 10) that whenever any street railway may have been constructed and shall remain on any street "which the council may direct to be paved," and when the owner of such railway may be bound to pave any portion of said street, etc,, and if the owner shall fail or refuse to comply with the order to pave, then the portion of the costs assessable against such railway shall be assessed against it, does not authorize an ordinance requiring a street railway company, as a condition precedent to laying its track on a street which it has the right to occupy, and which is already paved, to pay the cost of such paving.—(Oskaloosa St. Ry. v. City of Oskaloosa, 68 N. W. Rep. 808.)

PENNSYLVANIA.—A provision in the charter of a street railway company that it shall be subject to such regulations as might be made by the city "in regard to paving, repairing, grading," etc., of the streets on which its tracks are located, does not authorize the city to impose upon the company the cost of paving such streets.

A provision in the charter of a street railway company that it shall "keep" in "perpetual good repair," at its own expense, the streets on which its tracks are located, does not render it liable for the cost of repaving such streets with a new, different, and more costly material.—(City of Philadelphia v. Hestonville M. & F. R. Co., 35 At. Rep. 718).

PENNSYLVANIA.—Where the charter of a street railway company fixes the company's liability for street paving, the city cannot enlarge it.

A city determined to repave with asphaltum a street which intersected defendant's street railway tracks, and which was already paved with Belgian block. The contract for paving the street was let as a whole, without reference to intersecting streets, and the blocks removed were used for paving elsewhere. *Held*, that a provision in defendant's charter requiring it to keep in repair the street between its tracks did not render it liable for the cost of the paving at the intersection of its tracks with the street paved.—(City of Philadelphia v. City of Philadelphia Pass. Ry. Co , 35 At. Rep. 720).

PENNSYLVANIA—A provision in the charter of a street railway company that, on completion of the road, the company should be subject to city ordinances "regulating the running of passenger railway cars," does not enable the city to impose on the company the cost of street paving.—(City of Philadelphia v. Empire Pass. Ry. Co,, 35 At. Rep. 721).

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IN the STREET RAILWAY JOURNAL for 1897 we shall aim to make our pages even more interesting and indispensable than ever before to all interested in street railway construction and operation, whether he be manager or employe, builder or investor. We shall endeavor to maintain in the future the same standard that has characterized the STREET RAILWAY JOURNAL in the past and to make it the epitome of all important improvements which may occur during the year in street railway engineering, giving especial attention to the economical side and toward the practical points which go so far toward increasing efficiency and reducing operating charges. The division of the reading pages of the STREET RAILWAY JOURNAL into a number of different departments, inaugurated two years ago, has been generally endorsed by our readers, as enabling them to turn more readily to any particular class of articles in which they may be interested, and will be continued.

* * *

In addition, more attention than in the past will be paid to the foreign field. The STREET RAILWAY JOURNAL has now a very large circulation in foreign countries, but up to this time the number of lines equipped with mechanical power abroad has been comparatively small. The present rapid development of electric railways abroad, however, not only in Europe, but in South America, Australia, South Africa and Japan, warrants further attention. We expect not only to publish in each issue of the STREET RAILWAY JOURNAL news, which will keep our readers informed of the rapid strides being made in other countries in electric railway equipment, but have also arranged with a number of foreign engineers of note to contribute during the year upon topics of general interest. To foreign street railway companies and managers therefore, as well as to those in this country, the STREET RAILWAY JOURNAL will aim to be, at once, a compendium of all the technical improvements and advances made in the science and a medium through which current practice and methods of management can be compared to mutual help and advantage.

THE report submitted last month by the special commissioners appointed by the city of Glasgow, Scotland, to make an investigation into the best method of propelling street railway cars, promises to mark an epoch in the history of street railway transportation abroad. To remind our readers of the reason for the appointment of this commission, the history of the city of Glasgow during the last few years will be very briefly reviewed. Under the franchise granted the original street railway company in Glasgow, the city had the right to purchase the system at the end of a term of twenty-three years. This term expired June 30, 1894, and the system which was then operated by animal power passed under the ownership of the municipality. Since that time the tramway commissioners have been investigating the subject of improved motive power and during this year by virtue of authority granted by the council a committee made a personal investigation of the roads operating in Europe by mechanical power. The conclusions of the committee were so decidedly in favor of the trolley system that the general manager and engineer of the tramway system were deputed to make a visit to the United States to investigate the workings of the system in this country and the general satisfaction that it was said to be giving. The report, an abstract of which is published on another page, is so absolutely in favor of the trolley, to the exclusion of every other form of power, that it may safely be said that authority to commence the transformation of the entire Glasgow system to an electric road will shortly be given. The effect of this upon public opinion abroad, especially in Great Britain, cannot but be enormous, and far more powerful than if the change were made upon a system under private ownership, as it will show that the general public is in favor of the change.

SEVERAL disastrous accidents, which have occurred during the last few months, emphasize the necessity of some reliable and ready method of braking electric cars. In fact this subject is one of the most important to consider in the equipment with electric power of any road. But while a good brake is desirable for any road, its use is particularly necessary on railways where the grades are such as to make the speed acquired by a runaway car on them dan-

gerous. The importance of this subject has been such that it was especially mentioned in their last Annual Reports by the Railway Commissioners of New York, Connecticut and Rhode Island, as constituting one of the vital problems created by the operation of electric roads. Immediately after the fatality on the Nassau Railway in Brooklyn, some time ago, in which several persons were killed and a number of others injured by a runaway car on a grade, the New York State Railway Commissioners recommended the more general employment on grades of a trailing catch device used under the car, and having the advantage of being automatic when grades are being ascended. A power brake would, however, seem more desirable, as being capable of more ready and general use. The modern electric car has often been compared to the steam railroad car in weight and speed, and the statement is frequently made that consequently the need of good braking facilities is quite as great. But in several respects the necessity of powerful brakes is even greater. The grades attempted are vastly in excess of those on steam railroads, the curves are shorter, the highways and vehicles crossing the track are not protected and stops must be made much more abruptly. The energy of a modern swift electric car is so much greater than that of the old horse car that the means of stopping the latter are certainly not adequate to control the new equipment.

THE electrical transformation which American street railways have undergone during the past eight years, is thorough and complete. Now, a horse railway outside of New York City is as much of a rarity as was an electric road at the beginning of this decade. From present indications this change is to be duplicated during the coming three or four years by equally as radical and extensive changes in motive power among foreign tramways. During the last three years, and especially during the last twelve months, a large number of tramway engineers from abroad have visited this country to investigate the application of electric power and put in practice upon their return, American methods of construction and operation. In several instances also, representatives from prominent European municipal and financial bodies have arrived in this country to study the economical aspects of our roads and their adaptability to foreign conditions. America has been thus able to lead the way in electric railway practice, partly because the less conservative nature of our people has permitted the erection of overhead wires when it would have been difficult to secure such rights abroad, and partly because the electric lighting industry for other and entirely different reasons had been more extensively developed at the time of the commencement of electric railway operations in this country, and consequently we were more ready to take up and improve the new motive power. The system has, however, proved so desirable that it is safe to say that American practice will not be greatly modified for service on the other side of the Atlantic.

* * * * *

In some respects foreign tramway managers will be better off for having delayed the equipment of their lines until the present time. Eight years of development have occasioned many changes in form of apparatus, and the evolution of the present efficient types has been accomplished only at great expense, which, of course, has been borne by the street railway industry here. While improvements will, of course, continue to be made, it is safe to say, from the high efficiency of our present forms that, except possibly for long distance work, future changes will be of such minor character as not to materially change the types or methods now in use. The ability to purchase their equipment now, therefore, at a time when improved methods of manufacture and competition have reduced prices to one-third or one-fourth that of the early days of electric railroading, will put the new railways abroad in far better condition, so far as economical operation is concerned, than many of the leading American roads which embarked early in electric railway operation. Without expense to themselves, they may enjoy the benefits of the years of tedious experience by which the present forms have been brought to their present development and efficiency.

* * * * *

In many minor details, however, the electric railways built abroad will probably differ from the most recent installed in America. Not only will diverse conditions compel certain modifications in different portions of the equipment, but local habits and prejudices will have much to do with the adoption or retention of certain features. Thus the double decked car, the separation of first and second class passengers and the zone system of fares have each been employed more or less extensively, and where they are in use there will probably be a tendency to retain them. In fact, it seems to be the general opinion of European street railway managers that the American system of uniform fares, so universal and desirable here, is not adapted for systems of any considerable size in Europe. In station construction the high price of fuel in many parts of Europe and South America will dictate the use of machinery of the highest efficiency. Compound or triple expansion condensing engines will probably be generally used, and in those systems in which the location of the power station is such that water for condensing purposes is not easily obtainable, self cooling condensers, which we understand have been employed for some time with very satisfactory results in Continental electrical stations, will meet with general adoption. On the other hand, labor being cheaper, many of the distinctively labor saving devices, which are generally in use here, should not be so widely adopted. As to track and overhead construction we believe that foreign engineers will install at least as substantial work as in this country, our experience in this line being known to them, while probably more attention will be given to securing a tasteful and inconspicuous overhead construction than by most of the railway companies here. Municipal control, under which the foreign roads, even when operated by independent companies, are to a much greater extent than in America, will probably have much to do with this portion of the equipment, and will probably require the burial in many cases of the feeders and a greater attention to the aesthetic appearance of the overhead system.

* * * * *

The prejudice existing not only in foreign capitals, but even among foreign engineers to the erection of the overhead system, it is gratifying to notice, is rapidly wearing away. This is due in large part to the really very handsome and tasteful erections made by foreign electric rail-

way companies in the cities in which street railway companies have been allowed to erect poles, and to the growing conviction on the part of both engineers, councils and the general public that the only real solution of the municipal rapid transit problem lies in the trolley system. Other motive powers, such as steam dummies of different kinds, compressed air, gas, etc., have been tried to a far greater extent on the other side of the Atlantic than here, but without very satisfactory results, so that electricity will be welcomed as a grateful solution to the problem of street car propulsion. A recent visitor to Europe of long experience in the manufacture of electric railway apparatus reported upon his return that in his opinion there would be more electric railway construction in France and Germany during the next year than in all of the United States. Even if this estimate should be twenty-five per cent or fifty per cent too large it would indicate an enormous increase in electric railway activity in those countries.

Electric Power for Steam Railway Conditions.

The steam roads of our country have for some time past felt here and there a certain local irritation, such as might be produced by a kick—due to the competition of divers electric railways that would persist, in defiance of all precedents, in giving the public adequate rapid transit. At first they despised the intruders, then disliked, and have finally come to fear—and for good cause. The truth is that no matter how skillfully a steam road may be administered it cannot meet the requirements of rapid suburban and interurban service except by the quick and frequent trains that have been found necessary for such work in street railway practice. It is therefore in no wise extraordinary that community of results should ultimately enforce community of methods. Nevertheless we note with particular interest and approbation the recent action of the New York, New Haven & Hartford Railroad in deciding to equip its branch lines in the vicinity of Berlin, Conn., as electric interurban roads of the most advanced type. It is an example worthy to be followed in other places and by other roads, for it means the substitution of honest and open competition for legal and legislative chicanery. Indeed, this change of motive power is a complete answer to the disingenuous and time-worn contention that electric interurban roads should not be chartered, not being necessary to public convenience.

Aside from this moral aspect of the case, the new departure is of special interest from the standpoint of the engineer. It is the direct outcome of the experiments of the past two years on the Nantasket Beach road. These experiments on the use of electric power in the larger work of railroading were highly successful and creditable, both to the skill of the engineers in charge and the foresight and enterprise of the great system in the interest of which they were conducted. They showed, first, that a fast and frequent train service of a most trying character can be carried out in a very perfect and economical manner by electric power. Second, the work of the present season showed conclusively that electric power can be applied to existing lines in a singularly cheap, simple and reliable manner. It was a long stride from the overhead trolley to a central third rail low enough to clear all existing rolling stock and massive enough to serve the purpose of a distributing conductor on a long line. Yet this step was taken, and it now plainly appears that, at least for standard railway voltages, the third rail is entirely available as a general method of supplying power to moving trains. Leakage, which has been so dreaded in the past, has proved to be but a trivial difficulty, so far from formidable that there has been little hesitation in adopting the third rail on these new lines, where it must encounter the worst that a New England winter can do.

If we read the signs of the times aright, this admirable enterprise of a shrewdly and skillfully managed road is only the beginning of a change that will be impressive and may be revolutionary. The electrical problems that must disclose themselves during any general advance in this direction are, however, somewhat formidable. When the lines to be transformed, grow longer, and the traffic is relatively light, the supply of the necessary power is not altogether simple. So long as the cost of conductors for 500 or 600 volts does not become burdensome, the third rail method of supply as now in use, is excellently suited to the work. On long lines the trouble begins—if the voltage just mentioned be doubled there is strong likelihood of serious difficulties with the insulation, and the third rail, so beautiful in its simplicity must then be abandoned for the trolley wire. Even the advantage thus gained, leaves much to be desired. If electric traction is to pass from the special to the general, to conquer the locomotive as well as the mule, there must be radical changes in our methods of transmitting energy to the motors. These changes must be in the direction of higher working voltage. It is not enough to transmit energy by any of the well known polyphase systems and reconvert it to continuous current by rotary transformers. This procedure is well suited to certain cases, but it pays far too heavy a price in loss of energy. The problem on which the general use of electric power for railway purposes depends, is the problem of carrying energy at high voltage clear up to the moving car itself, and utilizing it without a complicated reconversion. Until the solution is in evidence, our friends the steam railroads must rest content to leave some things undone, and when it appears we will meet them on their own ground.

At present we are going through a transition period; standard electric railway practice is within sight of its limitations, and it is not yet clear how they can be escaped. If long lines are to be economically worked recourse must be taken either to continuous current motors of much higher voltage than usual or to alternating motors with or without change of voltage or phase relations on the car. No serious work has yet been done along either of these lines, but in both there lies promise of success. And when success comes it is not unlikely to come in such wise as will not only clear the way for the future, but lighten the burdens of the present, for the feeder system of an extensive road is to-day a load grievous to be borne.

A SCHEME to develop from 100,000 to 200,000 h. p. by building a canal from the St. Lawrence River to the Grass River in St. Lawrence County, in New York, is said to be under way. The St. Lawrence is to be tapped two miles below the southern end of Long Sault Island, and the canal will run over a comparatively level plateau till it reaches a drop of about forty feet at Massena, on the Grass River. Here the turbines will be put in, and an electric plant will be erected to generate the horse power.

CONSTRUCTION

A New Railway at Richmond, Va.

The advent of a new electric railway at Richmond, Va., the birth place of commercial electric railways was celebrated June 20 last, when the system of the Richmond Traction Company, construction on which was commenced November, 1895, was put in operation. Service was begun in time for the Confederate Veteran Reunion in Richmond and 45,000 passengers were carried daily during the first week without a hitch or accident of any kind.

The main line of this road extends in a straight line from east to west, the full length of the city. It thus connects the East and West Ends, which are separated by a broad, deep valley. In ascending these hills the only grades of any consequence are met. On the eastern slope the grade is about 1500 ft. long and has an average of eight per cent, except for about 300 ft. where it is 10.3 per cent. On the western side it is about the same length and has an average of nine per cent. There is also one branch line extending to Oakwood Cemetery, a distance of about 1½ miles, and another branch, which will run to Hollywood Cemetery about 1½ miles from the main line, is now

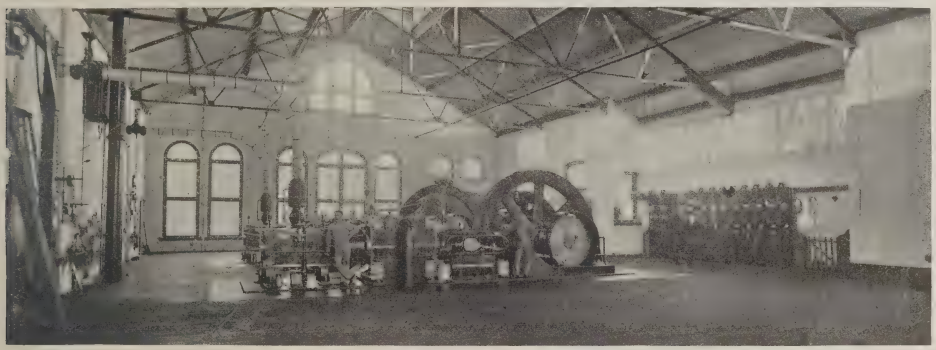
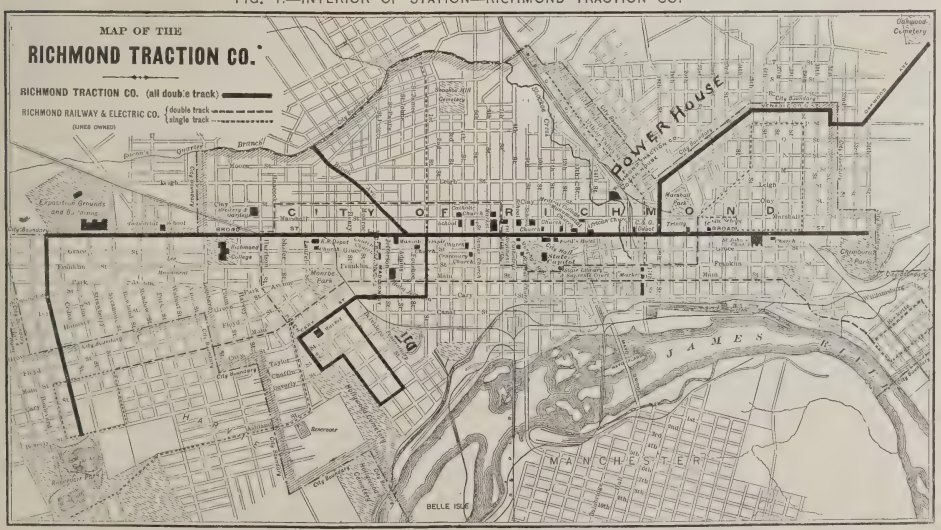


FIG. 1.—INTERIOR OF STATION—RICHMOND TRACTION CO.



under construction. Still another branch through Brook Avenue to the Corporate limits, will shortly be built. When these branches are completed there will be about fifteen miles of track.

The rails are ninety-five pound grooved girder, furnished by The Johnson Company. The ties are 6 ins. × 8 ins. × 7 ft., and are white oak. They are imbedded in concrete, which forms a continuous foundation for the roadbed and is laid six inches below the tie. The concrete is made of the following mixture: one part American cement, two parts sand, four parts broken stone or creek gravel. The ties are spaced 2½ ft. The space between the web of rail is filled with concrete, which method of construction was required by the city ordinance. The Johnson rail bond is used.

FIG. 2.—EXTERIOR OF STATION.

The overhead construction is very neat and ornamental, and on account of the widths of the streets, center pole construction is principally used, the tracks being spaced 8 ft. between the inside rails. At the intersection of the streets the center pole is used as an electric light pole also, as shown in Fig. 1. No. 0 trolley wire, with No. 00 to No. 0000 feed wire is used. The wire was furnished by John A. Roebling's Sons Company, the overhead material by the Ohio Brass Company.

FIG. 3.—STREET SCENE.

The company owns twenty-six summer cars which were made by the American Car Company, and twenty-two closed cars which were furnished by John Stephenson Company, Ltd., and the St. Louis Car Company. The company has recently added two extra handsome cars with single revolving seats made by the American Car Company. Peckham trucks and New Haven double car registers are used.

The power house, the exterior of which is shown in Fig. 2, is situated in the valley at the bottom of the grade, a short distance from the main line. It is a solid brick building, fireproof throughout with iron truss roof covered with slate. There are two 250 h. p. compound condensing Hamilton-Corliss engines, speeded to 100 r. p. m., direct connected to two 300 k. w. General Electric multipolar generators. There are two 300 h. p. Campbell & Zell water tube safety boilers in separate batteries. Deane condensers and Worthington pumps are used. The General Electric standard generator and feeder panels are used and the station is equipped with a recording wattmeter. The interior of the power house is shown in Fig. 1.

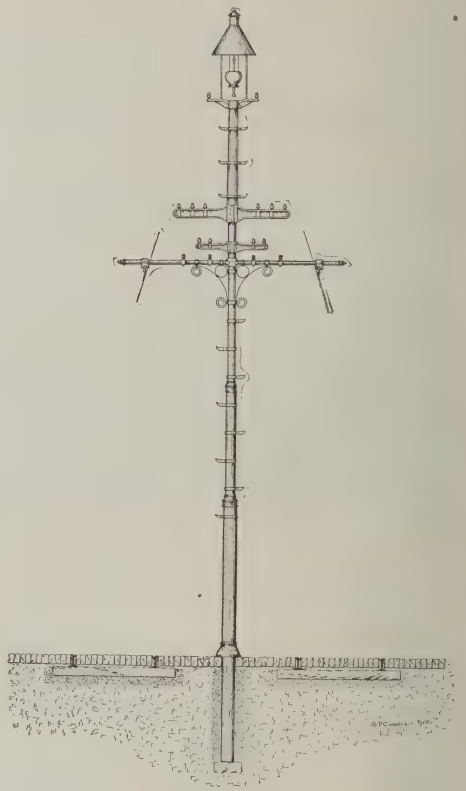


FIG. 4.—IRON CENTER POLE AND SECTION OF TRACK AND ROADBED.

The car house is situated at the west end of the road near the Reservoir Park and is a fireproof building containing room for about eighty cars. The rear of the car house is partitioned off for the repair shop.

The officers of the company are: John S. Williams, president; W. M. Habliston, vice-president and general manager; R. Lancaster Williams, treasurer; Addison Cook, auditor, and E. J. Willis, superintendent. During the construction A. Langstaff Johnston was consulting engineer, with S. P. Cowarding as assistant in charge of track construction, and R. P. King in charge of overhead construction.

Street Railway Roadbed.

By MASON D. PRATT.

VI.—Guard Rails—Special Work.

It is a comparatively simple matter to determine graphically the shape of groove in a guard rail, having given the flange, diameter of wheel, radius of curve and wheelbase. By reversing the operation the maximum flange may be found that will pass through any groove, having given the radius, wheelbase, etc. It was by such a process that the flange shown in Fig. 109 was developed. The guard rail taken is section No. 208, of the Pennsylvania Steel Company and the broken line shows the limits of the space in the groove occupied by the flange on a thirty-five foot radius curve. The flange which the

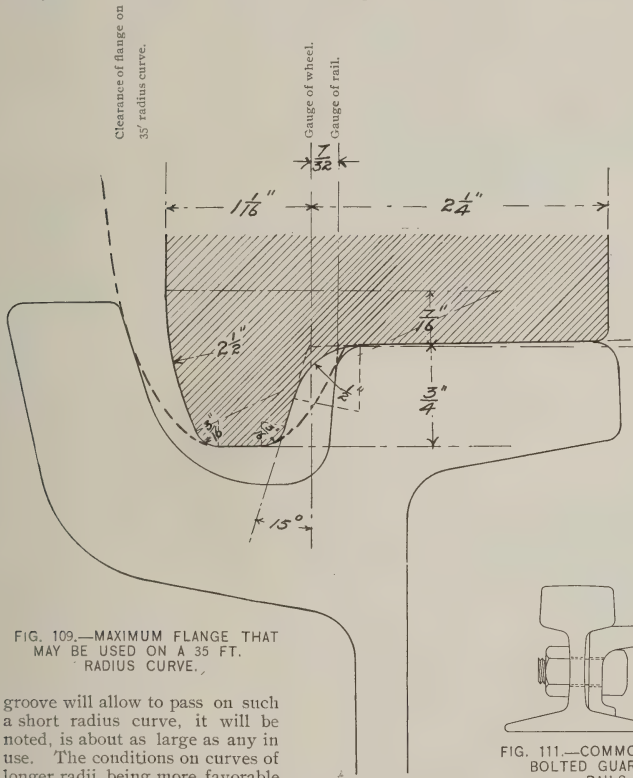


FIG. 109.—MAXIMUM FLANGE THAT MAY BE USED ON A 35 FT. RADIUS CURVE.

groove will allow to pass on such a short radius curve, it will be noted, is about as large as any in use. The conditions on curves of longer radii being more favorable the flange will pass them freely. The section of rail and wheel flange shown in Fig. 109 also gives us a clue to the proper gauge of tracks to be used on curves—a very much mooted question. It may be well to explain that in this figure the plane in which the wheel section is shown has been turned so as to coincide with the plane in which the rail section is projected, the line of intersection of the two planes being the vertical line marked "gauge of wheel." Therefore the relative position of gauge of wheel and gauge of rail is the same as on a curve, the distance between them being $\frac{7}{32}$ in. in the case of a thirty-five foot radius curve. Referring now to the diagram (Fig 110), the distance, *a c*, between the gauge lines of the rails along the axle is easily figured and for 4 ft. 8½ ins. gauge on a 35 ft. radius curve is 4 ft. 8¾ ins. Assuming that the wheels have been placed on the axles to gauge ¼ in. less than the track, as is customary, or 4 ft. 8¼ ins. and adding $\frac{7}{16}$ in., twice the distance between gauges in Fig. 109, we have 4 ft. $8\frac{11}{16}$ ins. or $\frac{1}{16}$ in. less than the distance, *a c*. This would indicate that the track should be the much tight gauge on a thirty-five foot radius curve. On longer radius curves the angle formed by the axle and a radial line through one end is less; therefore the wheel flange has more play, the distance, *a c*, approaches the gauge and there is less reason for changing the gauge from that used in straight track. The old theory that the curve gauge should be increased ½ in., or any amount, should be abandoned.

Besides the various forms of "solid" guard rails shown in Figs. 38, 46, 106, 109, 108, etc., there are several styles of compound guard rails—the four principal ways of making them being shown by Figs. 111 to 114. The use of these is limited mostly to T rail construction. That shown in Fig. 111, the one now generally used, was first devised and used by the writer. Its virtue lies in the ease with which it is adapted to a large variety of T rail sections, and that the groove has a floor which prevents buggy wheels going down too deep. The section (Fig. 112) has the same qualities with the added advantage of a larger base, and being more substantial generally; but it is more expensive as the rail which forms the guard has to be cut out on a planer, i. e., machine fitted for each particular case; while the guard on Fig. 111 may be, and is rolled in large quantities. None of these combination guards are as satisfactory as the solid sections, which latter, however, are used only on work of six inches and over. There are a few solid guard sections under six inches, but

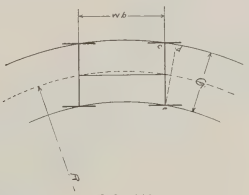


FIG. 110.

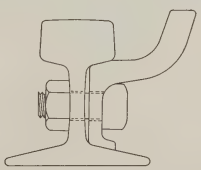


FIG. 111.—COMMON FORM OF BOLTED GUARD FOR T RAILS.

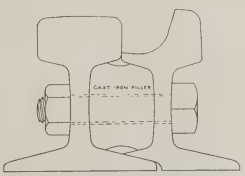


FIG. 112.—MACHINE FITTED GUARD FOR T RAILS.

the fishing space is so greatly reduced on the guard side that it is impossible to make a substantial joint, and they are but little used.

NOMENCLATURE.

Before going deeper into the question of special work I think it well to illustrate the various simple layouts, giving the names most generally used. (See Figs. 115 to 129.) The illustrations show single track work entirely. Double track layouts have the same names with the prefix "double track", and it is customary in all cases to describe them by the initial letters; for instance, S. T. R. H. B. O. meaning single track, right hand branch of. The "hand" is always determined by the side to which the curve turns off as shown to a person facing the point of curve. There are many other peculiar and complex arrangements of

tracks to which no specific names can be given except the general term "special work." Outside of the curves the pieces which go to make up a job of special work are switches, mates and frogs.

A switch is a piece having a movable part to deflect the car, and the one most commonly used on street railways is called a tongue switch. Split switches, Lorenz switches and stub switches are also used as on steam roads, but only in open track or car houses. A switch is automatic when it is so arranged that by means of a piece of rubber or a spring it will automatically return to its former position after allowing a car to "trail" through. The tongue switch is almost always placed on the inner or short side of the curve and when placed in the other position it should be designated as an "outside" tongue switch. An outside switch should not be used on curves of less than 150 or 200 ft. radius unless in connection with an inside tongue switch.

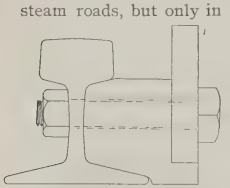


FIG. 113.—OLD FORM OF GUARD.

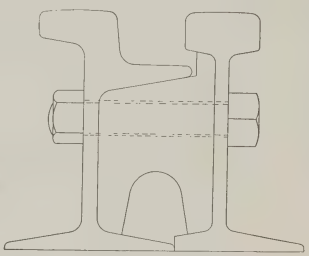


FIG. 114.—T RAIL GUARD USED BY STEAM ROADS IN PAVED STREETS.

A mate is a piece used in connection with a tongue switch on the opposite side of the track and has no movable parts. Corresponding to the tongue switch, its position is on the outside of the curve, and when otherwise placed is called an "inside" mate.

A frog is the intersection of any two lines of rails. Except in open track, frogs have no movable parts, the endeavor usually being to make them as rigid as possible. In crossovers which are used only for emergency and at other points where the track in one direction is little used the main line or rail of the frog is usually made "unbroken," i. e., with no flangeway for the crossing rail. The wheel is made to climb over the head of the main rail by inclines on each side. In open track the same thing is accomplished in a better way by a "spring frog" in which the main line is practically unbroken and the wheel in taking the side track opens its flangeway by pressing out the spring rail. (See Fig. 129.)

Frogs, switches and mates are the vital parts of special work, and there are many ways of making them. In the days of the light, slow-going horse car they were made almost universally of cast iron. Now that metal is used, but very little except in a manner to be described below. Until within the last two or three years these parts were mostly built of the rails themselves. This construction is used exclusively on steam roads, but there the conditions are altogether different from street railways. The tracks being exposed, repairs and renewals are easily and cheaply made. But with the track buried in pavements in busy streets their renewal is a serious and expensive matter, and the longer life there is in a frog the more valuable it becomes. For this reason there is a constant effort to improve on their construction, with the result that now we have three different types of first class construction, viz., "Manganese," "Guarantee" and "Solid Cast Steel."

As stated above, cast iron switch pieces have been abandoned. They do not possess the necessary durability for even the lightest kind of electric car traffic; nor is there any suitable way of joining the several frogs together, or to rails. Built work, if well and properly done, answers the purpose very well for roads of moderate traffic. A built frog should last on a road running fifteen minute headway, about ten years; when it is easy to figure that under a minute headway its life would be less than a year. The writer is familiar with built work that has given very much better service than this.

FIG. 115.—PLAIN CURVE.

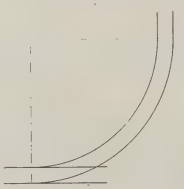


FIG. 116.—LEFT HAND BRANCH-OFF.

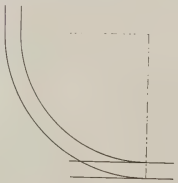


FIG. 117.—RIGHT HAND BRANCH-OFF.

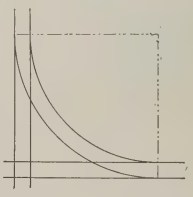


FIG. 118.—CONNECTING CURVE AND CROSSING.

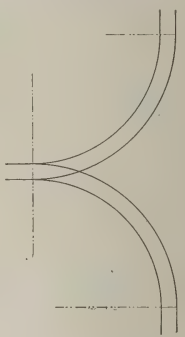


FIG. 119.—PLAIN Y.

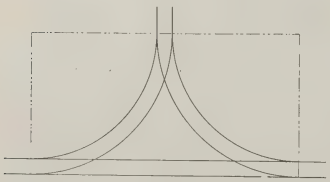


FIG. 121.—THREE-PART V.

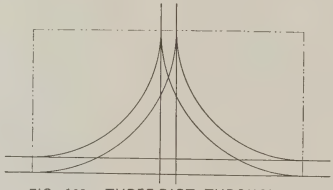


FIG. 122.—THREE-PART THROUGH Y.

FIG. 120.—CROSSING.

FIG. 123.—REVERSE CURVE.

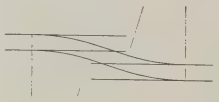


FIG. 124.—RIGHT HAND CROSSOVER.

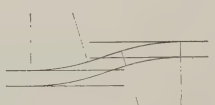


FIG. 125.—LEFT HAND CROSSOVER.

Managers should not complain if they are compelled to renew built frogs within a year or two when placed under heavy traffic. Their steam road brethren have to renew frogs every three or four weeks in places where the number of movements over them do not exceed those in many places on cable or electric roads. Fig. 130 shows the detail of a built frog for a square or "girder-crossing." The parts of a built frog are two or three pieces of rail, four angle plates, or braces (on small angles two of these are replaced by cast iron chocks), making seven large pieces, all of which are held together with from ten to thirty bolts and

rivets. A renewable tempered steel floor plate is often used, and this will prolong the life of the frog two or three times its normal length—if care is taken to renew the floor plate before the points are too much worn. There has been used a rail section with solid floor for building frogs, which adds something to the life of a frog—but since the

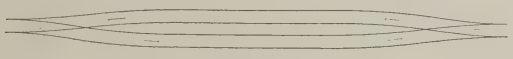


FIG. 126.—DIAMOND TURNOUT.

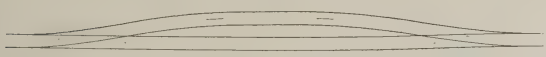


FIG. 127.—SIDE TURNOUT.

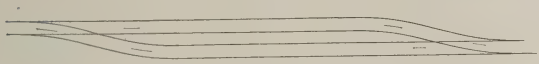


FIG. 128.—THROWN OVER TURNOUT.

floor is of the same steel as the rail it does not offer much resistance to the cutting action of the wheel flanges, and when worn there is no way of repairing the frog. A very good tongue switch may be built of rails, and if the radius is not too short, it will have a longer life than the frogs in the same job. T rails are particularly well adapted to building switches and frogs.

The mate is the most difficult piece to build substantially, from the fact that there is necessarily a considerable distance where the wheels have to be carried on their flanges entirely. These rapidly cut into the floor,

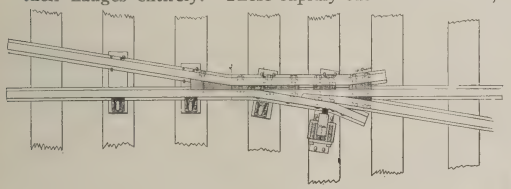


FIG. 129.—SPRING FROG FOR OPEN TRACK.

with the result that the outer edge of the wheel tread cuts into the head of the main rail at the point where it leaves, and pounds down the point of the mate. This has resulted in the use to some extent of a "tongue-mate," or mate with a movable tongue. This tongue mate is not objectionable on a running-off end, but when used facing it is almost imperative that some form of connec-

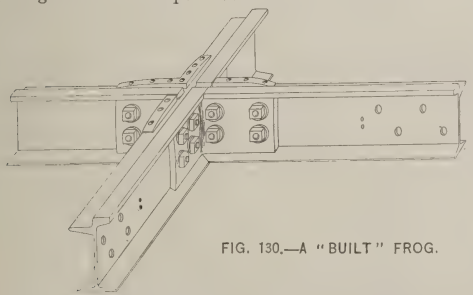


FIG. 130.—A "BUILT" FROG.

tion be used between the two tongues, usually a connecting rod placed in a cast iron box extending entirely across the track. This box without ample drainage is liable to become filled with dirt in summer, and ice in winter, and requires constant attention—a feature which renders its use almost prohibitory.

These latter remarks apply with equal force to all kinds of so-called automatic arrangements or other mechanisms which have to be placed underground. On cable or conduit electric roads where the drainage is well provided for, underground machinery is used without special objection, but on surface roads it should not be used without a good sewer connection, and frequent inspection.

Special work of the first class as made to-day is comprised in the three types known as "Manganese," "Guarantee" and "Solid Cast Steel." The first of these is shown in the typical frog (Fig. 131), which is composed of four short pieces of rail held to a center piece, which is a casting of manganese steel, by means of a mass of cast iron at each joint. It will be seen therefore that the frog is composed of seven separate and distinct pieces. A late modification of this construction has the four small pieces of rail held together by a single mass of cast

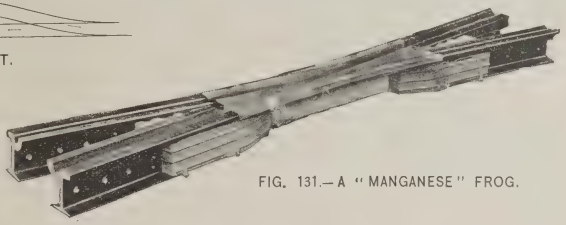


FIG. 131.—A "MANGANESE" FROG.

iron in which is cored a pocket to receive the center casting, which is much reduced in size, and which is held in place by bolts or wedges.

"Guarantee" special work, so called from the fact that the manufacturer sold certain guarantees with it, is made in a similar man-

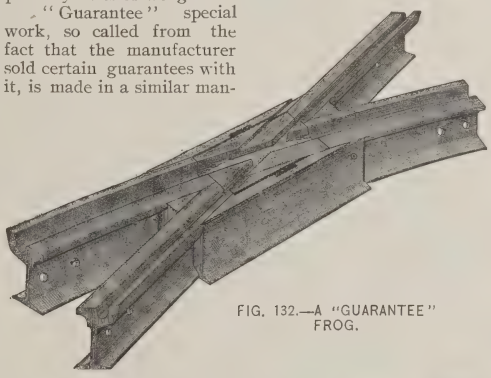


FIG. 132.—A "GUARANTEE" FROG.

ner to the later form of manganese work, except that the center pieces are made of tempered steel,

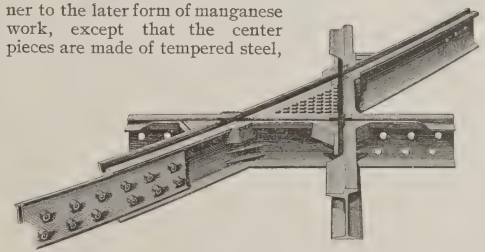


FIG. 133.—A "SOLID CAST STEEL" FROG WITH "HARD CENTERS."

and are retained in the pocket by means of zinc. It was originally intended that these pieces should be renewable without disturbing the main body of the frog in its bed in the pavement. But the difficulty of making anything like a good fit after the adjacent parts of the frog had become worn has compelled the abandonment of the "renewable" feature in all special work. Guarantee frogs are peculiar also in a very generous use of cast iron. (See Fig. 132.)

In "Solid Cast Steel" special work, as its name implies, the switch pieces are castings of open hearth steel, and each frog, switch or mate is one solid piece of steel. Large strides in advance have been made in the manufacture of open hearth steel during thepast five years, and it is now possible to produce castings of the most intricate shape of a fine tough quality of steel. Fig. 133 is a sample, and shows three frogs combined in one piece. The points most subject to wear are protected by pieces of a peculiar steel which is at the same time exceedingly hard and tough. These pieces, or "centers," are placed in the moulds and the main body of the frog cast around them. The contraction of the steel in the cooling holds them with a vise-like grip which never releases.

Special work of the first class, while expensive in first cost, is by far the most economical in the end, for not only will work of this class outlast built work from two to four times, but it saves the large cost of frequent renewals and repairs.

Track Joints.

By R. J. McCarty.

That track joint is manifestly best which conforms most closely to the following specifications; viz.: 1. It should be as strong, rigid and permanent as any other portion of the rail. 2. The interest on its first cost plus the cost of maintenance should be a minimum.

It has been only during the last few years that the problem of track joints has received marked attention from street railways. The reason for this is that everybody,

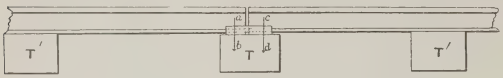


FIG. 1.

basing his calculations upon the requirements of the old horse railway, was mistaken at first concerning the requirements of the modern street railway track.

Previous to this time steam railroads had made many improvements in track and track joints, which improvements the street railways, now awakened to the importance of the subject, were not slow to adopt. In view of this, a discussion of the street railway track joint may properly include the experience of steam railroads, and on account of the many difficult rail sections in use on street railways, to all of which the same general principles apply, the T rail section will be taken as the type.

The track joint in most general use on steam railroads previous to the invention of the fish-plate was the lipped chair. This, as is well known, consisted of a plate spiked to the tie and containing lips or lugs embracing the rail flanges. This joint had within itself no transverse strength, no rigidity, and its permanence depended entirely upon the permanence of the bed of the tie upon which the joint was

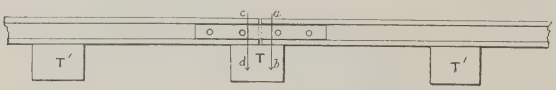


FIG. 2.

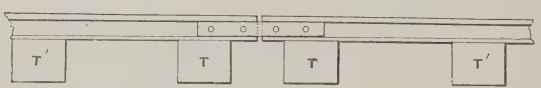


FIG. 3.

necessarily placed, and it happened that the conditions presented by this joint prevented the possibility of securing any great degree of permanence to the tie in question; for this tie, besides being subjected to much greater vertical pressure than any other on account of there being no strength or rigidity in the joint itself, was acted upon first along the line *a b* (Fig. 1), and next, along the line *c d*, the effect being to cant the tie first one way and then the other, thus working it down in its bed, a feature that was greatly aggravated by jars from passing wheels, made excessive by the looseness and insecurity of the joint. These conditions among others caused so many low joints in so short a time that some improvement became imperative.

The result was the fishplate which, small and light as it was at first, kept the rail ends securely in line and level, contributed largely towards relieving the tie of the canting strains, *a b* and *c d* (Figs. 1 and 2), and thus added greatly to the security of the joint. On the other hand, it added little to the transverse strength of the rail joint and hence depended almost entirely upon the joint tie for its support. As a consequence, low joints still appeared with much too frequent regularity. The question then arose of using the suspended joint (Fig. 3), the joint ties being placed at the minimum distance consistent with proper tamping. This gave considerable transverse strength to the joint and gave it better support from beneath. It was found, however, on the other hand, that there resulted a certain deflection in the rail and a cantilever effect upon the joint ties which the plain splices did not entirely meet. In other words, the joint was still lacking in transverse strength. To improve this feature the angle splice (Fig. 4) was designed.

By means of this splice, the joint can be given a transverse strength equivalent to that of the rail. But there are several reasons why, even with sufficient transverse strength, the angle joint cannot be given the proper degree of rigidity and permanence. The rigidity of the joint depends upon a perfect fit at A B and C D (Fig. 4), and since the rails and splices are of rough surface, and since in practice neither rails nor splices are of uniform size it follows that no perfect fit by ordinary methods can be expected. Even with a perfect fit the narrow contact at A B in some sections in use permits wear and thus interferes with the permanence of the joint.

In order to avoid the foregoing defects the angle splice has been improved so as to extend underneath the rail as is shown in Figs. 5 and 6. The angle, G K N (Fig. 6), is slightly sharper than the angle of the rail flange, G S N, so that the bolts through G' G' tend to open the said angle as the splice is drawn into position. The bolts through I I

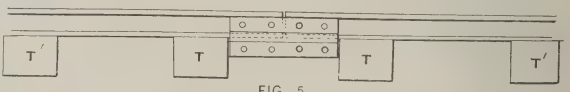


FIG. 5.

when set up tend to close this angle, to cause the splice to exert a powerful grip upon the bottom flange of the rail, to bring the bottom of the rail in contact with the splice clear across and to hold it firmly in place. Thus the rail is seated securely upon and within the splice, and great rigidity as well as strength is obtained. In fact it seems impossible to improve upon this splice in these respects. Could the ties, T T (Fig. 5), be so bedded as to be perfectly firm, the splice could be made practically as strong and as rigid at first as any other part of the rail. In such a case it may be remarked, by the way, that the plain or

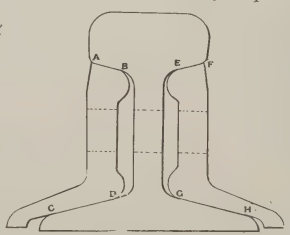


FIG. 4.

the angle splice with the joint on the tie would insure the necessary degree of strength, rigidity and possibly permanence. But it is neither practicable nor advisable to give the tie so firm a bed; so that under passing loads the ties, T T, will yield to some extent. This causes the rails to deflect at the joint with respect to the ties, T' T', and produces strains that the joint is not calculated to resist with perfect rigidity. It is this feature that makes it impracticable to construct a splice joint so as to be as rigid as the rail. Nevertheless, the angle splice joint and the grip joint shown in Figs. 5 and 6 with a good firm bed and with ties properly ballasted and well tamped, may, when accurately fitted be regarded as having tolerable strength and rigidity. This is, of course, only true in a limited sense with a light rail, but as the depth and weight of the rail are increased it is evident that the strength and rigidity of the splice joint can be proportionately increased so that at last a point may be reached at which the joint can be made sufficiently strong and rigid for all practical purposes. To increase the weight of the rail solely for the purpose of strengthening the joint, has, of course, certain limitations in view of the secured specification; for the cost of such increase would then become a proper charge to the cost of splice joints.

But it happens in street railway work that, owing to the presence of paving, it is usually necessary to sink the top of the tie from V to G below grade, and owing to the great reduction in the price of rails during the last few years, it has been found that the actual cost of a rail reaching in depth from grade to the top of the tie is about the same as that of a lighter rail, plus the cost of the necessary chairs and furnishings incident to its use. Such considerations among others have led to the recent use of rail sections in street railway work which would have seemed ridiculous five years ago.

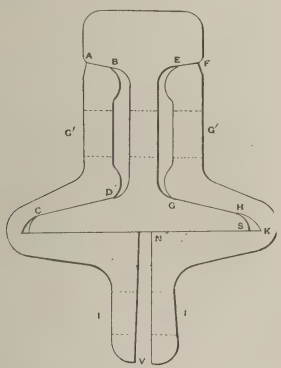


FIG. 6.

Here then, is an independent reason for using a rail so deep and heavy as to give to the splice joint the necessary strength and rigidity at least at first; so that if strength and original rigidity were all that is necessary, the question of track joints for street railway work might properly be regarded as having been solved in all those cases where a rail from seven to nine inches in depth has been or can be used.

But it happens that original strength and rigidity do not necessarily insure permanence of the splice joint. It is evident that owing to exposure to the weather, all parts of any splice joint will become rusted. It is also evident, that owing to the slight gap in the rail as well as to the impracticability of obtaining exactly the same elevation for the heads of the two abutting rail ends by ordinary methods, there is a slight jar every time the wheel passes such a joint. The rust already formed is soon pulverized by these jars and, assisted by the moisture which caused it in the first instance, soon finds its way out. This loosens the joint, and owing to the flexure in the rail thus permitted and to the general loss of rigidity, the jar becomes worse and worse in course of time and the rate of deterioration increases.

In addition to this, the sliding of the rail between the splices as its length changes with the temperature, facilitates the entrance of water, the formation of rust and its escape. It also increases at times the opening in the joint and augments the jars from passing wheels. It may be well to point out at this place that the effect of wheels upon the joints depends somewhat upon whether the cars run in the same or in both directions over the joint. in case of the suspended angle joint and where cars run always in the same direction it is the secured rail end in the joint that yields most under wear. This is because this is the end that receives the blow from the wheel. In view of this a certain degree of permanence can be gained by placing the joint tie which supports this end nearer to the end of the rail, as is shown at Fig. 7. This has an equalizing effect that is very advantageous. When it appears that while under certain conditions the splice joint may be made originally as strong and rigid as is necessary, its permanence under the most favorable circumstances is problematic.

With the question of rust out of the way it is altogether probable that the splice joint with a sufficiently deep and heavy rail could be given a degree of strength, rigidity and permanence suitable for all practical purposes. And it is by no means certain that this cannot be accomplished by good workmanship in spite of the rust, for it is not necessary that the joint should more than last out the life of the rail. Nothing but experience, however, can ever settle this point conclusively.

These last remarks apply, of course, only to cases where the heavy rail section is or can be used.

The time will undoubtedly arrive, however, when all important street railways will adopt the heavy rail section, and in the meantime there will be ample opportunity for determining the permanence of the heavy splice joints. If it should be found that deterioration from rust can be reduced to the proper minimum and that the natural wear

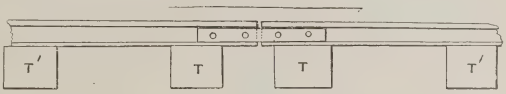


FIG. 7.

from use during the life of the rail is unobjectionable, there will be nothing more to be desired unless it should be found that the continuous rail is superior in permanence and economy. This last question, fortunately is in process of settlement by experiment so that the rail joint problem seems to be in a fair way of settlement within the next few years, so far as street railways are concerned.

Concerning the continuous rail joint, experiment has already shown that it is by no means as impracticable as was for a long time supposed. That such a joint can be made with facility, there is no longer any doubt, and that it is within itself close up to the stated specifications, cannot be disputed. The only question is as to its effect upon the track in general, in consequence of changes of temperature.

Ordinarily the rail is subjected to variations of temperature of about 100 degs. F. in the course of the year. By putting down the rail when its temperature is a mean between the two extremes of weather, the strains in a continuous rail resulting from changes of weather can be reduced to a minimum. In such a case these strains will be of compression in the summer, and of tension in the winter.

Strains of compression, however, are objectionable as tending to throw the rails out of line, while tensile strains tend to pull the rails asunder. A difference of 100 degs. F. in the temperature of a continuous rail is theoretically equivalent to a tensile strain of from 16,000 lbs. per square inch up to an amount dependent upon the composition and temper of the steel in the rail. The greater the percentage of carbon and the higher the temper the greater will be the theoretically equivalent strain. The equivalent strain represented by a certain change of temperature does not seem to bear any definite relation to the tensile strength of the steel, so that it is possible that a certain piece of steel might be damaged by a change of less than 100 degs. F. if securely fixed at each end, while a piece of different quality might easily withstand the strains, resulting from a much greater change. For, instance an iron rail would

probably never be damaged by such strains, while a high carbon steel rail might be greatly injured by them. It is probable that to this feature is due the rupture of many continuous rails during the winter weather.

The complete success, therefore, of the continuous rail seems to require the accurate determination of the mixture for steel best suited for withstanding such strains. That is the mixture which shall be sufficiently hard for wear and yet develop strains within its elastic limit, when subjected to the stated changes of temperature.

In view of the fact that the deep rail section is not subjected to such great changes at its bottom as at its head, and that this gives it great advantage in resisting such strains, and in view of the other fact that shallow sections have been made continuous, not without success, it is probable that experiment will yet indicate a mixture which shall meet every requirement.

The consideration that the imposition of these arbitrary strains may cut down the life of the rail should not, however, be left out of the question. And here again arises a point which only experience can settle. Thus, it appears that the question of track joints is more complicated and far reaching than one would at first suppose and the conclusions seem to be as follows:

1. That where light rails are unavoidable for any reason the best that can be done is to use the angle splice or the grip splice to the best advantage that local conditions will permit.

2. Where heavy rail sections can be used they should never be omitted.

3. That the joint splice may possibly, with the heavy rail, be used in such a form as to practically fulfill the splice features given.

4. That the continuous rail may possibly be brought fully up to the stated specifications without injury to the track or detriment to the rail.

5. That much in the way of observation and experiment yet remains to be done before any intelligent decision can be reached as between the heavy rail splice joint and the heavy continuous rail.

Large Trolley Road for New York City.

The Third Avenue Railroad Company, of New York, having recently been granted the necessary franchises, has commenced construction on an extensive overhead line in the northern part of New York City. The railway will extend from the corner of Tenth Avenue and 165th Street out Kingsbridge Road for a distance of 3¾ miles. The station will be at the junction of the Kingsbridge Road and the Government Canal, at about where 214th Street would be, if it had been laid out. The station will be complete in every particular, and modern in design, and will contain as the first portion of its railway equipment three Allis engines each directly connected to 300 k. w., 500 k. w. and 800 k. w. General Electric railway generators. There will also be a 125 arc light Brush machine direct connected to another Allis engine. The boilers will be of the Babcock & Wilcox type.

The track will be laid with nine inch Jonnson girder rails of the new standard head recently adopted by the city municipal authorities as the standard for future construction. The joints will be cast welded. A great deal of attention will be paid to the quality of the overhead construction. The center poles, which will be furnished by Morris, Tasker & Company, will be exceedingly graceful in design, and every other one will carry at the top an arc light supplied with current from the Brush machine at the station. The supply of this light is not called for by the company's franchise, but will be a gift by the company to the public. The feed wires will all be laid underground.

The type of cars has not yet been definitely settled, but the engineers of the company are inclining to the use of a long car. Superintendent Robertson is making some experiments with a six wheel swivel truck for possible use under these long cars. The truck has one pair of large thirty-three inch wheels which will carry the motor and give traction, and two pairs of smaller twelve inch wheels, chiefly for guiding purposes. From experiments made with the truck it would seem as if the truck will ride very easily over low joints, being always supported at five points in passing a low joint. As the boxes are swung on links the truck has been found to pass around a thirty-five foot radius curve as easily as an ordinary four wheel truck. The wheel base of the truck is four feet six inches.

Underground Conduit Railways for New York.

An important decision was reached last month by the directors of the Metropolitan Street Railway Company, of New York. The company has for a long time felt that it needed additional traffic facilities on its longitudinal lines in the city of New York, only one of which, the Broadway line, is equipped with mechanical power below Twenty-third Street. Despite the very short headway on which cars are now run on the Broadway line, and the most efficient management, the line is unable to carry all the traffic which is offered, and the possible traffic is constantly increasing. The engineers of the company have consequently been engaged ever since the opening of the Broadway line in determining the best motive power to use on some of the lines which the company owns parallel to Broadway. It was largely to assist in the solution of this problem that the Lenox Avenue line was installed a year or more ago. If this should be successful the company intended to employ the system on one or more of its through lines. Careful study has also been made of all of the other motive powers in use in this country and Europe.

As a result of this investigation the company has decided in favor of the use of the underground conduit system upon two lines parallel to the Broadway line. One of these is the Fourth Avenue division of the company, recently leased from the New York & Harlem Railroad Company. This line extends from beyond the Harlem River on the north to the Post Office. The other line will be the Sixth and Eighth Avenues line, the Eighth Avenue being used above Fifty-ninth Street, and the Sixth Avenue below, connection between the two being made through Fifty-ninth Street on the tracks of the Central Park, North & East River Railroad division. Construction will be commenced as soon as the weather permits, and the mileage to be equipped aggregates over forty. The system to be employed is that used on the 118th Street branch of the Lenox Avenue division, and was illustrated in the STREET RAILWAY JOURNAL for December, 1895.

The company has awarded the contracts for the station equipment of the new underground electric railway as follows: for the Twenty-fifth Street station, four 850 k. w. General Electric generators, directly coupled to Pennsylvania Iron Works engines; for the 146th Street station, an addition of three 850 k. w. generators of the same type coupled to the same type of engines. Babcock & Wilcox boilers will be used.

Report of the Board of Commissioners of Electrical Subways of Brooklyn.

The Board of Commissioners appointed to examine and take charge of the Electrical Subway of Brooklyn, consisting of Geo. W. Plympton and Fred. R. Lee, submitted their report recently to the mayor. The report, which is dated Oct. 31, 1896, is a brief summary of the extent of the various electrical system in the City of Brooklyn, the estimate being made to apply to the condition existing on Oct. 1. An abstract of the report as far as it relates to the question of electrolysis follows:

The subject of corrosion of underground pipes and cables still demands serious consideration. The survey made in 1894, of the electrical condition of the districts traversed by the trolley lines was not continued in 1895, for the reason that the Nassau trolley system was in process of construction, and the whole problem of underground currents was assuming larger proportions and presenting new complexities. As the new lines were practically completed early in the present year, a new survey was made during the summer under the direction of Mr. John A. Barrett, whose report is submitted as a part of this communication. The appended map (p. 48) plainly exhibits the danger areas within which service pipes are probably suffering deterioration.

This survey included numerous examinations of the water pipes which could only be made by excavations in the streets. In this work this board received the efficient and hearty co-operation of the Department of City Works. Excavations were made wherever it was deemed desirable to make a direct examination of the water main. One gratifying conclusion was arrived at as a result of this thorough examination, and that was that in the districts where underground pipes are most liable to destruction by electrolysis, the cast iron water mains remain intact. Wrought iron and lead pipes deteriorate steadily and rapidly, in places where cast iron shows no sign of decay.

The statement in a former communication from this board that the water system of the city was seriously endangered and probably already impaired by electrolytic corrosion, now requires modification to the extent that such injury is confined to such branches as are constructed of wrought iron or lead. The immunity from injury by the ordinary process of oxidation, possessed by cast iron, was long since pointed out by engineers, one of whom declared that it was his belief that the so-called white casting is practically indestructible under the action of ordinary oxydizing influences. It would seem likely, therefore, in view of the perfect preservation of the water mains under conditions that lead to the destruction of wrought iron and lead pipes, that whether through design or not the large pipes have been made of a quality of iron that insures their safety. The map plainly shows danger areas at some distance from the street railway lines.

The trolley companies have during the year done much to keep the destructive current on the path of their own conductors, so that the injury is doubtless less rapid than it was two years ago, but a means of absolute prevention of the injury so long as the pipes are of a kind liable to corrode, is not yet made known. The escape to the earth of a portion of the current discharged into the rail is a condition inseparable from the single trolley system. Non-metallic service pipes for conveyance, both of gas and water, are plainly desirable in the present emergency.

One citizen who has suffered the loss of service pipes, three times, is about to adopt a remedy, which although admissible in his case (in a narrow street near the water front), is plainly impracticable in other localities. The pipe is to be carried across the street (which is occupied by three trolley lines) on elevated supports.

The report of Mr. Barrett herewith appended, plainly and specifically sets forth the situation, and will be found a valuable contribution to the literature of a subject which has lately risen into prominence, and is regarded with lively interest in many American cities.

The total length of electrical conductors within the city limits when this board began its work in June, 1892, was in round numbers 9800 miles, of which about 6000 was on poles or house tops. Since 1892 there has been an increase in the length of wires of about 12,200 miles, of which amount, somewhat over 10,200 miles have been provided for in conduits or on the elevated railways. One hundred and eighty miles of conduit containing 280 miles of single duct have been constructed in the same period.

REPORT BY MR. JOHN A. BARRETT.

In carrying out the purposes of the board, I have had a survey made of the electrical state of the Brooklyn City water mains, and a map prepared upon substantially the same plan as that followed in the survey of 1884.

The condition of things broadly stated, is that heavy quantities of electricity are being sent out by the trolley lines from power houses diversely located in the city, and from the overhead wires are being discharged through the moving cars into the track rails.

After passing through the car motors to the rails the electricity returns by all available paths to the several power houses. It was originally designed and expected that the rails would be able to carry back practically all of the returning current, but the path afforded by the rails is not ample for the purpose, and the rails being in intimate contact with the earth which is itself a conductor of electricity, a considerable amount of electricity is crowded off into the earth in certain parts of the city, and from the earth is largely gathered up by the neighboring water and gas pipes, and is generally by these pipes carried back into the vicinity of the power houses, and is there discharged into the earth again.

As a rule the main underground pipes are receiving electricity in those sections of the city which are remote from power houses and are parting with it into the earth again in districts near to power houses, though this rule is subject to exceptional instances. And finally the liability to corroding electrolysis is confined to those conditions under which there is a tendency of electricity from the pipe into the earth.

This brief recapitulation of what is recognized as fundamental in the electrolysis of underground pipes by trolley currents, is all that is necessary to enable us to proceed with a discussion of the subject in the light of recent observations.

Referring to the map, the roman figures indicate the tendency, as measured at the hydrants above the surface, of the trolley currents to flow towards and into the water mains. This tendency is not regarded as locally hurtful to the pipes, but all the electricity, which is thus imposed upon a pipe passes along the pipe to some other locality more or less distant, where the conditions favor its leaving the pipe for the earth towards its destination at the power house.

Where the measurements at the hydrants indicate a tendency of electricity from the pipes into the earth, the figures are printed in italics and the pipes in districts so marked are generally considered as liable to electrolytic corrosion.

Since 1894 the return paths have been materially improved in some parts of the city, both by a better bonding of the rails together, and by attaching to the rails at intervals overhead return feeders, by means of which much of the current is drawn off from the rails and conveyed back to the power houses by special conductors. If a suitable and complete system of return feeders were worked out and applied to the entire surface track of the city, it would be reasonable to expect the reduction of a large proportion of the damage now being committed upon the pipes and it would leave fair hopes of treating by other means the residue of the trouble so as to bring it within bounds.

But after every advisable effort has been made in this radical method of reducing the overflow of current: namely, by improvements in the bonds and return feeders, there will yet inevitably remain considerable, though dimished, earth currents which will subject the pipes to electrolysis under favorable conditions, and the question will still arise as to other serviceable means for meeting and removing these remaining instances of damage.

A large share of the comparatively limited time allotted to the survey was devoted to looking for and explaining instances where electrolysis was known to exist, or was to be expected from surface indications, with a view to useful suggestions upon this head.

First, in behalf of the city, excavations were made in not less than fifteen places upon the water mains, where the tests upon the hydrants showed what was regarded as a decisive liability to damage.

The mains at these excavations were in nearly every instance inspected, both by H. S. Wynkoop, inspector of gas and water for the Department of Public Works, and by myself, and in several cases by Professor Plympton, of your board, and always by experienced pipemen of the Water Department, and in no instance did we find evidences of corrosion distinctly attributable to electrolytic action. This is so interesting and remarkable an observation that it is worth while to state in detail the noted conditions of some of the cases.

On July 29, an excavation was made at a hydrant under the East River Bridge upon a branch running down towards the river from the main on Water Street. There is a general drop in potential from the main towards the river in this vicinity, and a discharge of electricity into the earth from branches and service pipes extending from the main in that direction.

The effect of this has been manifested in the destruction of service pipes, both of lead and wrought iron. The electrical test upon the hydrant in question showed a fall in potential varying from 1.4 volts to 2.2 volts into the water of the river, and it was fully expected that we should find unmistakable electrolytic action.

The branch leading to this hydrant is of cast iron, and is bedded in a mixture of what appears to be sand and cinder, and is below the high tide level. The pipe is said to have laid here for about seventeen years, for more than two of which it has been discharging trolley electricity into the earth. The pipe showed some deterioration on its surface and in some places patches of crusted scale. There was no deep corrosion, and from the fact of the long exposure of the pipe to the action of cinder and salt water at a level between high and low tides, the present fair state of the pipe precludes its being taken, to say the least, as an example of electrolysis.

On July 30, an excavation was made in Plymouth Street, between Main Street and Dock Street, where the fall in potential from hydrant to river was 2.7 volts and also at the foot of Adams Street, where the fall of potential was about 1 volt, and on Aug. 5, on the fire dock at the foot of Main Street, where the fall of potential was 1.3 volts.

The same observations were made in all these cases. Where the pipes, being of cast iron, lay in cinder within reach of the tide water, there was present a considerable amount of hard, red scale; otherwise, the pipes appeared generally free from corrosion. The pipes were not in any case deeply corroded.

Perhaps the most notable instance examined was at the foot of First Street, between Bond Street and Canal. The fall in potential from the hydrant at the end of a branch, was on the average four volts into the water of the canal at a distance of about forty feet. There was a considerable fall of potential from point to point in the earth between the hydrant and the canal. Upon having the pipe uncovered, I found that the fall in potential from the pipe to a point in the earth, less than an inch removed from the pipe, was .36 volt. The cast iron pipe showed no evidence of electrolysis.

But what is to be specially noted in this case, is that some wrought iron clamps and bolts, employed to fasten a cap upon the end of the pipe, were seriously injured by corrosion.

In all the cast iron pipe examined by us, the same observations were made.

Associated with this apparent preservation of the cast iron mains under conditions generally supposed to favor electrolysis, is the observed fact that wrought iron and lead service pipes and wrought iron clamps and bolts immediately attached to the uninjured cast iron and exposed to the same conditions, show unmistakably the expected electrolytic corrosion. It is to be regretted that our observations upon this matter were necessarily so limited, since an exact and reliable determination of it is of immeasurable interest, both to the city and the railroad companies, as well as to all people who are concerned with buried pipes. From such an examination as we were able to make, it would be unwarrantable to assert broadly that cast iron of any particular quality, possesses an abso-

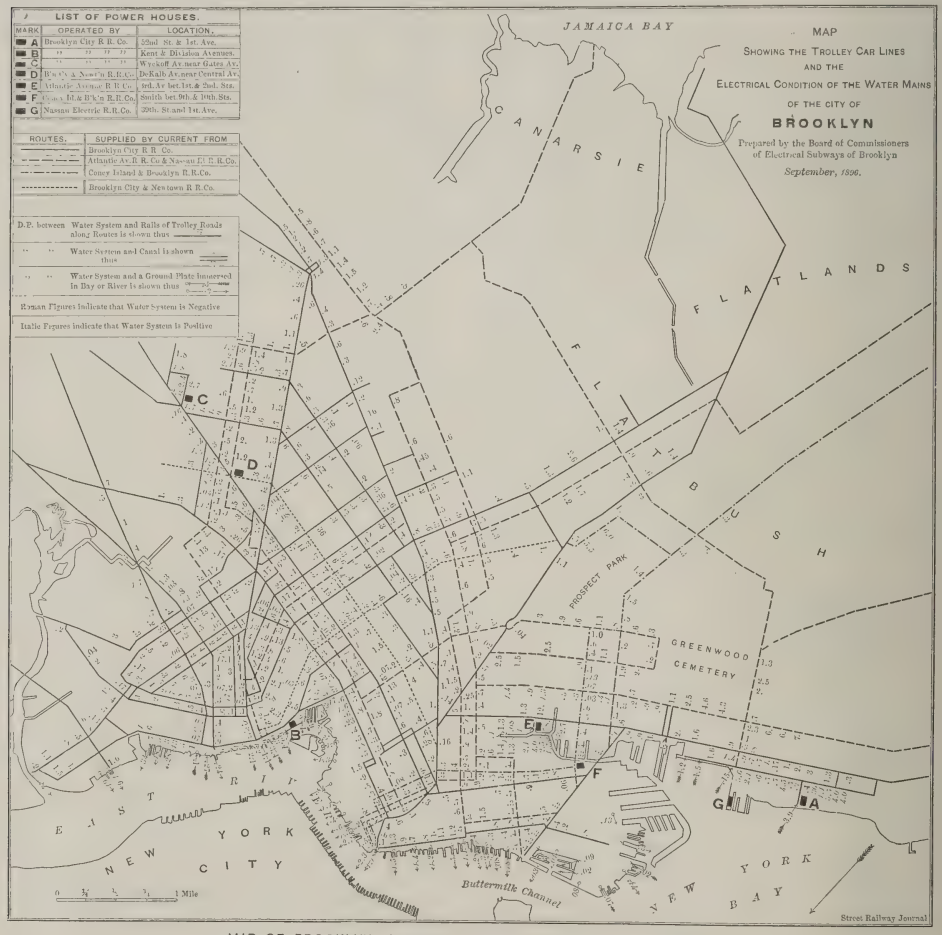
lute immunity from electrolysis. In fact, a test applied to a fragment of cast iron pipe in a tin pail of earth, with a drop of potential of ten volts from the fragment to the pail, gave in three weeks undoubted evidences of electrolysis of the iron. But from a careful investigation of the facts so far as we were able to proceed with it, I think it is at least safe to suggest that at low potentials, cast iron, of such quality as exists in the water mains which were examined, will endure practically unharmed a flow of current into the earth, which under the same conditions is totally destructive to wrought iron and lead.

It is not to be taken, from what has thus been said, that no damage is being done to the city's water mains by the trolley currents. The statement simply is that a number of excavations were made upon the mains in places where, according to all the published

mains to the rails or by any other similar means which might be serviceable.

In this connection it has been objected that any plan which permitted the attachment of conductors from the pipes to the return systems of the railroads would, by promoting an increased flow of current along the pipes, cause a very serious corrosion at the joints in the pipes throughout an indefinite extent of the city. On this account no permits have been granted for making such attachments except in the case of lower Third Avenue in 1894.

Examples of electrolysis of wrought iron pipe at joints are of common occurrence; but in all the cases of cast iron mains which have come under my observation in Brooklyn, no such corrosion at or by any reason of joints has been discovered. The most notable instance of absence of this particular kind of trouble upon the


LIST OF POWER HOUSES.
MARK | OPERATED BY | LOCATION.
A | Brooklyn City R. R. Co. | 52nd St. & 1st. Ave.
B | " " " " | Kent & Division Avenues.
C | " " " " | Wyckoff Av. near Gates Av.
D | Brooklyn & Newtown R.R.Co. | DeKalb Av. near Central Av.
E | Atlantic Avenue R.R.Co. | 3rd. Av bet. 1st. & 2nd. Sts.
F | Nassau Elec. & B'k'n R.R.Co. | Smith bet. 9th. & 10th. Sts.
G | Nassau Electric R.R.Co. | 39th. St. and 1st. Ave.
ROUTES. | SUPPLIED BY CURRENT FROM
Brooklyn City R.R. Co.
Atlantic Av. R. R. Co & Nassau Elec. R.R.Co.
Coney Island & Brooklyn R.R.Co.
Brooklyn City & Newtown R.R.Co.
D.P. between Water System and Rails of Trolley Roads along Routes is shown thus
" " Water System and Canal is shown thus
" " Water System and a Ground Plate Immersed In Bay or River is shown thus
Roman Figures Indicate that Water System is Negative
Italic Figures Indicate that Water System is Positive
JAMAICA BAY
MAP
SHOWING THE TROLLEY CAR LINES AND THE ELECTRICAL CONDITION OF THE WATER MAINS OF THE CITY OF
BROOKLYN
Prepared by the Board of Commissioners of Electrical Subways of Brooklyn
September, 1896.
CANARSIE
FLATLANDS
FLATBUSH
PROSPECT PARK
GREENWOOD CEMETERY
EAST NEW YORK
NEW YORK CITY
Buttermilk Channel
NEW YORK BAY
0 1/4 1/2 3/4 1 Mile
Street Railway Journal

MAP OF BROOKLYN, SHOWING RESULTS OF POTENTIAL TESTS.

propositions which have come to my attention on the subject, a strong presumption of damage existed, and no damage was found; while under the same conditions wrought iron and lead contiguous to the cast iron were being destroyed.

If it could be determined by sufficiently extensive investigations that some specified fraction of a volt in drop of potential from pipe to earth could safely be allowed in the case of cast iron, it would, in my opinion, be entirely feasible for the railroad companies to reduce the present potentials upon the pipe to a fair standard in nearly every situation in the city, by a proper extension and adaptation of their return feeder system.

Wherever potentials greater than the prescribed standard were still found to exist there would then be the opportunity to treat the cases specifically by means of negative conductors attached to the mains as was done in 1894 along Third Avenue, or by bonding the mains was found in Third Avenue between First and Third Streets. This location was selected for excavation because the condition indicated an excessively heavy flow of current along the main, probably heavier than in any other place in the city. The flow here has continued for two years to our certain knowledge, and no doubt, longer. It is far above what should be permitted to exist and may readily be reduced. I was unable to get a measurement of the flow, but some indirect calculations indicated that it amounted to several thousand amperes. The drop in potential around joints in the main was found to be from one to two volts, and at our request four lengths of pipe including three joints intact were removed. In company with Mr. Wynkoop and experienced pipe men of the Water Department, I inspected this pipe with the closest attention, and it was agreed that there were no evidences of electrolysis or any other corrosion to be found.

Again, it is to be regretted that the number of observations upon this point was necessarily so limited, for while this case is an extreme one I do not know a situation in the city where a pipe of the same size is carrying so heavy a current, and it is supported by all our experiences in Brooklyn; still altogether these hardly constitute broad enough grounds upon which to base the absolute negative conclusion that there are no cases of electrolytic corrosion at the joints in the cast iron mains of the city.

The whole proposition with respect to the electrolysis of cast iron pipes must be left by us with the summary statement that, although we hunted for it to the extent of the time and means provided and in situations where, under the generally accepted principles of the subject we expected to find it, we did not find a single instance of corrosion of cast iron which we could attribute to the action of electricity.

As a matter of general interest, although somewhat aside from the present subject, I will state of the main examined in Third Avenue, that it was difficult from the condition and appearance of the pipe to suppose that it had been in the ground for any long period, and yet the records of the Water Department show that it was laid twenty-eight years ago, and during the last two years and more it has been subject to the passage of trolley currents. It is said to have been manufactured by the Camden Iron Works. Upon breaking up a sample of the pipe the iron was found to be exceedingly hard, and the appearance of the fracture is of a brilliant light gray, and of a fine even grain.

But granting that the city's water mains are not so seriously menaced by the trolley currents as has been supposed, all this does not help the situation with respect to wrought iron and lead service pipes, or with respect to wrought iron gas pipes, or electric conduits, or lead cable sheaths, all of which are found to be attacked and rapidly destroyed under conditions by which the cast iron mains appear to be unaffected.

Whatever may further be done by the railroad companies to improve their rail bonds and to increase their return feeders, will be of direct advantage to any case of electrolytic trouble upon other than water mains which now exists, because that is a radical treatment of the cause of the difficulty. Beyond this every instance of damage will have to be treated specifically and for the most part locally according to the special conditions. Only the most general and brief suggestions can at present be made in this direction.

There are situations in the city where a marked difference of potential exists between the gas pipes and water mains. Where such situations are located it is my opinion that it would be of mutual advantage to bond the two systems of pipes together by metallic conductors. We have noted cases where there is a difference of potential between gas and water service pipes in the same house. This is not only an undesirable condition with regard to possible electrolysis, but it is entirely conceivable that under favoring circumstances it might prove to be the origin of fires for which no other cause is assignable. This would be entirely met by bonding together the gas and water service pipes just inside the cellar wall of the house.

There are undoubtedly localities in the city where service pipes are being destroyed by electrolysis, and are being renewed at great cost to the householders, only to be rapidly eaten out again, and where the trouble would be very much reduced if not altogether removed by a systematic and thorough bonding of the service pipes to the trolley rails; but care would need to be taken in applying such attachments to service pipes to avoid an increased joint corrosion to which the wrought iron pipes are liable, and no water pipe should be allowed to be bonded to the rails without including with it the gas pipe for the same house.

There are other situations where no method of bonding would be of of material advantage. Such a condition exists along the river front generally from Erie Basin to and including a part of the Navy Yard. Service pipes in this region are discharging current from the mains towards the river.

In these cases unless the pipes could be removed from the ground and suspended in the air, which might be feasible in a limited number of instances, I see no relief for the continued destruction of service pipes where the electrical conditions promote it, except in the employment of some material for the pipes which would not be subject to electrolysis. What such a material should be I do not undertake to say, but it is presumable that amongst the fibrous compounds manufactured for various purposes, something might be found adaptable to this use. In fact, the general employment of non-metallic material as a substitute for iron or lead in exposed places, if something suitable could be procured, would radically and finally remove all the electrolytic troubles from the smaller pipes in the city, and with an appreciation of the extensiveness of the damage now affecting the metallic pipes in considerable districts, I bring this suggestion forward as well worth the attention and research of those interested in the matter.

With such rather broad and general remarks I am obliged to dismiss the subject for the present, but not without characterizing the report as on the whole indicating a state of affairs with regard to the electrolysis of the Brooklyn water mains not nearly so bad as was reasoably to be expected, and expressing a degree of hopefulness in respect to what may be done to protect and help the private owners upon whose pipes the indications are unfavorable, and the damage already done undeniably extensive.

THE Newton & Boston (Mass.) Street Railway Company has applied for permission to extend its lines in Newton.

Improvements in a Large Car Works.

During the past season, especially during the dull times, the J. G. Brill Company has been improving the opportunity for repairing, enlarging and altering its works, with a view to a large increase of business in the immediate future. The change and additions have been both extensive and costly. The total expenditure up to Jan. 1, 1897, will be a little more than $40,000.

The first item in the list of improvements was the 18 ft. × 260 ft. extension of the erecting shop. This greatly increased the convenience of the line of shops. While the work of enlarging the erecting shop was in process, a forty foot electric transfer table was built and placed upon a track running between the erecting, paint and finishing shops. Gipsy heads are provided by which cars can be pulled on or off from the table and shifted in or out of the shops. It is quick and economical in operation and saves a large number of men.

A new underground coal vault has been put in for the blacksmith shop. It is 15 ft. wide, 160 ft. long and has 7 ft. head room. The coal cars run upon the track over its roof which is supported by iron girders, delivering the coal by scuttles along the whole length. A new counterbalanced drop table has been put in at the east end of the long transfer table track. This was erected as soon as the new twenty-four inch oval sewer was completed. This sewer takes the drainage of the whole establishment and is 576 ft. long.

The truck shop has been extended, the addition being 27 ft. × 34 ft. The blacksmith shop has had a 56 ft. × 50 ft. addition to accomodate a number of new tools and a new reverberatory furnace. During the fall all the track has been relaid and several curves have been made of larger radius. Several new switches have been put in and 3000 ft. of additional track laid with 70 lb. rails. At the same time eight acres of land were taken into the grounds and the fence rebuilt at the side and ends. The total space now enclosed is a little more than eighteen acres.

To facilitate the handling of material from the storerooms and between the erecting shops, a new transfer table has been purchased. It will give an unobstructed yard for the passage of wagons, and at the same time perform its own work perfectly. The new tools and appliances have been numerous. Among them is a new three ton hydraulic lift for the cabinet shop to deliver material upon the second floor.

A pneumatic system for raising water from the deep wells has been put in. The general supply for the works is a gravity system from elevated tanks. A new deep well steam pump with a capacity of forty gallons of water per minute has just been put in as a reserve. A new Ideal engine, of seventy-five horse power, has been installed to drive the machinery in the blacksmith and machine shops and thus relieve the main engine.

In the office an overhauling of furniture and an addition to the lighting system (electric) has been made. A considerable number of changes have been made in the power house of the establishment, and a 500 volt generator has been added. All tracks in the works are provided with a trolley wire carrying a 600 volt current from this generator. This furnishes power for the two electric locomotives, the transfer tables and various other machines driven by electricity. It also enables all electric cars to be tested by running them with their own motors before leaving the works.

Compressed air is now forming an important instrument in the successful operation of a large car building establishment. The works have just set up two pneumatic chipping machines and hoists over the axle lathes with the necessary compressing apparatus for furnishing air. This is a compressor with a capacity of 300 cu. ft. of air per minute. This also furnishes air for the pneumatic pumping apparatus. Another air compressor has been contracted for and will soon be in position. It is of the three stage type and has a capacity of 300 cu. ft. of free air per minute at a pressure of 2000 lbs. per square inch. This machine is so arranged that its high pressure compressing cylinders can be disconnected so that the machine can then deliver a much larger quantity of air at a lower pressure for the general use in the shops. Two new heavy bending machines or "bulldozers" have also been placed in the blacksmith shop. A new 2½ in. Blakeslee upsetting and forging machine with the necessary furnaces have recently been erected, together with the necessary dies, etc., for them. The shop has also just been fitted with a new trimming press to be used in connection with the drop hammers. This became very essential because the establishment is now using a large quantity of drop forged work made from the solid instead of the forged and welded pieces generally employed.

In the stock department a new combined shear and punch has been set up. The capacity of the shear is ¾ in. thick × 6 ins. wide. The punch will punch a three-quarters inch hole in half inch iron 24 ins. from the edge.

In the machine shop the following new tools have recently been placed. One new 2½ in. Jones and Lampson turret lathe, one 24 ft. × 30 ft. Fitchburg iron planer, one Morse universal twist drill grinder; one four spindle Bement & Miles multiple drill, 1½ ins. capacity and one Bickford six spindle multiple drill of 1¼ in. capacity.

In the wood working department the new tools are a Goodell & Waters 8 in. × 18 in. four sided timber dressing machine and a Berry & Orton hollow chisel mortiser with a three spindle boring attachment and a 40 ft. bed. This machine has a series of stops to bore and mortise without laying off with the rod or a pattern. In the cabinet shop a six inch moulder and a saw bench have just been added to the equipment.

SCIENCE · ENGINEERING · INVENTION ·

New Standard Air Compressor.

The problem of building an air compressor which, while operated by an electric motor, should nevertheless always be under perfect control, is not an easy one and the latest type of the Standard Air-Brake Company therefore possesses points of interest. This apparatus is claimed to solve the problem of an air compressor which is entirely independent of the car axle. The one horse power type occupies a space of 22 ins. long × 13 ins. wide × 17 ins. high, thus making it possible to put the complete outfit under a car seat. The motor is iron clad and securely protected against dust and moisture. It is of the slow speed, series, multipolar type. The brushes are easily accessible for inspection and renewal. The armature can be readily withdrawn by removing front head of motor. The motor frame is of steel and combines lightness with maximum capacity. The motor is insulated with extreme care to guard against possible grounding or breaking down of the insulation. The armature is of the well known drum type with the sections made separately and bedded in slots in the face of core. Damaged sections can be renewed in case of injury, as is common in car motor armatures.

Special provision is made to prevent the ingress of oil from bearings and compressor.

COMPRESSOR.

The compressor is of the single acting type, with double cylinders. These are placed vertical with trunk pistons connected directly to eccentrics in the crank case. The pistons are carefully balanced to insure freedom from vibration and noise. The eccentrics are effectively lubricated by revolving in a closed chamber partly filled with oil, which is kept at such a height as to be always in contact with the sliding surfaces. The openings for the intake and discharge are of ample capacity, and thereby the usual noise due to induction and discharge is effectively prevented.

The compressor is bolted centrally with the motor and the shaft of compressor is a prolongation of the armature shaft, but is not a part thereof. Bearings are phosphor bronze and may be readily renewed without dismantling the compressor.

The pistons are made airtight in the cylinders by the use of two piston rings of cast iron, with overlapping joints. Any vibration of the compressor and motor is taken up by the rubber cushions which are interposed between the motor-compressor and base, which latter is arranged in the form of a tray to catch any oil which may escape from the bearings. Oil cups which, with occasional filling, maintain a regular height of oil in the crank case are suitably arranged.

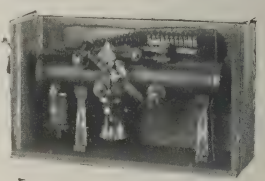
The automatic controller maintains a practically uniform pressure in the air-storage reservoirs placed under cars or elsewhere. By its use, when the air supplied to the reservoirs reaches a predetermined limit, the motor compressor is entirely stopped. As long as the air pressure in the reservoirs remains within eight or ten pounds (or other adjustable limits) of the required maximum, the motor compressor remains inoperative. Should the pressure, however, be reduced below the minimum limit, the motor compressor is immediately started, slowly at first, and gradually increasing as the resistance is automatically removed from the circuit, and continues operating until the maximum limit is reached, when it again immediately stops as before.

The motor is series wound and when starting with empty reservoirs, would naturally run away, but under such conditions, the resistance remains in the circuit and is only cut out as the pressure increases. The apparatus is equally applicable to a shunt wound motor. The speed of the motor compressor is at all times automatically controlled by the amount of work required.

While the motor compressor is in operation, if for any reason the line circuit should be interrupted, if the trolley leaves the wire, or if the conductor changes the trolley, the resistance is thrown in circuit with the motor compressor simultaneously with the stopping of motor. When the current is again restored the motor compressor resumes operation, gradually increasing speed in the way above indicated. The automatic controller not only controls the air brake compressor, but is applicable to various forms of motor and power control, such as in electric and other elevator practice, hydraulic and other pumping, handling cranes, bridges, etc. It may be used in all places where it is desirable to start or stop motors which, without its aid, would be well nigh inaccessible. For example, a freight or passenger elevator may be operated from any one of several landings by touching a button, once for starting and a second time for stopping. The controller occupies a space of 9 ins. × 10 ins. × 14 ins. and is furnished with lock and key, to be retained by the proper custodian, so tampering may be prevented.

This newest type of apparatus makes it possible for the Standard Air-Brake Company, to equip any car, locomotive or train with its air-brakes. It is especially valuable on narrow gauge roads on which high speeds are maintained and where the car motors leave no room on axles for air compressors.

CONTROLLER HANDLE.



AUTOMATIC CONTROLLER.

Meeting of the National Association of Manufacturers.

The executive committee of the National Association of Manufacturers met in Philadelphia on Dec. 18. Their proceedings were preparatory to the annual convention which will occur in Philadelphia. on Jan. 26, 27 and 28, 1897. The convention will be held in the new Horticultural Hall, which will provide ample accommodation for a large assembly.

Another important matter dealt with by the executive committee, was the adoption of the following resolutions:

"RESOLVED: That it is the sense of this executive committee that the tariff laws should be revised at the earliest possible moment, in order that uncertainty be removed, confidence restored and business permitted to revive.

"That rates of duties should be made as low as possible, consistent with the fair protection of our industries and the labor they employ."

During the convention a number of interesting addresses will be delivered by men of high standing.

THE Greenbush & Nassau Railway & Power Company (Nassau, N. Y.) has been incorporated with the following officers: president, W. H. Nichols, of Greenbush; vice-president, Thomas E. James, of Nassau; secretary, S. C. Curran, of East Greenbush; treasurer, Fred Carr, of Greenbush; general manager, John F. Lape, of Greenbush; executive committee, John F. Lape, W. D. Barnes and Thomas E. James. The company will build an electric railway from Greenbush to Brainards, a distance of seventeen miles.

A New Departure in the Ground Return.

BY H. S. NEWTON.

There are three ways to establish a first class ground return. One is to electrically weld the ends of the rails together, another is to electrically weld the bonds to the rail, a third just as efficient, a great deal more practicable and twenty times as cheap as the last is to solder the bonds tight to the rail.

This plan has been adopted on construction in Syracuse, N.Y., during the past year and has been in every sense an unqualified success. So far as I know it is the first attempt toward absolutely homogeneous metal throughout the length of the rail which has proven its claims, outside of the welding processes mentioned above. A peculiar notion seems to have prevailed among mechanics and engineers that it was impossible to solder small pieces of metal to a large mass like a rail without raising the temperature of the latter to that of the melted solder. Experience with the soldered bond has proven this to be a myth. A liberal use of soldering salts and a moment's steady use of the gasoline torch has never failed to make a joint which only the disrupting of the solder itself could loosen from its seat.

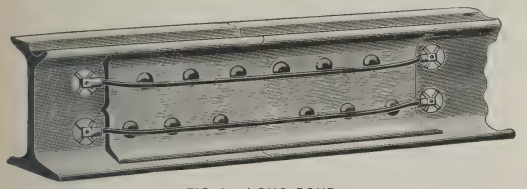


FIG. 1.—LONG BOND.

The bond employed has been used in two forms, one placed around the fishplates, and in plain sight whencver the track is taken up for repairs, the other under the fishplates out of sight and out of the way. The former has the advantage of being easy to inspect while the latter is much the cheaper, is a better conductor because it makes a shorter path between the rails and is doubly secured by the fishplate bolts which go through the holes in the bond and reinforce the solder in holding it in place.

The long bond, which is used around the plates, consists of a single No. 0000 wire 40 ins. in length and tipped at each end with the bond contact plates. (See Fig. 1.)

These plates are made a part of the wire and their contact surfaces are ground down true on a surface grinder. They are then cleaned with soldering salts and dipped in melted solder, the superflous metal being allowed to run down and settle on the surface where the plate meets the steel of rail.

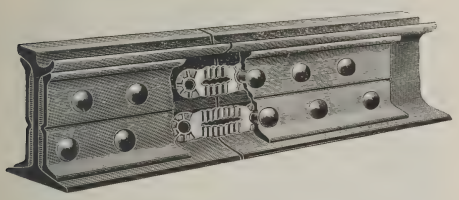


FIG. 2.—SHORT BOND.

When the operation of putting on the bond is undertaken the space around the bond holes in the web of the rail (these holes having been punched at the rail mills) is faced off with a facer, the clean metal is treated with some soldering salts and the bond bolted in place. This is done by inserting an ordinary machine bolt with a lock washer through the hole in each contact plate and the hole in the rail and by tightening up the nut on this bolt until the washer is flattened out.

The final and most important operation, the soldering process, is accomplished by the application of heat from a gasoline torch similar to that used by brazers. The heat from this is directed on each end of the bond for a space of about a minute. The first noticeable effect of the heat is the melting of the solder on the surface of the bond plate. This is accompanied by a springing action on the part of the lock washer which draws the bond plate into closer contact with the rail and squeezes the superfluous solder out around the edges. The torch is held against it a few seconds longer to insure the solder taking hold of the rail and the operation is completed.

The short or under the fish plate bond, which is to be particularly recommended for straight line work, is applied to the rail in the same general way. (See Fig. 2.) Instead of additional holes punched or drilled in the rail however, the holes for fishplate bolts are used. As the bonds must be put in place before the fishplates are adjusted and as the holes in the bond must be occupied by the fishplate boltswhen they are in place another method is employed for holding the bond in position during the soldering process. This is effected by a clamping device (Fig. 3) with a cam arrangement for tightening the bond contact which has proven to be cheap (consisting of two comparatively rough castings), and of a nature to reduce the labor item to a minimum. In actual service several dozens of these tools are used and taken off the bonds from time to time during the day after they have cooled off.

One of the characteristics of this method of connecting the rails which has proven particularly gratifying is the condition of permanency which the bond insures. The bond will tear in two before the solder will loosen. It is possible also on nine inch girder work to put on four bonds having each the capacity of No. 0000 copper wire under a pair of fishplates connecting one joint. Where one line of fishplate holes is used, as on a seven inch rail, only two can be used, but they may be of any capacity desired. These bonds are there for all time. The contact surfaces are designed to be ten times the cross section of the bond itself. This makes the resistance at the joint less than that of the bond section. The labor of putting on the bond is much lsss than on any bond which we have tried before. On the common type, that used under the plate, there is nothing to do but face off around the holes, clamp on the bond and apply the heat. On the special work type, the hole should be punched at the rail factory when the same operation is gone through with, except that a bolt is inserted instead of the clamp, and a nut with a lock washer screwed on. The whole operation may be done for an average of ten cents a joint, which, I think, will compare favorably with any work which has hitherto been done.

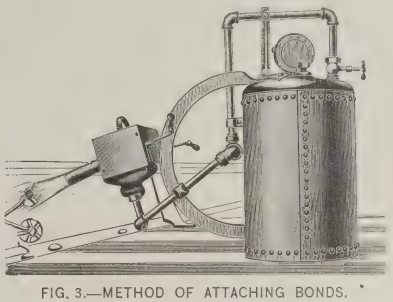


FIG. 3.—METHOD OF ATTACHING BONDS.

As for inspection, the short bonds show for themselves. The moment the clamps are taken off a poor joint will open up on pushing the rail with the foot. A moment's work with a wrench and a few blows with a hammer will develop any weakness in a long bond. As a matter of fact our inspection showed about one bad joint in a hundred bonds as an average for the season, and then the result could always be attributed to poor facing of the rail. Unless the rail is properly faced the solder absolutely refuses to take hold, a circumstance which we have found a perfect safeguard against carelessness on the part of our own labor and which would be of still more benefit as a protection against the contractor.

Looking at it from every standpoint the soldered bond in Syracuse has proven a success. The overhead rail feeds which it has been considered necessary to leave as supplementary ground returns have been converted into trolley feeds instead, wherever the new system of bonding has been put in force. The results are shown in better lights, hence better power and an entire absence of all evils resulting from poor bonds.

Important Move of a Well Known English Manufacturing Company.

Messrs. Dick, Kerr & Company, Ltd., of London, England, engineers and builders of cable railway plants, have just established an electrical department, and will hereafter make contracts to build and equip electric railways complete. This is a most important move on the part of this company, whose high reputation as engineers and manufacturers has given it a leading position among European railway contractors. The company has taken this step in view of the prospect of the early adoption of electric power by railway and tramway companies throughout the world, and it is easy to predict the same high grade of work which has always marked the engineering work of this company will be characteristic of its electric installations.

The managers of the company have selected as the head of their electrical department W. Rutherford, formerly chief engineer of the Canadian General Electric Company, Ltd. Mr. Rutherford, who is fully conversant with American practice in electric railway construction, is now in this country for the purpose of visiting American manufacturers of electrical machinery, and for making preliminary arrangements for the new work abroad.

Armature Construction at the Walker Works.

The armature of a railway generator or motor may be described as the heart of the machine. It is the only moving part and upon it comes not only all of the mechanical wear, with the exception of that on the brushes, but also the electrical stresses and strains. Good armature construction is the Ultima Thule of railway apparatus, and

FIG. 1.—MODEL FOR 1200 K. W. ARMATURE SPIDER.

upon the quality of this portion of the equipment depends probably more than upon any other factor the successful mechanical operation of an electric railway.

The advance made in armature construction during the last three or four years has been enormous both in electrical efficiency and in mechanical improvements to protect the motor against outside injuries and facilitate repairs. In this line the Walker Company, has occupied a leading position, the engineers of the company realizing the importance which correct armature construction occupies in electric railway work. The care with which every detail of armature construction has been worked out is striking and much in-

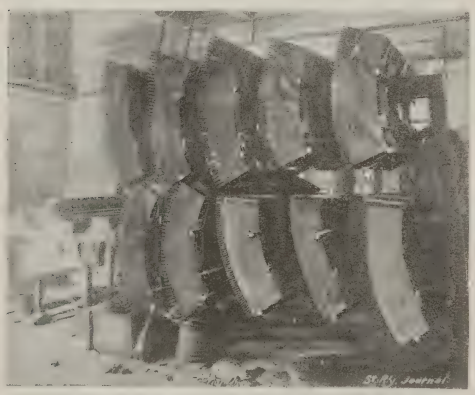


FIG. 2.—DRYING THE DISK SEGMENTS.

genuity has been displayed in improvements on this one department of manufacture of railway apparatus. A description of the general features of manufacture was published in the October issue of the Street Railway Journal, but some of the details of the armature manufacture were not then discussed.

The employment in the generator armature construction by the Walker Company of a spider with solid hub is well understood, the principal advantage claimed for this form of construction over the former split hub construction being the eliminating of all danger of shrinkage strains. At the rim of the spider armatures are dovetailed slots into which fit corresponding projections on the soft iron laminated segments. The form of the armature spider is very clearly shown in Fig. 1, which illustrates the wooden model used in casting the spiders for the 1200 k. w. generators of the Walker Company. The size of this spider is shown by the man standing near it. The segments are made in two punchings. The first stamps out the entire segment, with the exception of the teeth for the armature coils; the

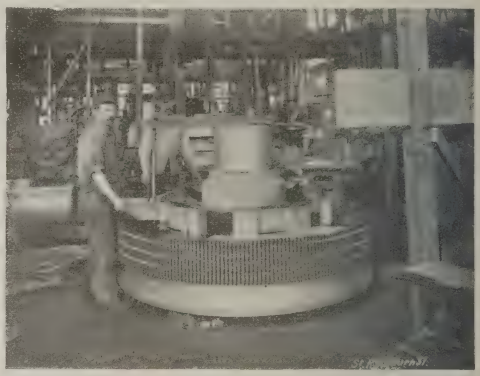


FIG. 5.—ASSEMBLING THE GENERATOR DISK SEGMENTS ON SPIDER.

second stamps the teeth, four at a time. The number of segments to make a complete circle varies with the size of the machine, but when assembled on the spider arms the segments break joints to give greater mechanical stability. To provide against eddy currents, every other layer is coated with shellac or other magnetic insulator before being placed in position on the spider. This process is accomplished by a special machine, shown at the left of Fig. 2, and the segments are then hung on racks to dry, as shown in that engraving. The method of assembling the segments on the spider is illustrated in Fig. 3. In this the spaces left in the laminated ring for ventilating purposes are clearly shown. The armature, after

FIG. 4.—BUILDING A MOTOR ARMATURE CORE.

receiving the end plate, is then placed in a hydraulic press, and the ring is bolted up tight. It is then ready for winding.

The method of motor armature construction is very similar to that described for the building of armatures for generators, except in such particulars as the smaller size of the armature and its drum form compel different methods. The laminations, for instance, are not in segments, but are complete disks which are cut with a keyway to fit a key on the armature shaft, and are then slipped over the end of the armature shaft, as shown in Fig. 4. These disks

are 018. in. thick. The appearance of an armature in the hydraulic press is illustrated in Fig. 5. The bolts which hold the core in place are fitted with nuts and lockwashers. The end disks upon the motor armature are saucer shaped, however, to prevent any stray oil from the bearings when the motor is in operation from being

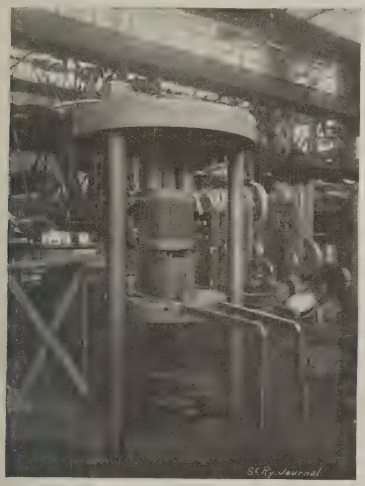


FIG. 5.—ARMATURE CORE IN HYDRAULIC PRESS.

thrown on to the winding. This is an important point, as experience has shown that the insulation of the armature coils rapidly deteriorates when precautions of this kind are not taken.

The commutator for both motor and generator armatures are drop forgings and well insulated from the commutator sleeves by micanite rings. The insulating segments are cut out of No. 1 amber mica. The copper and mica segments are then set up by hand in a ring in the usual way and then tightened up. The inner ring is split and can produce with the set-screws a pressure on the assembled commutator of several tons per square inch. After the commutator has become set in shape it is tooled off, set on the shaft, and the insulation resistance between each bar is tested with a 5000 volt alternating current. The attachment of the commutator to

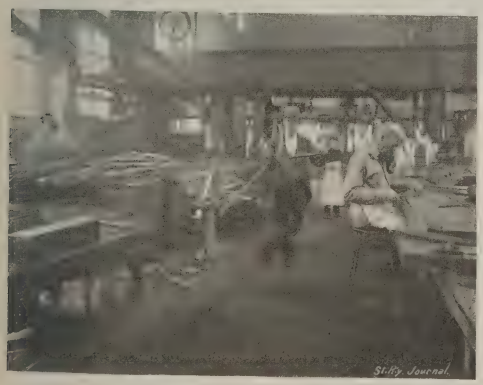


FIG 6.—RIBBON BENDING MACHINE.

the shaft is independent of the attachment of the armature core so that it can be readily removed for renewal or repairs if desired.

The armature is now ready for winding. The general system of ring winding employed by the Walker Company has been described in the STREET RAILWAY JOURNAL. As will be remembered, for the generators and large sizes of motors, round wires are not employed, but the conductors instead are formed from flat ribbons of copper which are bent to proper shape and insulated. The windings are entirely independent of each other and are shaped and insulated before being placed in position. They are then slipped on the armature and can be as easily removed should it be at any time desirable to take one off for renewal purposes. The machine for bending the coils in shape is illustrated in Fig. 6. It is exceedingly ingenious in construction and enables a sharp turn to be made horizontally in a flat strip without cracking the copper at the joint. The inventor of the machine, Mr. Elliott, who is superintendent of the winding department, is operating the machine.

The method of connecting the commutator bars with the coils

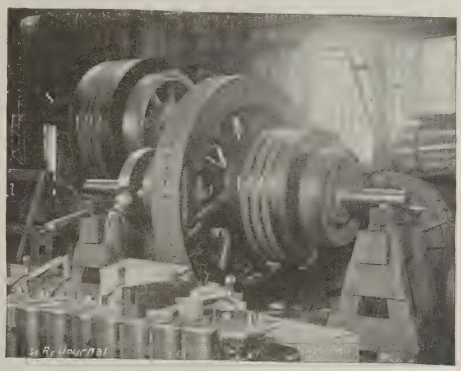


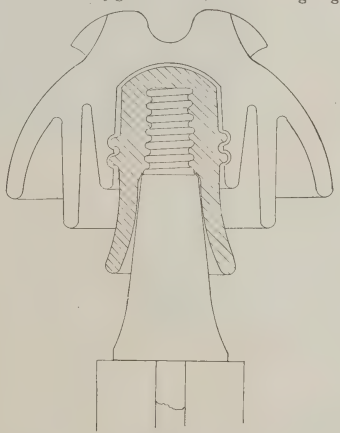
FIG. 7.—400 K. W. ARMATURE IN HYDRAULIC PRESS.

in the generators is by flexible leads made of tinned copper soldered and riveted together. In the motor coils these leads are not considered necessary, and the terminals of the coils are brought down to the bars and soldered in place.

The final engraving (Fig. 7) illustrates a completed generator armature of the 400 k. w. 200 r. p. m. type with flywheel in the hydraulic press. The larger armature immediately behind the one in the foreground of this engraving is of the 800 k. w., 80 r. p. m. type.

New Insulators for High Voltage Lines.

A new insulator which is herewith illustrated has just been brought out by Fred. M. Locke. It is made of porcelain with separate center insulating attachment, which may be made of either glass or porcelain. Its construction is both mechanically and electrically strong throughout, suitable for carrying high potential currents, having shown remarkably good results in transmitting large currents



HIGH VOLTAGE INSULATOR.

for long distances at a pressure of 15,000 volts. At a recent test these insulators on Mr. Locke's steel pins carried 70,000 volts for four hours, without heating, arcing or breaking down, which is an unusually good record. This test showed conclusively that this combination of glass and porcelain offers a very high resistance to puncture and surface leakage.

These insulators have over twelve inches of surface between the wire contact and the supporting pin. About ten inches of this surface is on the under side of the insulators out of reach of direct rainfall, where it keeps comparatively dry. The surfaces of the bottom of the insulators are perpendicular and therefore catch no foreign matter. Locke's patent steel insulating pin, the top of which is made of locust wood boiled in paraffine, is designed to be used with these insulators.

Electric Locomotive in New Haven.

The use of the electric locomotive for switching purposes in steam freight railroad yards is likely to receive a marked impetus by the fact that one is now employed in connection with the New York, New Haven & Hartford Railroad, at New Haven, Conn. It is in constant service switching freight cars between the main line of that road and a number of factories located along the river front.

The line over which this locomotive operates is about two miles long and is the property of several large manufacturers.—The Bigelow Company, manufacturers of boilers, The National Pipe Bending Company, The Quinnipiac Brewing Company, The New Haven Rolling Mills and others. It starts at the tracks of the New York, New Haven & Hartford Railroad, at Cedar Hill Junction, which is located about one mile from the New Haven passenger depot, and follows a devious course, throwing off sidings at each of the different factories. The track is of regular steam railroad type with heavy steel rails well ballasted and provided with switches and turnouts. In addition to the curves there is a 2½ per cent grade against the load both ways on each side of Grand Avenue.

The practice followed by the manufacturers hitherto in switching their cars has been for the freight engines of the New York, New Haven & Hartford Railroad to drop the cars at the junction and from here they were hauled to the different factories by horses. This method was so slow, with the several curves and grades and so hard upon the horses, that the manufacturers were driven to the conclusion that some other method of traction must be employed. Steam traction was rejected, for the excellent reason that the line runs for some distance along a frequented thoroughfare where a switching steam engine would be a dangerous adjunct. That the steam locomotive would also be standing idle under steam for a large part of the day, and consuming coal uselessly was also a weighty consideration.

Electric traction was finally adopted as presenting many economical and other advantages, and an order was placed with the General Electric Company for a thirty ton locomotive, which the company could guarantee would haul two loaded freight cars up a 2½ per cent grade at a speed of seven miles an hour.

THIRTY TON LOCOMOTIVE AT NEW HAVEN, CONN.

The locomotive was delivered at New Haven on Dec. 8 and on Dec. 11 was put into actual operation, without preliminary tests on the line. Since that date it has been handling the entire movement of the cars between the factories and the junction.

On receipt of the locomotive, the purchasers painted upon the cab the words "Manufacturers' R. R. No. 1", and after two weeks' experience are extremely proud of their new acquisition.

The dimensions of the locomotive as it stands are as follows:

Weight	58,000 lbs.
Drawbar pull	7,000 "
Length over drawbars	16 ft. 6 ins.
Height over all	11 " 6 "
Width over all	8 " 3 "
Wheel base	5 " 6 "
Diameter of drivers	44 "
Number of drivers (with cast iron centers and steel tires.)	4
Size of journals	5½ ins. × 8 ins.
Gauge	4 ft. 8½ ins.
Voltage	500
Amperes, full speed and normal drawbar pull	600
Amperes, half speed and normal drawbar pull	300

The motors are two in number, each axle being provided with its own motor. The motors are gearless and are supported upon a system of spiral springs resting on the side frames of the locomotive truck. The suspension being entirely upon springs the wheels are free to adjust themselves to the irregularities of the roadbed and the wear on both tracks and motors is thus consequently diminished.

In the armatures the iron clad type of construction has been followed, that is, the windings are placed in a mica lined slot cut in the surface of the laminated core. The armature and commutator are wound upon a sleeve through which the axles pass. The sleeve rests in bearings on the motor frame. Two projecting arms from the sleeve fit into the openings in an iron plate, loose upon the axle and similar projections from the other side so that as the armature revolves the wheels are naturally revolved also. This coupling being flexible allows perfect freedom of motion. The commutators are of substantial construction and each motor has four sets of brushes.

The truck is constructed of I beams and forms the foundation for a locomotive cab of sheet iron with sloping shields at each end. It has two hinged doors, one on each side, and sliding windows at the sides, the front ones being stationary. As there are windows on all sides the motorman has a view in all directions. The interior of the cab is a large room finished in cherry and contains the rest of the electrical equipment—automatic circuit breaker, controller, lightning arrester, reversing switch, air pump, air gauge, etc.

The controller is of the L 2 series-parallel type, arranged for the control of two motors. It is of the same general type as the K 2 with which we are so familiar in ordinary street car practice, and is provided with a separate reversing switch and the magnetic blowout. The resistances are set beneath the shields and are of the packed ribbon type.

The automatic circuit breaker is of 500 amperes capacity and involves also the magnetic blow-out principle, as does the lightning arrester, which is set upon the floor of the cab behind the controllers. In the front of the cab and above the controller is a circular dial amperemeter reading to 500 amperes, and facing the motorman is the air pressure gauge. On the other side of the cab, opposite the controller, is set an oscillating cylinder air pump, driven by a motor. This furnishes air to two air tanks suspended beneath the cab and is automatic in its action.

The air pressure pump is controlled automatically by a pneumatic governor, consisting of a cylinder containing a piston working against a spring. The action of this automatic control is as follows: a pipe running from the main reservoir enters the cylinder below the piston. As the pressure rises the piston is forced upwards against a spring. The other end of the piston rod carries the contacts through which the pump motor circuit is made and broken. When the pressure falls below that at which the automatic control is set the spring forces the piston down and the circuit is broken. Any arcs that may be formed when the contact is broken are blown out in the magnetic field. The locomotive is provided with a chime whistle blown by compressed air and a railroad headlight is set upon each shield. Beneath each one of the shields and motor is an iron sand box, with a pneumatic feeding device.

Electricity for this locomotive is furnished from the Fair Haven & Westville power house, which stands on Grand Avenue, about the middle of the line, and the current is taken by trolley from an overhead wire suspended from brackets. The operation of the locomotive is marked by extreme smoothness, and without load it can be run at almost any speed and with load starts without jerk of any kind. It responds immediately to the motion of the controlling lever, and can be backed up to a freight car for coupling as gently as the movement of a hand. One of the difficult duties it has to perform is the kicking of the freight cars over the curves in the New

Haven Rolling Mill, in which there is one with a radius of only fifty feet. The locomotive can handle seven heavily loaded cars around this curve as easily apparently as it can two. The operation of the locomotive is already attracting considerable attention from railroad engineers, several of whom have already visited the scene of its operation. In order to show one of these engineers what the locomotive would do, six loaded cars were hauled up the steepest grade with the slack all out, the start being made on a grade of about one per cent. 150 amperes only were required to start this heavy train and it moved off very smoothly and gradually.

Car Heater.

In the September, 1896, number of the STREET RAILWAY JOURNAL, was published an illustration of the 33 in., or smaller size electric car heater manufactured by the H. W. Johns Manufacturing Company. This company also manufactures a larger size of electric car panel heater, which was illustrated in the November, 1896, number of the STREET RAILWAY JOURNAL. This size is 50 ins. long, 9 ins. wide and ⅞ in. thick.

Essentially, the heater is composed of an asbestos covered and insulated resistance wire woven into a mat or cloth, which is attached to an asbestos mill board back. The mat and backing are thoroughly impregnated with an insulating varnish, which is baked at a high temperature, so that the heater is practically impervious to moisture. The resistance wire does not come in contact with the air, and hence is free from deterioration which might result from atmospheric influences. The wires cannot come in contact with each other, owing to the asbestos which separates and most effectually insulates them from each other. As all the wires are held securely in place there can be no danger from short circuiting, crystallization and breaking of the wire from vibration or oxidation, so that the heater may be considered as having a most durable, safe and reliable construction. The completed heater is enclosed in a stamped steel casing which is ornamental in appearance and unobtrusive when in position on the panels below the seats of the car.

In the "H. W. J." system of car heating, it is the intention to install as many heaters in a car as the available space will permit, instead of utilizing from four to six heaters, working at high temperatures to produce the heat necessary to warm a car. The heating surface is made as large as possible, so that the temperature of the individual heaters is comparatively low and safe from the danger of burning dresses or causing discomfort to passengers. The heat given off is distributed equally throughout the car. The wires being enclosed in practically airtight envelopes are not subject to sudden fluctuations due to the frequent changes of temperature occuring from draughts from the open doors, so that a car is more evenly and satisfactorily heated when in service.

The H. W. Johns Manufacturing Company also manufactures a heater for use in cars having cross seats or in situations requiring an upright heater. The heating mat or electrotherm is in this heater similar in construction to that in the panel heater. The heater is enclosed in a substantial and ornamental cast iron casing, japanned, bronzed or enameled, as desired, 18 ins. long, 10½ ins. high and 2¼ ins. thick.

HEATER MAT.

The "H. W. J." heaters are designed for three degrees of regulation controlled by a simple and substantial knife switch, with positive and quick break which is automatically self locking, so that there is no danger of short circuits or errors in throwing on the separate combinations. When the switch is in use, the current passes through all the heaters, instead of through only a few of the heaters as in other systems of regulation.

The heating mat or electrotherm is divided into two sections. The first position of the switch throws in the top sections in all of the heaters, the second position cuts out the top sections and throws in the lower sections in all the heaters, and the third position throws in the top and bottom sections in multiple. These heaters are in use on a large number of roads.

THE power station of the Janesville StreetRailway Company, Janesville, Wis., caught fire from the generator on Dec. 23, and the building and machinery were totally destroyed. Loss, $15,000, and insurance $5000.

NEWSPAPER reports state that the stockholders and directors of the Los Angelos Terminal Railway, Los Angelos, Cal., have decided to equip their Glendale division with electricity. The road extends from Los Angeles to Verdugo Park, a distance of thirty-seven miles. S. B. Hynes, Los Angeles, Cal., is general manager of the road.

Roller Bearings for Street Cars.

While expensive devices to save a small per cent of the amount of coal burned or the steam consumed in a power station are being purchased and installed, and while much thought is being paid to the best arrangement of feeders by which the power lost in transmission shall be kept down to a minimum, but little attention has been paid by street railway managers to reducing the waste power at the final point where all the force is applied, i.e., at the car journal box. While ball bearings or roller bearings have been applied to many kinds of machinery with very satisfactory results, but little has been done in a practical way in applying it to the conditions of street railway service.

This may be in large part due to the fact that several early attempts to apply roller bearings to street car conditions were far from successful, and in this way a prejudice was created in the minds of many managers against all kinds of roller bearings. Again, the newness of all electric railway apparatus has forced upon street railway managers so many important problems that those which have not required immediate attention, like the bearing question, have been overlooked until more weighty problems could be solved. The fact that railway apparatus has now reached a stage when it is gradually becoming standardized has resulted in the giving of more attention to those small details in which a saving can be made. The introduction of roller bearings into street railway equipment will therefore attract more attention now than would have been possible a year or two ago.

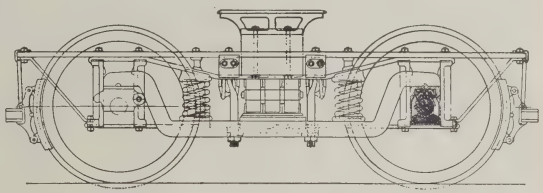


FIG. 1.—TRUCK WITH ROLLER BEARING.

The bearing illustrated herewith is made by the Mossberg & Granville Manufacturing Company, and differs in a number of particulars from any previously put on the market. The rolls, which are of hard steel, are held in a cage as shown and are thus kept in their proper positions around the circumference of the axle. The size of the bearing is such that the same boxes can be used on the truck as with the ordinary Babbitt journal, no change being required.

A set of these bearings was installed some fifteen months since on an open car of the Interstate Consolidated Street Railway Company running between Pawtucket and Attleboro, and has been in constant use since. A letter received from one of the members of the executive committe of that road says that he has no hesitation in stating that this car was run with fully fifty per cent saving in power over the regular equipment. In recent testimony given by the Brown & Sharpe Manufacturing Company relative to the saving of power on rolling mills by this bearing, the company claims that ninety per cent has been saved them by using this bearing. The bearings will stand on rolling mill work 20,000 lbs. pressure per square inch to the projected area of the journal.

Equally satisfactory results have been secured in other machinery, and tests have been made on these bearings at speeds from fifty r. p. m. to 10,000 r. p. m., and in pressure upon bearings of varying diameters from a few pounds to 150 tons.

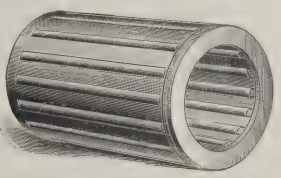


FIG. 2.—ROLLER BEARING.

The bearings were first applied to the ordinary form of rolling mill, their application doing away entirely with all heating of the journals and making it possible to run the mill at double the former speed and with a saving of from fifty to seventy per cent of the power. These mills have been run continuously for the past five years. Concerns such as the Browne & Sharpe Manufacturing Company, the Carnegie Steel Company, the Gorham Manufacturing Company, the Mergenthaler Linotype Company, the Washburn & Moen Manufacturing Company, and many other of the leading manufacturers of the country have given testimony after several months, in some cases years of use of the efficiency of the bearing.

The high speed work was tested by the Hotchkiss Company on the Howell tornado, on which the bearing was run at a speed of 10,000 r. p. m., the test being made in the following manner: a 130 lb. steel flywheel, forty inches in diameter, run upon one of the Mossberg roller bearings, was revolved at a speed of 10,000 r. p. m. for ten minutes, and the clutch mechanism was adapted in such a manner as to release the wheel while running at this speed. Upon the wheel clutch being released, the wheel continued to revolve

under different experiments that were made for a time varying from fifty-two minutes and ten seconds up to one hour, thirty-three minutes and forty seconds before coming to rest.

The following are the results of a test recently made of a truck equipped with two G. E. 800 motors and roller bearings of the Mossberg type. One motor was supplied with the ordinary bearings in general use, and the second motor was equipped with roller bearings of the Mossberg pattern. The axle with which the pinion of this motor was engaged was also fitted with rollers bearings of same pattern. The truck was suspended so that the flanges of the wheels cleared the floor, and load was applied by means of a brake consisting of a thirteen foot lever with a fulcrum one foot from end giving a ratio of twelve to one. The lever was arranged to distribute load equally on all bearings.

The motors in the test are designated No. 1 and No. 2, the latter being the one fitted with roller bearings.

TEST A.

Load	3660 lbs.
Power required to start motors by pulling at tangent to radius of wheels on track (radius 16½ ins.)	
No. 1 motor	240 lbs.
No. 2 motor	18.5 lbs.

CAR AT CLEVELAND WITH SLIDING CONTACT TROLLEY.

TEST B.

ELECTRIC POWER TEST.

No. 1 MOTOR:

Duration of test	2 mins.
Watt hours absorbed	198
Distance covered	0.636 mile
Watt hours per mile	291
Time per mile	3 mins. 14 secs.
Miles per minute	0.318
Load	4200 lbs.
Length of time in motion after power shut off	12 secs.

No. 2 MOTOR:

Duration of test	2 mins.
Watt hours absorbed	112.6
Distance covered	1 mile
Watt hours per mile	112.6
Time per mile	2 mins.
Miles per minute	1.2
Load	4200 lbs.
Length of time in motion after power shut off	1 min. 42 secs.

The figures given in test "B" are the average of several trials, the conditions being identical with either motors, except bearings.

New Trolley.

In the accompanying illustration is shown a car now running on the Willson Avenue line of the Cleveland Electric Railway, equipped with the new Walker roller trolley. This trolley was described and illustrated in the August, 1896, issue of the STREET RAILWAY JOURNAL, but is shown herewith in actual practice for the first time.

The trolley head consists essentially of a roller 3 5¾ ins. long and 1½ ins. in diameter. This roller is made of seamless drawn steel tubing, case hardened and sheathed with a suitable coating of metal to make the best contact with the trolley wire. The ordinary trolley pole is used. The trolley has no lateral motion whatever and therefore it is impossible for the roller to leave the wire.

Invisible Weather Strips.

Weather strips for car windows not only add to the comfort of passengers, but are a very valuable adjunct to the heating system of a street car, as they prevent a great deal of cold from entering the car, and striking immediately upon the backs of the passengers.

May's invisible weather strips have been in use for a number of years for this purpose, and seem to be giving entire satisfaction. These strips consist of a parting bead with a strip of coated felt on both sides, also a strip of coated felt between the meeting rail and on the under side of the bottom rail and when necessary across the top rail of the upper sash. The felting is first coated with a preparation that is perfectly water and weather proof and is then fastened to the sashes and parting bead with a cement of similar composition, thus rendering the strip soft and pliable and not liable to crack or peel. In addition to rendering the car weatherproof these strips are designed to keep dust from entering the car, thus adding to the comfort of the passengers, and also reducing the expenses of caring for the furnishings of the car. These strips in addition for use in street railway cars, are designed for steam railway cars, houses, hotels, etc. These strips are sold by the Young Lock Nut Company, which acts as special agent for the manufacturers.

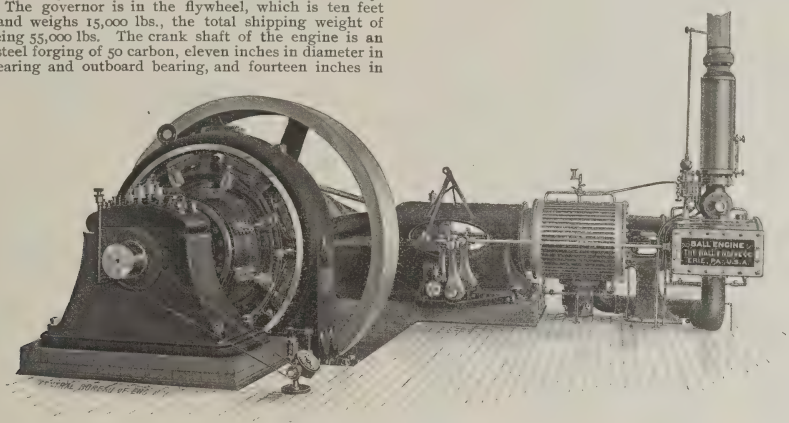
Wire for Electric Circuits.

Of first and most important consideration in the equipment of an electric light, telephone or telegraph line, or an electric railway, is the wire which must be used. All the copper wire should be of the highest conductivity, and stranded conductors should be compact. Where insulated wire or cables are used the insulating material should be carefully prepared and applied. Copper covered wire well braided, for light circuits in building, or lead covered for underground service are thought to be safest and most efficient. The Washburn & Moen Manufacturing Company is a large manufacturer of all the material required to make the best and safest electrical circuits. This company also makes span wire, signal strands, guy and guard wire of every description. It also controls the manufacture of the Chicago rail bond. This bond is in use on a number of roads and great electrical efficiency and mechanical simplicity are claimed for it.

New Compound Engine.

The accompanying engraving illustrates a new tandem compound condensing engine recently built by the Ball Engine Company, of Erie, Pa. Three of these have been installed in the great steel works of the Apollo Iron & Steel Company, at Vandergrift, Pa.

The engine shown is rated by the manufacturers at 300 h. p. at 180 revolutions. The diameter of the high pressure cylinder, sixteen inches; low pressure, twenty-eight inches; stroke, twenty-two inches. The governor is in the flywheel, which is ten feet in diameter and weighs 15,000 lbs., the total shipping weight of the engine being 55,000 lbs. The crank shaft of the engine is an open hearth steel forging of 50 carbon, eleven inches in diameter in the engine bearing and outboard bearing, and fourteen inches in diameter in the dynamo fit. The journal boxes are made up of bottom, top and quarter boxes, lined with removable babbitt metal shells, and with adjustments for all directions, so that the shaft may always be kept in alignment. The piston rods are made of hard crucible steel, and the attachment to the head is in the most perfect manner. The cylinders are made of a special mixture of hard, close grained charcoal iron, accurately bored to size, both cylinders and heads being made perfectly tight by ground joints. An asbestos covering surrounding the cylinder protects against heat radiation, and a handsome nickel plated jacket covering this leaves a dead air space between.



TANDEM COMPOUND BALL ENGINE.

The connecting rods and straps are forged from steel blooms. The adjustment of the boxes on both ends of the rod is by wedges operated by T-pointed set-screws placed in the top of the rod, which move the wedges up and down for adjustment, and as the movement of the wedges is in the same direction the length of the rod is not changed, nor is the position of the piston altered. These adjustments are made by hand and with a great degree of accuracy. Oil guards covering the crank disk prevent any throwing of oil.

Each engine is fitted with a Nordberg quick closing throttle valve. The engine is especially designed for heavy duty work, and has a very stout, heavy frame and large bearings and wearing surfaces. The valve operating mechanism permits of each valve being driven direct, the high pressure valve and its connections being upon one side and the low pressure valve and its connections upon the other side. This arrangement makes readily accessible the moving parts and avoids complexity.

An Extensive Foundry at Lorain, O.

The Lorain Foundry Company has been organized at Lorain, O., within the past year, and has recently completed there an extensive plant suitable for the manufacture of ingot moulds, rolls and heavy castings up to 75,000 lbs. A specialty will be made of castings for rolling mill and blast furnace work. The company is also well equipped for the economical production of general foundry work and machinery castings, and is prepared to engage largely in the manufacture of brake shoes and other repair castings for street railway use, also journal brasses, overhead trolley castings of copper, brass, bronze, etc.

The facilities which the company enjoys for this work are excellent. Pig iron, fuel and sand stockpiles are convenient of access with a minimum haul. The main building of the company's works is 154 ft. × 160 ft., and is of brick and iron throughout. The central bay has an entirely clear floor space of approximately 10,000 sq. ft. for casting operations and those incident to the moulding of the heavier class of castings. On one side of this bay, extending the full length of the building, thirty feet in width, is a floor space of nearly 5000 sq. ft. available for light moulding and castings. On the opposite side of the central bay are located two air furnaces at one end of the building, a cupola at the other, and the core ovens, four in number, between them. Room is also provided for additional core ovens when required and for a second cupola.

The officers of the Lorain Foundry Company are: president, Max M. Suppes; vice-president, F. A. Smythe; treasurer, W. F. Saltmarsh; superintendent, Hugh H. Davison. While the company is composed largely of the officials and employes of the Johnson Company, it is an entirely independent organization.

Revolving Chairs for Street Railway Cars.

The accompanying illustration shows the interior of a car equipped with Henry revolving chairs, for which a number of strong points are claimed. As will be seen these chairs have a central support and it is therefore much easier to keep a car clean than with seats that are fastened to the side of the car. It will also be seen that by this method of fastening, the seat is not subjected to the straining and movement of the side of the car when going over rough places or around curves. The sides of the car are not defaced in any way and the general appearance is that of a parlor car. This seat is adjusted to a car quite easily and cheaply.

CAR WITH REVOLVING CHAIRS.

This arrangement of the seats supplies as large a seating capacity as with the side seats, or the regular railway reversible seats, and gives each passenger a seat by himself; at the same time it pre-

vents the passenger from occupying more than his legitimate share of room. These chairs measure but 31 ins. from the side of the car to the outer edge of the aisle chair, thus giving an aisle 6 ins. wider than ordinarily; or, if it is desired, the chairs may be arranged to give the regular width of aisle, and the extra space can be used for more seating room. The chair is manufactured by the Wakefield Rattan Company.

New Designs in Overhead Material.

The Billings & Spencer Company is about to place upon the market several new designs in overhead material which will embody a number of improvements and unique features.

Fig. 1 represents a form of insulating stud recently designed by this company. The company has been unable to determine the tensile strength of the insulation on this form of stud, owing to the fact that in all tests which have been made, the threads were stripped from the studs at a strain of from 15,700 lbs. to 16,000 lbs. without the slightest injury to the insulation. It was found possible to force a plug down through the top of the stud under a crushing strain of 40,200 lbs. In these tests the stud was placed in a steel holder, reamed to fit the outside of the stud the same as in the hangers. The metal portion of the stud is drop forged steel of a shape to conform to the outside of the insulation, but ½ in. less in diameter, making ¼ in. of insulating material at all points. The studs are provided with a hexagon collar for convenience in inserting into the clips or ears. The insulation is "Colophite."

FIG. 1.—BOLT.

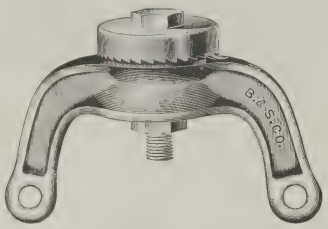


FIG. 4.—DOUBLE CURVE HANGER.

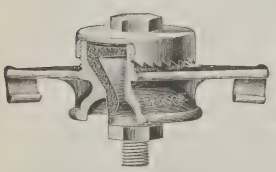


FIG. 2.—STRAIGHT LINE HANGER.

FIG. 3.—SINGLE CURVE HANGER.

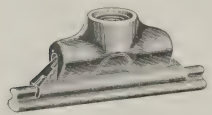


FIG. 5.—NEW CLIP.

Figs. 2, 3 and 4 represent respectively a straight line hanger, single curve hanger and double curve hanger. These devices are made either from aluminum bronze or galvanized malleable iron. The bodies are reamed to a perfect fit for the studs and being on a taper overcome any chance of moving and chafing the insulation.

Another new and unique feature of these hangers is a series of ratchet teeth on the lower side of the caps which engage with a spring phosphor bronze pawl, thus overcoming any possibility of the caps loosening, thereby allowing the stud to turn and disengage from the ear and let the line drop.

Fig. 5 represents a new clip for either figure 8 or round trolley wire and is especially desirable on account of its simplicity and strength.

Calendars for 1897.

A number of very attractive calendars have been brought out this month by manufacturers of street railway apparatus. Among the firms that have sent calendars to this office are Joel H. Woodman, manufacturer of veneer car linings, seatings, etc., The Ashton Valve Company, manufacturers of safety valves, and pressure and vacuum gages, Edw. P. Sharp, manufacturers' agent for mica, overhead material, etc., and L. K. Hirsch dealer in old railway material.

The Duluth (Minn.) Street Railway Company may extend its lines to Itasca.

Special Type of Street Railway Motor.

The accompanying illustrations show a special type of motor which the Walker Company has recently designed for the Upper Silesian Steam Railway which passes through the whole industrial

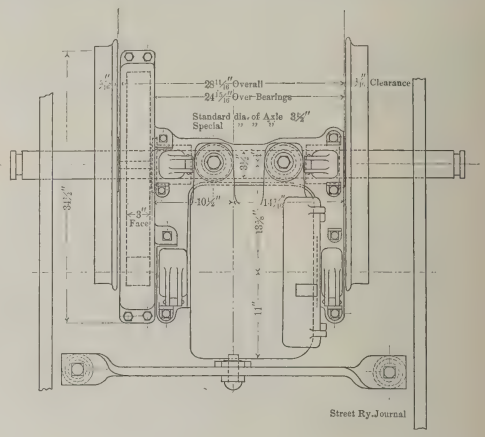


FIG. 1.—PLAN OF MOTOR

district of Upper Silesia, Germany. This company is equipping its entire line with electric locomotives in place of steam engines

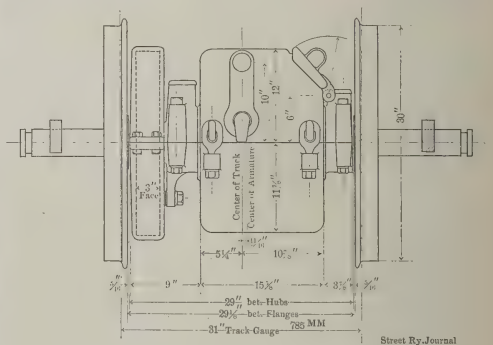


FIG. 2.—END ELEVATION.

which were formerly used. The Walker Company will furnish this road with 400 of these motors. Four motors will be used on each

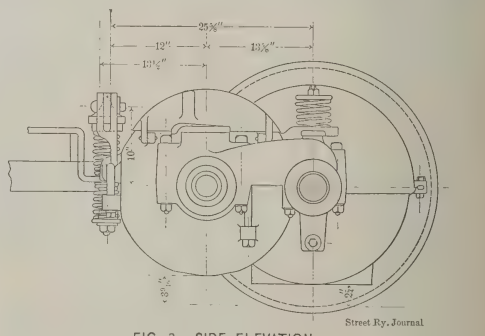


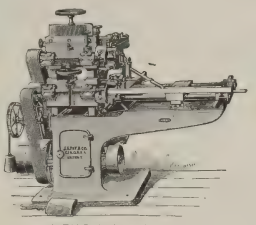
FIG. 3.—SIDE ELEVATION.

car, with a No. 4 motor controller at each end. The motors will make 315 r. p. m. when running five miles per hour and will be of eighteen to twenty horse power each.

As will be seen from the illustrations, the gauge of the road is unusually narrow, and this, of course, necessitated a specially designed motor of very narrow dimensions, the distance over bearings being but 24⅛ ins. and over all but 28 1/16 ins.

Door and Sash Tenoning Machine.

The door and sash tenoning machine of the J. A. Fay & Company is illustrated herewith. This machine is built upon a heavy column, and each end of the carriage is supported and runs on ways bolted upon an extension of the column. The arbors are of large diameter, lead ground, and run in self oiling bearings. The cutter heads, both upper and lower, are vertically adjustable by hand wheel and screw at the top to regulate the thickness of the lower shoulder of the tenons.



TENONING MACHINE.

The upper cutter head is independently adjustable to suit the thickness of the tenon, and has also an endwise adjustment to allow of making one shoulder longer than the other. The cope heads are attached to the cutter head gateways, and adjust simultaneously with them, besides having a separate vertical and cross adjustment.

The carriage is long, made of wrought pipes with end connections, and runs on broad ways. It is provided with extension rods and stops, wrenches, etc. The driving belt is at the end of the machine, and operated by an automatic, self-adjusting binding pulley which takes up the slack and secures a uniform speed to the heads.

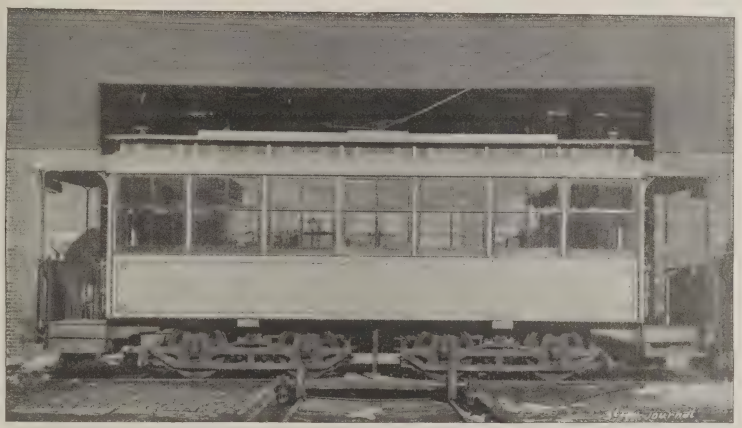
Peckham's Double Cushioned Swivel Truck.

The most important advance which the Peckham Motor Truck & Wheel Company has made during the year is embodied in the new double cushioned swivel truck which the company has recently put on the market. Until the advent of this new truck, Mr. Peckham confined his attention to the manufacture of single trucks only, but the demand created by the rapid growth of interurban lines, as well as the tendency to use long cars for city work, has induced the company to bring out a new truck especially adapted for this service. The truck has now been in use for some time on the Piedmort & Mountain View Railroad of Oakland, Cal., where grades as high as 14¼ per cent are encountered. Even in this severe service no difficulty has been found in operating thirty-five foot cars when loaded with one hundred or more passengers.

In the design of this truck Mr. Peckham has followed as closely as practicable the line of the steam railroad trucks used on the Empire State Express on the New York Central Railroad. The main feature of the truck is its great strength, simplicity of construction, easy riding, and its very powerful and efficient braking arrangement. As in the steam railroad trucks, half elliptic springs are used on the side frames. The center of gravity of the trucks is brought down as low as possible, so that cars with straight sides can be mounted in such a way that the car body is not more than 27½ ins. from the rail. The wheel base is kept down to five feet, but the space between the axles is kept so clear that there is no difficulty in mounting two motors on each truck. The brake levers are double compound acting on the outside of the wheel, and are so sensitive that they will respond to the slightest motion of the brake handle. For the side frames, the standard Peckham cantilever bridge truss form has been retained.

A special feature of the truck is the facility with which the motors can be reached. The car body can be jacked up with the bolster when the half elliptic springs are raised, thus giving full and free access to the motors.

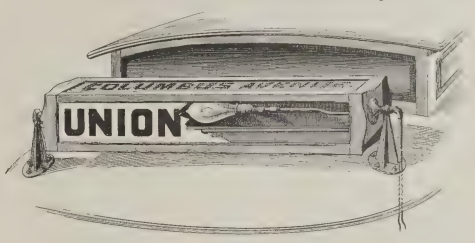
A number of these trucks have been put in service on different lines in the United States. Among these is the North Hudson County Railway, Hoboken, N. J., on whose line they are used under cars twenty-three feet long inside, with four foot platforms. One of these cars is shown in the accompanying illustration. They are old steam cars rebuilt and are intended for high speed service between the Weehawken Ferry and Coitsville, and sometimes attain a maximum speed of twenty-five miles per hour. Some of these cars are equipped with four G. E. 800 motors, while others are equipped with two G. E. 1200 motors. At times more than one hundred passengers are hauled. The trucks are giving excellent satisfaction for this service. No trouble is experienced in either going up or down the heavy grades which frequently occur on this line.



DOUBLE TRUCK CAR.—NO. HUDSON COUNTY RAILWAY, HOBOKEN.

Illuminated Rotatable Street Car Sign.

The accompanying illustration shows a perspective view of an illuminated sign for street cars. The sign is shown mounted in its normal position on the roof of an electric car. The sign as shown has four sides and a part of one side is broken away so as to show the method of illumination. An incandescent lamp is carried on the end of a hollow spindle and through the bearing at the end of the sign, connecting from here with the wiring system of the car. The framework of the sign is so constructed that any one of the glass or transparent sides can be brought to the front by rotating the sign. The spindle on which the lamp is carried is curved so that the lamp is held close to the back of the sign, thus giving more uniform distribution of the light. The sides containing the street or route names may be removed and replaced with others when the car is put in service on a different line.



ILLUMINATED SIGN.

The bearing at the left is of such a shape that the sign may be held firmly in any one of the number of positions, thus bringing to the front any desired sign.

The inventor and patentee of this sign is Chas. H. Bayley, who claims that his patent which bears date of July 29, 1890, is fundamental and covers the general principles embodied in all signs of this character.

THE citizens of Elmwood are circulating a petition to be given to the Holyoke Street Railway Company, Holyoke, Mass., requesting it to extend its lines a distance of 1½ miles from Elmwood.

THE Minneapolis & St. Louis Railroad Company, Minneapolis, Minn., is preparing to convert its road from Minneapolis to Lake Minnetonka into an electric line. Wm. Crooks, of Minneapolis, is chief engineer of the company.

STREET RAILWAY NEWS

Important Legal Decision in Cincinnati.

The opinion of Judge Rufus B. Smith, on the application of the Cincinnati Inclined Plane Railway Company for an extension of time in which to preserve its property rights from the effect of a judgment of dispossession recently affirmed by the Supreme Court of Ohio, and to enable it to continue the operation of its cars during the settlement of its present suit with the city, was delivered on Dec. 19 and was in favor of the company.

The original suit by the city was to recover car licenses alleged to be long past due and unpaid, and to oust the company from further operation on the ground that its franchises had expired for a part of the route, and as to the remainder of it, had been granted without authority of law. The finding of Judge Smith, the trial judge, was affirmed in all the higher courts and finally in the Supreme Court. After this certain non-resident stockholders sued in the Federal Court, and that tribunal, sustained by the Supreme Court of the United States, has taken the same view of the rights of the parties, with the exception that the grants of the right of way of the company on certain streets were held valid. These holdings were, however, of little avail to the company unless it could secure a general renewal upon such portions of its lines as were held to be invalid or expired. The road has been in the hands of a receiver, but a motion to discharge the receiver was agreed on Dec. 19, before Judge Taft.

During the pendency of the litigation in the United States Courts after the affirmation by the Supreme Court of Ohio, of the judgment of ouster by Judge Smith, the Board of Administration granted a franchise to another company over the streets occupied by the defendent company, and they feared that should the receiver be discharged, the latter company would at once take possession of the route. The application was therefore made to Judge Smith for a stay of the order of injunction under that clause of his decree which gave the Inclined Plane Company a stay of the order of injunction for six months, with liberty to apply for a further extension thereafter.

The decision of Judge Smith, which was a long one, went carefully into the history and merits of the litigation. After giving his decision in favor of the Inclined Plane Company, he made among other statements the following on the principles of the subject of the control of the street railway companies by cities:

"But even if plaintiff's objections were well taken, it would not follow necessarily that the application of the company should be denied. The public living upon the line of this road, and the general public who use the streets for travel, are entitled to consideration quite as much as the immediate parties to this action. To allow the city authorities in the middle of winter to tear up several miles of streets of this city would be to permit them to create what, in effect at least, would be an intolerable nuisance. If, however, some great public interest were to be subserved, of course, the public would be compelled to submit to this inconvenience and annoyance. But what is the public purpose to be subserved? The only purpose that would be subserved would be that of another street railway company, whose object is to abolish this line and crush out the life of this company." * * * "The present application is granted for the purpose of enabling the company to make a reasonable proposition to this city for a renewal or extension of its grant. I concede the right of the city to reject such an offer, even if reasonable, if it is the city's will so to act. But before I make an order which in effect wipes out this investment of three-quarters of a million dollars, I must be satisfied that such is the city's desire. Who is the city? Not this official or that official, or this board or that board. Officials stand merely as trustees of an express trust. The beneficiaries of the trust are the people, and when I become satisfied that it is the will of the people of this city that this thing shall be done, I shall, of course, submit my judgment to their will. Until I do I will not." * * * "The city has properly asserted and had determined the legal status of this company. But under the circumstances it should not insist upon the very letter of the bond. The pride and dignity of this city is, and should be, such that it cannot afford to deal with this road solely in the legal forum. The demands of the forum in conscience must be obeyed or the city's fair name will be irretrievably smirched."

Colorado Notes.

The Colorado Springs, Victor & Cripple Creek Railroad Company incorporated some time ago to operate an electric railway, has succeeded in placing its bonds in Boston, and work on the line will be pushed as rapidly as possible. The grading for the road for seventeen miles was done several years ago. The rails will be laid for this distance before the end of the present year. A corps of engineers will be put in the field soon to survey the line from the west end of the present old grade into Victor. Major Moore, one of the directors of the road, states that the road when completed will be thirty-one miles in length and gives the cost at $300,000. The bonds are six per cent semi-annual gold bonds. The route of the new line is via Crystal Park and Seven Lakes, and the right of way has all been secured. The directors expect to have trains running by July 1, 1897. The rails will be furnished by the Pueblo Steel Works and the cars by the Pullman Car Company and the St. Louis Car Company.

A street railway company has been organized at Colorado Springs which proposes to build a line through certain streets to be operated by gas motors. The capital is $125,000.

The Colorado Springs, Pike's Peak & Cripple Creek Railway Company has been incorporated with a capital stock of $500,000. The articles of incorporation, as filed, state that the company is organized for the purpose of constructing, maintaining and operating an electric road, telephone and telegraph lines between Colorado Springs, Pike's Peak and the Cripple Creek district, a distance of about thirty miles. The incorporators are Lisle Harris, N. M. Keith, C. B. Weeks, W. A. Stoose and H. E. Headley. The company is incorporated for a term of fifty years. The suburban passenger service, from the mining camps to Colorado Springs and Manitou and intermediate points will be made a special feature of the road's operation. This company is altogether another concern from the Colorado Springs, Victor & Cripple Creek Railroad, although its line of route lies somewhat in the same direction.

The first mile of the grade of the Golden Circle Electric Railway is now completed. The track is laid over half the distance to Goldfield and it is expected to have cars running to Goldfield by Jan. 1, 1897.

S. B. Hines, the new general manager of the Terminal Electric Company, states that his company expects to extend its road to Salt Lake City. The intention of this company is to have its line for the most part operated by electricity, although some branch lines over hard grades and mountains will be operated by steam.

The Colfax Electric Company will extend its line as far as the Kansas Pacific Railway, about one mile east of the present terminus. The company until recently has found it necessary to reduce the number of cars to four, but as business is picking up again the company will operate nine cars and trailers and will add more if the traffic demands it. The company has also made important improvements in its track and rolling stock. The company is watching with interest some of the performances of the high geared tramway cars, preparatory to adopting some on its line. The electrician of the company states that his company wishes to cut the time about twelve minutes between termini and that it could only do it with fast high speed cars. He says that he has every right to think that next summer will see at least fifteen high speed cars on its line. A right of way has been asked for a line to run three miles due north on Alabama Street from the power station. If this is obtained the company will need new rolling stock, as the present equipment is just sufficient for the other four lines when the usual number of cars are being operated. This company as a whole is coming up wonderfully. Transfers are now given to and from all cable lines. This helps the patronage of the line greatly. Plans are being drawn for the enlargement of the present car house, in order that it may accommodate fifty-four cars with two store tracks. The company also wants a new repair shop with capacity for more cars than the present one will accommodate.

The Denver Tramway Company is to equip the Cook's Addition road with electricity and operate three cars thereon.

The West End Street Railroad Company, the Denver City Railroad Company, and the Colfax Avenue Electric Railway Company, have all adopted the Meaker stationary register as the standard, the portable register being found difficult to keep in order.

The West End Street Railroad Company is repairing and repainting all of its seventeen motor cars for summer service. New equipments, trucks, hoods, etc., are being added to the cars.

The Colorado Springs Rapid Transit Company, reports that the new Steel equipments and also the new McGuire trucks, which have recently been purchased by this company, are giving entire satisfaction. The passengers say that the cars equipped with these trucks and motors, ride unusually easily, and the motormen say that they can get the cars started and stopped with half the labor. Since the company added the new electrical equipment the running time has been reduced four minutes, between Colorado City and Manitou. The company is considering the advisability of adopting double truck cars on some of its interurban lines.

Foreign Notes.

Algiers, Africa.—We are informed that there are no street railways in Algiers at present, but that a conference is being held with the view of connecting Algiers with its suburbs by a street railway system. The promoter of the project is Mr. Dalaye, of Algiers.

Barranquilla, Colombia.—Advices from this place state that the horse tramway line of Barranquilla is owned by J. F. Cisneros & Company, of Barranquilla, and that an extension of a few miles will, probably, be built with a few months. American citizens have the same privileges as Colombian citizens, taxes are said to be very light and foreign interests are perfectly safe.

Besancon, France.—The electric railway line building in this city will soon be put in operation. The station will contain two generators, of fi ty horse power cach.

Bordeaux, France.—The commission appointed to decide upon the question of the electric equipment of the tramway lines in this city has published a detailed report. It decides that the trolley system, while permissible on certain lines, should not be installed on all lines, but recommends the authorization to use accumulators.

Bourgoin (Isere), France.—The Railroad Commissioners, of the General Council of Isere, have awarded a franchise for an electric railway to M. R. Moyroud for an electric tramway between Bourgoin and Chateauvillain. The electric railway is said to be much needed in this industrial region.

Brighton, England.—The Brighton & Rottingdean Electric Seashore Railway was badly damaged a short time ago by a severe storm. The directors have decided to repair all damage done to the line, to rebuild the damaged cars and re-erect the station, and to put in hand another car and make provision for the safe accommodation of cars in future gales.

Buenos Ayres, Argentine Republic.—In the city of Buenos Ayres, Argentine Republic, there are nine tramway companies operating 397 kms. (246 miles) of track, employing 4071 men, 602 cars, and 8952 horses are in service. About 7,500,000 passengers per month are carried, and 220,000 trips run.

Chamounix, France.—An electric railway has been proposed for carrying passengers up Mont Blanc. Up to a certain altitude the railway would be on an inclined plane, and the ascent would be completed by a vertical shaft, through which electrical elevators would convey passengers to the observatory on the summit.

Chateau-d'Œx, Switzerland.—M. Schenk is proposing the equipment of an electric railway between this place and Châtel-Saint-Denis. Water power will be used. A bill will be presented before the Council at Berne for a concession.

Christiania, Norway.—One of the street railway companies here is to double track its line and will probably need more cars. H. E. Heyerdahe, civil engineer of Christiania, may be addressed. The Gothenburg Tramway Company, now running by horses, expects to equip for electricity at an early date. Fred W. Stoddard is managing director.

Florence, Italy.—There are two street railway companies at this place. The aggregate length of track is 81.30 miles of which 4.50 miles are electric, 19.20 miles are horse and 57.60 miles are steam.

Frankfort, Germany.—The tramway company in this city will equip two of its lines with accumulator cars. The cars on one of these lines will have a capacity of from thirty-six to forty passengers, and if the service is satisfactory, larger cars will be built. It is proposed to operate the cars at a speed of twelve miles an hour.

Freiburg, Baden, Germany.—There is no street railway system in this city or its neighborhood. A resolution has, however, been passed by the Municipal Council looking to the construction of an electric tramway in the near future and a commission has been appointed to study the different systems. Manufacturers who may desire to have their apparatus considered by the Council may send printed matter to Mr. J. H. Thieriot, United States Commercial Agent, who will refer it to the proper parties.

Freiburg, Switzerland.—It is proposed to install an electric railway in this city. The lines will have a length of about 2½ miles, and it is proposed to have it in operation by June, 1897.

Ghent, Belgium.—This city is about to award a new franchise for a street railway line. The present system is said to be very antiquated and inadequate, and the crying need of the town, which has 200,000 inhabitants and is quite large in area, with many outlying suburbs, is a good transportation system. The franchises will, probably, be awarded early in 1897, and any responsible party may compete, but the company must be organized according to Belgian law.

Havana, Cuba.—Advices from Cuba from three sources are to the effect that the Cuban war has demoralized all business enterprises, and nearly every industry in the island is ruined. A general reorganization of business in all lines will have to take place after political matters are settled, and new capital will be necessary.

Kingston, Jamaica.—There is but one tramway in Jamaica, and that in the city of Kingston. The charter has expired and the government has advertised for bids. Specifications and conditions may be seen at the office of Messrs. Gillespie Brothers & Company, 2 and 4 Stone Street, New York.

LePuy, France.—The first application in France of turbines in connection with electric traction will be made shortly in this place. The waters of the Loire will be utilized and the current employed on the electric line here.

New South Wales.—The report of the railway commissioners of New South Wales, on the condition of tramways in that country is as follows:

Quarter ending Sept. 30,	1895.	1896.
Miles open	61	61
Revenue	£56,578	£58,833
Expenditure	£66,220	£70,606
Car miles run	659,835	745,170
Earnings per car mile	2s 0	1s 10¾
Expenditure per car mile	1s 8½	1s 7
Percentage expenditure to earnings	85.44	83.32
Number of fares collected	15,517,996	16,653,775

Nuevo Laredo, Mexico.—Mr. L. Goodman of this city owns a valuable concession for a street railway in Tampico and may be written to regarding purchases for his road.

Rome, Italy.—A high speed trolley line is projected between here and Frascati. The running time between the termini will be about one hour and the cars will run at an average speed of fifteen miles an hour. The maximum grade is less than eight per cent. It is proposed to operate the line by means of water power.

Rouen, France.—M. Requier, the owner of the recently awarded franchise for an electric railway here, expects to have his line in operation during the spring of 1897. The Westinghouse system will be used.

Sheffield, England.—The Sheffield Corporation Tramways Committee has recommended the city surveyor and manager to obtain certain information regarding the working of the cars on the electric system. One of the items relates to the adaptation of ordinary cars into electric cars.

Trieste, Austria.—Messrs. Gairinger & Company, of Trieste, are trying to get permission to build an electric railway about eight or twelve miles long at Trieste. There is already one street railway at this place.

Turin, Italy.—We are informed that there should be plenty of room for American capital at this place. The street railway system is owned by two companies; one is in the hands of Turinese citizens and the other is owned by Belgian capitalists. The Turinese company is operated by horses, but is obliged to equip its lines with electricity by Apr. 1, 1898. The other company operates its lines by horses and steam, but will gradually introduce electricity on all its lines.

West Indies.—The Danish West Indian Islands comprise St. Thomas, St. John and St. Croix, upon which there are no street railways at present. We are advised that a street railway, if built, connecting the two large seaports on St. Croix, which are about sixteen miles from each other, ought to be a profitable investment. All foreigners can do business in these islands, provided they take out a burgher's brief, which costs from $100 to $150.

Wolverhampton, England.—A company has been formed for the purpose of purchasing the horse railways at Dudley, Wolverhampton, Wednesbury, South Staffordshire and Stourbridge and a bill will be presented at the next session of Parliament for the purpose of uniting the various systems, and afterwards of equipping them with electricity. Branches are also projected from Wolverhampton to Bilston and other places. Stephen Sellon, electrical engineer of the British Electric Traction Company, Ltd., represents the new company.

The Street Railway System of Stuttgart, Germany.

The only street railway company in Stuttgart is the Stuttgarter Strassenbahn Gesellschaft. This company received its charter from the city of Stuttgart some years ago, under the condition that it should immediately lay its tracks upon certain streets and that upon

demand of the city the system should be extended to certain other streets. The lines of the company now occupy nearly all the principal streets of the city, and further extensions are to be built soon. The charter was also given under the condition that all privileges granted should revert to the city at the end of the year 1926.

This railway was recently equipped with the overhead electric system. The trolley wire is supported by cross wires, fastened to the houses, except in outlying districts, or where the streets are of too great width to permit of this construction. Both rails and cars are of German manufacture, the latter having been built at Ehrenfeld near Cologne, by the Herbrandt Stock Company.

The capital stock of the Stuttgarter Strassenbahn Gesellschaft, originally $150,000 in shares of $40 each, was issued at par; as the system was extended further issues were made, the second issue being $190,000 in shares of $238 each; and a third issue of $133,875 was also made. There is also $41,650 of preferred stock, at $238 par value per share. The company is paying large dividends.

Some Recent Improvements in an Air Brake System.

The Hunt Air Brake Company having its works at New Kensington, Pa., is making marked strides in the way of recent improvements, among which may be mentioned the use of aluminum in the manufacture of this company's air brake equipment. The first equipment, which was somewhat objected to in the way of weight (the motor and pump and connections being combined in one piece of apparatus), has by the use of aluminum been made very materially lighter, and the apparatus can now be carried upon the platform of almost any well constructed car.

Aluminum, which is the product of the Pittsburgh Reduction Company (whose works are at Niagara Falls and New Kensington where they adjoin the works of the Hunt Air Brake Company), has been brought to a point where it is now possible to use the same for the construction of the brake castings. All parts of the apparatus other than the pump and motor castings, are composed of aluminum and the apparatus in its complete form makes in itself a very handsome piece of machinery.

Another improvement and addition is a small compound combined pump motor brake, being a special design for short cars and which can be carried under the seat or under the car; this apparatus is also manufactured out of aluminum except such parts as are required to be of brass and iron, and therefore is very light and occupies a space thirty-two inches long, fourteen inches high and twelve inches wide. Both of these combined motor brakes are controlled by a recently completed automatic controller, which occupies a space 14 ins. × 7¾ ins. × 3½ ins., and is made of polished aluminum (other than the points of contact). It is encased in an aluminum case, with glass face. By this device the pump is absolutely automatically controlled, the maximum pressure being, for instance, set at seventy pounds, and the minimum pressure being at forty pounds, allowing a variance of thirty pounds between the cut-in and the cut-out of the pump. Should the trolley jump from the line the pump is automatically stopped and when the trolley is again adjusted, is started.

The motorman has no care of the apparatus; he simply handles the air by the three-way valve which is directly in front of him in making the stops. To avoid any possibility of an accident coming to the equipment by excess current, etc., the Hunt Company has provided a "Midget" cut-out, manufactured by the Cutter Manufacturing Company, by which the excess current is discharged, and every possible precaution has been successfully provided for, to protect the apparatus.

Another novel feature to which the combined motor pump is being put, is that of furnishing air by means of a hose connected with the pump by which the motors and controllers are cleaned; air is also used for cleaning car seats and other parts of the cars and this method is also being used in power houses for cleaning the machinery.

The Hunt Company has now in successful operation its axle connected brake on the following roads: Cleveland & Elyria Electric Railroad; Akron, Bedford & Cleveland Railroad; Pottsville Electric Railway; Norfolk & Ocean View Railway, and the Binghamton Railroad. Orders are now being filled for combined motor brakes for Norfolk & Ocean View Railway; Cleveland & Elyria Electric Railway; Elyria & Lorain Railway; Mt. Clemens Fast Line and Akron, Bedford & Cleveland Railroad. The company has recently completed the successful equipment, with Hunt air brakes, of the Saginaw & Bay City Interurban Railway. On this road forty foot cars are used, which weigh complete about 35,000 lbs., and in a recent test one of these cars, while going at the rate of forty-five miles an hour, was stopped within two telegraph poles' length.

This company has just equipped with its trail brake, the new cars of the Wilkesbarre & Northern Railroad, it has also orders for brakes for roads in Pittsburgh, Buffalo and points in the East and West, and inquiries are being received daily from foreign roads for descriptive matter of its brakes. It is furnishing some roads with its combined motor pump for use in power houses for cleaning purposes; this apparatus can be so arranged upon wheels, that it can be carried around the plant and connected up with the current at points most convenient for the work required, and by the use of hose connections the air can be applied for cleaning in spaces where the cleaning could not otherwise be done.

The Largest Air Pumps in the World.

The remarkable success which has attended the installation of independent air pumps of the type known as the Blake vertical twin system on the war vessels of the United States Navy, and the high economy of these pumps, have recently led to the adoption of this system by the Germans for use on the new steamer of the North German Lloyd Steamship Company, to be christened "Kaiser Wilhelm der Grosse," now building at Stettin, Germany.

To give an idea of the economy of these pumps, from the official reports of the trial trips of the United States cruisers and battle ships, the indicated horse power of the Blake air pumps averaged less than one-eighth of one per cent of the total horse power of the main engines, a result, it is claimed, that has never before been obtained in marine engine practice. The explanation of this small amount of power is perhaps due to the very perfect arrangement of the steam valve gear, so that a very low rate of piston speed is sufficient to give the desired result of a good vacuum. Also an important cause for their efficient operation is the pause which takes place at the end of each stroke, allowing time for the opening and closing of the valves and proper filling of the air buckets. The average speed of the air pumps on the trial trip of the cruiser "Brooklyn" was less than sixteen double strokes per minute. This was when the main engines were developing somewhat over 18,000 h. p., while the air pumps were developing about 16 h. p., which, it will be noted, is something less than one-tenth of one per cent of the power of the main engines.

It is confidently expected that this high showing will be outdone by the performance of the big pumps for Germany, and that they will do their work with one-twelfth of one per cent of the indicated horse power of the main engines.

The pump has two inverted double acting steam cylinders, each 18 ins. diameter × 24 ins. stroke. On the "Kaiser Wilhelm der Grosse" there are two pumps of the above dimensions, one for each of the two 1400 h. p. engines which drive the ship. It is expected that this new German express steamer will beat the records of the big Cunarders "Campania" and "Lucania," in crossing the Atlantic with a consumption of fifty tons of coal less per diem. Besides the air pumps, this vessel has a full equipment of feed, fire and bilge pumps of the Blake manufacture.

A New Catalogue.

The Peckham Motor Truck & Wheel Company has recently issued its new catalogue for 1897. The catalogue is an unusually large one and is substantially bound in cloth. On the second page of the catalogue is given a complete list of the United States Patents granted to Edgar Peckham for improvements in motors, motor trucks, gears, wheels, etc. There are forty-nine of these patents and still others are pending.

A few pages of the catalogue are devoted to a list of the roads using Peckham trucks and testimonials regarding these trucks. The remaining pages are devoted to illustrations and descriptions of the various types of trucks, wheels, etc., manufactured by the Peckham Company. The catalogue is very finely illustrated, is tastefully gotten up and will prove interesting to users of motor trucks everywhere.

Personals.

Mr. T. E. Mitten has been appointed general manager of the railway department of the Milwaukee Electric Railway & Light Company.

Mr. Frank A. Lapham, general agent of the Cleveland Frog & Crossing Company made a business trip East last month. Mr. Lapham reports business as improving, and states that his company has recently added sixty new men to its works in Cleveland.

Captain Eugene Griffin, returned last month from a short business trip to Europe and states the prospects for electric railway construction abroad during the coming year as very promising. He spent four or five weeks on the other side of the Atlantic.

Mr. I. B. Walker, general manager of the Sioux City Traction Company, has accepted a position as chief electrical engineer of the Suburban Railroad Company, of Chicago, and also as consulting engineer of Naugle, Holcomb & Company, also of Chicago. He will leave Sioux City on Jan. 1.

Mr. H. N. Ransom, of the Consolidated Car Heating Company, of Albany, N. Y., has recently opened an office in the Electrical Exchange Building, New York, and will make that his headquarters. Mr. Ransom reports the demand for electrical heaters as constantly growing and anticipates a large business for heaters during the present winter. Having devoted a great deal of attention to this subject he is well posted on the heater question.

Mr. G. Coleman, formerly secretary of the Metropolitan Railroad Company, of Washington, D. C., has been appointed general manager of the company. Mr. Coleman has been connected with the Metropolitan Street Railroad company for fifteen years. At the annual meeting of the directors of the company, at which this appointment was made, a dividend of $1.25 per share was also declared and the affairs of the company were reported to be in excellent condition.

Mr. H. H. Lynch, superintendent of construction of the Market Street Railway Company, of San Francisco, who has been for several years identified with the construction and operation of street railways in San Francisco, spent a recent six week's vacation in a trip to the Atlantic seaboard, passing en route through a number of important cities, whose street railway systems he has been examining with much interest. Mr. Lynch was accompanied on this trip by Mr. H. S. Manning, who is connected in an important capacity with the Southern Pacific Railway Company.

Mr. N. Scott-Russell, a prominent English engineer returned to London last month after a visit of several weeks in America taken to study the latest developments of American street railway practice by personal observation. Mr. Scott-Russell is a member of the English Institution of Civil Engineers, and a son of Mr. John Scott-Russell, a prominent marine engineer and contractor and one of the firm which built the "Great Eastern." Mr. N. Scott-Russell has devoted a great deal of attention to marine engineering and spent a considerable time in the employ of the Russian Government in designing large engines for the navy of that country. He has recently devoted considerable attention to electrical work and has acted as consulting engineer for a number of important English electrical installations. So far as street railway service is concerned Mr. Scott-Russell is a strong believer in the merits of compressed air motors, and has given much time to a study of the theory and practice of this form of motive power.

Mr. Frank A. Wardlaw, who is in the employ of Flint, Eddy & Company, of New York, sailed on Saturday, Dec. 19, for Argentine Republic, to construct electric railways in South America. Mr. Wardlaw is an engineer of much experience, having commenced the electric business in 1880 in the laboratory of Thos. A. Edison, at Menlo Park, remaining there until it was closed in 1882. He has been employed some time with the Edison Machine Works in Goerck Street, New York, both in the testing room and department of isolated lighting for two years, installing some of the first incan-

FRANK A. WARDLAW.

SAMUEL BARNES.

descent plants in the City of New York; with the Brush-Swan Electric Light Company, installing several theatrical, steamship and factory plants for them; with the Daft Company as chief of its testing room and installing the electric road at Camden, N. J.; with the Edison General Electric Company at the Schenectady Works, for eighteen months; with the Union Railroad Company of New York City as its chief engineer for nearly three years, which position he left to become supervising engineer for the Atlantic Coast Electric Railway Company at Asbury Park, N. J., building the lines from Asbury Park to Pleasure Bay and Long Branch. He finally went with the General Electric Company, installing power stations for the West End Street Railway Company, of Boston, and the Coney Island & Brooklyn Railroad Company, which position he now gives up to take charge of electric railway construction in South America.

Mr. Samuel Barnes, electrical engineer of the Lindell Railway Company, of St. Louis, Mo., whose portrait is given herewith, has been engaged in electrical interests since 1886. In that year he was appointed manager of an electric light plant at Grayling, Mich. After remaining in charge of this plant for two and a half years he accepted the position of superintendent and electrician of the West Bay City (Mich.) Electric Railway Company. After operating this line successfully for about two years he was offered the position of electrical engineer of the Consolidated Street Railway Company, of Grand Rapids, Mich., with which company he remained for considerable length of time. During this period he invented a number of electrical devices which are now in general use, and after leaving this company engaged in the manufacturing business for some time. In 1894 he made a tour through Europe, filing patents in France, England and Germany for different inventions and visiting all of the large electric railway and power plants. Upon returning to the United States he accepted the position of electrical engineer for the Lindell Railway Company which he now holds. Mr. Barnes is thirty-eight years of age, and is English by birth, but has lived in America for thirty-five years.

Mr. A. Langstaff Johnston, the prominent street railway engineer, has just completed the construction of the lines of the Richmond Traction Company, at Richmond, Va. Mr. Johnston began his career as a street railway engineer in 1887, when he had charge of the building of the Richmond Union Passenger Railway, the well known pioneer line in that city. Mr. Johnston had to meet an entirely new set of conditions in the construction of this railway, and no precedent could be followed in solving the various

A. LANGSTAFF JOHNSTON.

N. SCOTT-RUSSELL.

problems. He was entirely successful in meeting all questions and his reputation as a skillful street railway engineer dates from the completion of that installation. Before entering the street railway field, Mr. Johnston was employed on the construction of the Chesapeake & Ohio Railway, served as assistant city engineer of Richmond, and later, in 1876, was made city engineer of Manchester, Va., where he designed and established a system of street grades and introduced a number of other improvements. In 1889 he constructed the Richmond & Seven Pines Electric Railway, extending to the battle fields about Richmond. In 1890 he built the Richmond & South Side Electric Railway, and laid out in connection, Woodland Heights and Forest Hill Park. He has since that time constructed the New Orleans & Carrollton Railway, twenty miles in length, the first electrically operated road in New Orleans. After the completion of this work he accepted the position of chief engineer for the Hestonville, Mantua & Fairmount Passenger Railway Company, of Philadelphia, and the entire electrical equipment of this line was done in conformity to his plans. This line has had a remarkably successful career. Mr. Johnston left Philadelphia to take charge of the construction of the Richmond Traction Company. He is a member of the Institute of Electrical Engineers, of the American Society of Civil Engineers and of the Franklin Institute, and was recently honored by the city of Philadelphia, through the Franklin Institute, with the John Scott medal, for his system of electric bonding of rails and joints.

Mr. John B. Parsons, formerly vice-president and general manager of the West Chicago Street Railroad Company, has been elected vice-president and general manager of the Union Traction Company, of Philadelphia. Mr. Parsons began his street railway career in Philadelphia, in 1870, when he entered the service of the Philadelphia City Passenger Railway Company as a clerk. He advanced rapidly, and in 1887 he moved to Chicago to take charge of the West Chicago Street Railroad Company. Mr. Parsons has an enviable reputation as an energetic and judicious director, and has been successful in reorganizing and placing upon a dividend paying basis, a number of important roads. He is a director of the Chicago, the Union and the Illinois clubs of Chicago, and a trusteee of the Presbyterian Hospital of that city.

JOHN B. PARSONS.

Mr. N. W. Wells, president, and W. S. Dimmock, general superintendent of the Omaha & Council Bluffs Railway & Bridge Company, have been making quite an extensive inspection trip covering St. Paul, Minneapolis, Chicago, Louisville, Indianapolis and other points. They have made a thorough examination of

power houses and electrical equipment preparatory to erecting a thoroughly modern power plant. Through President Wells' careful judgment, and Superintendent Dimmock's systematic management, their road is now equipped in a most satisfactory and modern way. Steel motors are used, and the rest of their plant they desire to give equally as good results.

Mr. H. E. Seemuller, of London, England, who is associated with Mr. Robert W. Blackwell, consulting engineer, of London, returned to England last month after a visit of five or six weeks in this country. Mr. Seemuller is a steam engineer of large experience and has charge of the steam engineering features of the electric installations in which his firm is interested. While in this country he made a tour of the principal cities east of the Mississippi River to become acquainted with the latest practice of American electric railway engineers. He reports that European tramway and railway managers are taking the greatest interest in electric railway equipment and anticipates during the next year an extensive development in electric railways abroad. In this he thinks that Great Britain will lead during the coming year, but anticipates nearly as many changes in Continental roads.

Glasgow Engineers.

Mr. John Young, general manager of the Glasgow Corporation Tramways, who recently made an extended tour of inspection of American street railways in the interest of the Glasgow corporation, has returned home and made his report, an abstract of which is given in another column of this issue. Mr. Young before taking charge of the Glasgow tramways, served the city of Glasgow for many years as head of the cleansing and street cleaning department, and the evidence he gave in this post of thorough grasp of details and masterful resources in meeting every call made upon him, pointed him out as one whom the city could rely upon, when it was decided that the city corporation should take charge of the tramways.

JOHN YOUNG.

Mr. Young was born in Paisley and was educated at the Paisley Grammar School with a view of entering one of the professions. However, country life had more attraction for him, and he accordingly devoted himself to the study and practice of agriculture, and very soon became able to conduct the business of his father's several farms. In 1875 he applied to the Glasgow Town Council for the position of superintendent of the Street Cleaning Department and was unanimously appointed, out of a long list of candidates for the place.

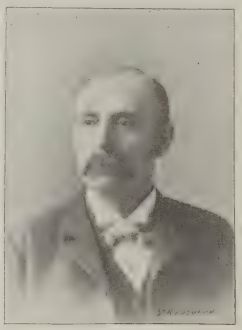
Under his command this department was thoroughly reorganized, with the result that Glasgow is one of the cleanest cities in the world. Mr. Young's large and varied experience obtained in the organizing and administration of large numbers of men and horses, while Superintendent of Cleaning, eminently qualifies him for the position he now holds.

Mr. William Clark, who was associated with John Young in his recent inspection of street railways in the United States, is a thoroughly trained and eminently practical engineer. He served his apprenticeship in the workshops of John Norman & Company, engineers, and boiler makers of Glasgow. He was afterwards draftsman and assistant engineer, for eleven years, with Chas. Tennant & Company, St. Rollox Chemical Works, Glasgow, where he gained a large and varied experience. For a short time afterwards he again entered the employ of John Norman & Company, taking charge of that company's fitting and erecting shop. About eleven years ago his services as engineer of the Street Cleaning Department, were secured by the city. When Mr. Young was appointed general manager of the Corporation Tramways, he secured Mr. Clark's services as engineer, knowing that in him he had a tried and trusted engineer, who could readily adapt himself to any new situation connected with his profession. Mr. Clark has assisted in the designing of all the new buildings, cars and equipment of the Glasgow Tramway Company.

WILLIAM CLARK.

C. B. Fairchild.

The Standard Air-Brake Company is to be congratulated in having secured the services of Mr. Charles B. Fairchild, who will hereafter devote himself to actively representing that company's air brakes. Mr. Fairchild, as is generally known, was formerly editor of the STREET RAILWAY JOURNAL. He is well acquainted among street railway managers through his travels in the interests of this paper, and is admired by all for his sterling qualities and his practical knowledge of street railway practice.



C. B. FAIRCHILD.

Mr. Fairchild was born in Berkshire County, Mass., in 1842, and moved with his family in 1853 to Binghamton, N. Y. While preparing for college in that city in April, 1861, he volunteered in response to President Lincoln's first call for troops and served throughout the war, first for two years in the Twenty-Seventh Regiment, New York Infantry, and then in the First New York Veteran Cavalry as first lieutenant. During 1861-62, having been captured at the first Bull Run Battle, he spent 10½ months in Confederate prisons, being at Richmond, New Orleans, and Salisbury, N. C. In 1867 he entered the State Normal School at Brockport, N. Y., and was graduated from the classical department in 1870, and soon afterwards received the honorary degree of A.M., from Amherst College. After his graduation he was appointed professor in the Normal School, where he remained until ill health obliged him to resign, when he moved to North Carolina, where he engaged in horticulture and farming. In 1880 he returned to New York and was engaged in teaching in the public schools of New York City until 1885, when he resigned and employed his time for nearly three years in the promotion of a cable railway system which he had invented. On July 9, 1889, he was appointed associate editor on this paper, and the year following editor.

In connection with his editorial duties he was required to travel to a considerable extent, and has visited most of the principal cities of the United States, having in the winter of 1892-93 made a trip across the continent. In addition to his editorial work on the STREET RAILWAY JOURNAL, Mr. Fairchild has produced two books; the first, "History of the Twenty-Seventh Regiment, New York Volunteers," a work of 335 octavo pages with illustrations, printed in 1888; the second, in 1892, "Street Railways," issued by the Street Railway Publishing Company. He resigned from the Street Railway Publishing Company June 1, 1895, and has since been engaged in developing an emergency pavement brake for street railways, the work having been carried on in Chicago and New York. This pavement brake will shortly be placed upon the market by the Standard Air-Brake Company, in connection with its system for braking cars and trains.

Obituary.

H. L. LUFKIN, manager of the Crocker-Wheeler Electric Company and a well known electrician, died last month of peritonitis. Mr. Lufkin returned a few weeks ago from a Western business trip, and was taken ill a few days afterward. He was taken to the Mt. Sinai Hospital where he underwent an operation for appendicitis. After the operation peritonitis set in which caused his death. Mr. Lufkin was born in Cleveland in 1857. Fifteen years ago he became interested in electricity and was associated with S. S. Wheeler and F. B. Crocker in the C. & C. Electric Company. In 1892, he became identified with the Crocker-Wheeler Electric Company. He was one of the leading spirits in the Electrical Exposition held in New York last May.

DAVID L. BARNES, the well known consulting engineer, died in New York, Dec. 15. The immediate cause of his death was a surgical operation, though Mr. Barnes had been out of health for some time. He was born in Providence in 1858, and was educated at Brown University and the Massachusetts Institute of Technology. Mr. Barnes has held several positions in connection with the mechanical department of railroads, and for some years he had been on the editorial staff of the *Railroad Gazette*. He was a member of the American Society of Mechanical Engineers; Institute of Civil Engineers (London); Western Society of Engineers; Manufacturers' Club, of Philadelphia; Engineers' Club, of New York, and other technical bodies, and had received the degree of Master of Arts, from the Brown University.

A Novel Paper Weight.

The Broderick & Bascom Rope Company is supplying to its customers and friends a neat paper weight. This paper weight was distributed by the company as a souvenir at the Street Railway Convention recently held in the city of St. Louis. It was also distributed at the Convention of Mechanical Engineers held at the Southern Hotel, in St. Louis, during the early part of 1896.

The paper weight consists of a section of street railway cable, 1¼ ins. in diameter, such as is now used in the cable railway service, and three inches high. The base, which is 1½ ins. wide, is made of metal, hexagon shape, so that the paper weight cannot roll off the desk, while the top is beautifully mounted with a circular metal cap with a ball handle, the entire paper weight being plated with nickel or silver, making it a very desirable article for any desk.

There has been quite a demand on the Broderick & Bascom Company for these articles since they were first introduced, and the company is finding some little trouble in keeping up the supply to meet the demand which is constantly increasing.

AMONG THE MANUFACTURERS.

The Fuel Economizer Company, of Matteawan, N.Y., is sending out as a souvenir of the New Year, a pocket calendar for 1897.

The John Stephenson Company, Ltd., of New York, has recently received an order for 150 cable cars from the Metropolitan Street Railway Company.

The Kensington Engine Works, Ltd., whose main office and works are at Philadelphia, Pa., have opened a branch office at 74 Cortlandt Street, New York City.

The American Electrical Works, of Providence, R. I., are sending to their friends a neat card bearing Christmas greetings, at the same time calling attention to the bare and isulated wires manufactured by them.

The Central Electric Company, of Chicago, has just issued a very tasteful catalogue giving details and prices of X-ray apparatus manufactured by this company. The catalogue contains several plates made from X-ray photographs.

Nicholas D. Sourmely, merchant and agent for machinery, hardware, etc., and a government contractor, of Piraeus, Greece, is said to be in a position to be of service to American manufacturers of street railway apparatus, in introducing their products into Greece.

The Edward P. Allis Company, of Milwaukee, Wis., is now building for one of the large mining companies in South Africa three cross compound direct connected engines of about 1000 h. p. each. These engines are to be used for electric power to drive pumps and hoists.

Edward Ridley & Sons, of New York City, carry an excellent line of shades and awnings for stores, hotels, flats, offices, street cars, etc. They make and put up to order curtains of silk, plush and tapestry of every description. On all their shades they use Hartshorn's spring rollers.

The Chicago Varnish Company, of Chicago, reports that it has been extremely busy since the election filling orders for its varnishes and paints. The company has recently added to its plant, already covering nearly four acres of ground, and contemplates additional buildings at an early date.

The Globe Electric Heating Company, of Philadelphia, has issued a new catalogue giving details of the electric heaters manufactured by this company. Among the good points claimed for this heater are high efficiency, simplicity and durability, and positively no oxidizing or crystallizing of the wire.

McIntosh, Seymour & Company, of Auburn, N. Y., have published a very extensive catalogue, tastefully decorated, of their engines. The catalogue is finely illustrated and contains a number of very interesting tables, giving dimensions, powers and speeds, etc., of the different types of engines manufactured by this company.

Morris, Tasker & Company, Incorporated, of Philadelphia, Pa., report a very large increase in business during the past year, especially in foreign orders. The company's work is as well known abroad as in this country, and a large number of the foreign railway companies which have installed lines have purchased Morris, Tasker poles.

The J. A. Fay & Egan Company, of Cincinnati, O., has recently supplied to the Cincinnati Street Railway Company a full equipment of woodworking machinery for that company's works at Chester Park. The Cincinnati Street Railway Company is proposing the manufactnre of its own cars, and this equipment is for that purpose.

The Sterling Varnish Company, of Pittsburgh, Pa., reports that it has made twenty-seven shipments to Europe already this month. This company is planning to send a representative to Europe in the spring, who will visit all the large manufacturing companies, and a branch house will probably be opened in Europe in the near future.

W. Gisbert & Company, of Hamburg, Germany, are an active importing firm, who are in a position to be of great value to American manufacturers. There seems to be an opening field in Germany for American street railway apparatus and this firm is said to be well qualified to help introduce it. The firm's address is Graskiller 17, Hamburg.

The Henry R. Worthington Company, manufacturer of pumping machinery, has just received word through its London office that the exhibit of Worthington pumps at the Hungarian National Exhibition at Buda-Pest has been awarded a grand millennium medal. This medal is the only award made for pumping machinery at the exhibition.

J. P. Johnston, for some years with the Babcock & Wilcox Company in its main office and later salesman in its Pittsburg office, will take charge Jan. 1, of the Cleveland office for the Cahall Sales Department for the sale of Cahall Vertical and Cahall-Babcock & Wilcox boilers, manufactured by the Aultman & Taylor Machinerp Company, at Mansfield, O.

The Electric Mutual Casualty Association has moved its main office to the Fidelity Mutual Life Building in Philadelphia. The present officers of the company are: president, W. B. Rockwell, president of the Staten Island Midland Railway Company; vice-president, George B. Lindsay, of the Chester Traction Company; secretary, William W. Wharton.

Hobson & Company, of Tatamy, Pa., have recently issued an illustrated catalogue of the dumping horse carts, sprinkling carts, etc., manufactured by this company. This company manufactures a number of different types of two and four wheel carts, and also several types of sprinkling wagons. The company maintains a high standard in all its work, and materials used are of the best.

The A. Mertes Manufacturing Company, of Allegheny, Pa., is using a very acceptable method of advertising its motor gears and pinions in the form of a thermometer mounted on a card upon which an advertisement of the A. Mertes Manufacturing Company is tastefully printed in silver. This thermometer is meeting with a great demand among the company's customers and friends.

J. A. Fay & Company, of Cincinnati, O., have recently issued a very tastefully decorated catalogue of the carving and edge moulding cutters, mortising chisels, etc., which they manufacture. This catalogue will be sent on application to the company. The tools of this company are made of the very best material, and embrace the very latest machines for carving, paneling, hand tracing and edge moulding now in use.

The Standard Air-Brake Company, of New York, in addition to receiving the foreign order recently reported in our columns, has just secured a further order from abroad and is now in treaty for its air-brakes with a large system. It is very evident that General Manager Wessels keeps his weather eye open. His acquisition of Colonel Fairchild, referred to elsewhere, shows he is surrounding himself with the best available talent.

The Aultman & Taylor Machinery Company, of Mansfield, O., has recently secured the services of Mr. Kennedy Park who will take charge of the erecting department for Cahall vertical and Cahall-Babcock & Wilcox boilers in New England. Mr. Park was for ten years in the erecting department of the Babcock & Wilcox Company, of New York, and for the past five years was superintendent of the New England erecting department of that company.

The Electric Insulating Company, of St. Louis, Mo., manufacturer of the well known Peerless armature compound is meeting with great success in the introduction and sale of this compound among electric railway companies. The secretary and treasurer of the company, Louis Honig, has recently returned from an Eastern trip and reports a large demand for the compound and high grade shellac, and that the companies using this compound speak highly in its favor.

The Joseph Dixon Crucible Company, of Jersey City, N. J., has just issued a pamphlet describing the different uses to which its graphite is put. The pamplet is well illustrated and the cover is decorated with views printed in colors of the company's different mills and factories. This company recently sent to the office of the STREET RAILWAY JOURNAL a neat box containing a large assortment of blue, red and black lead pencils which the Dixon Company manufactures.

Janney & Steinmetz, of Philadelphia, manufacturers of iron and steel specialties for electric road equipment, say they are looking for a large business before very long in their line. This firm are the Eastern sales agents for the Shickle, Harrison & Howard Iron Company, of St. Louis, which manufactures an open-hearth cast steel motor gear, which they claim to be equal, if not superior, to any gear in the market. All of the roads who have used these gears report in the highest terms about them.

The New Process Raw Hide Company, of Syracuse, N, Y., reports that it looks for an unexampled improvement in its trade in the coming year, on account of the betterment in business generally which is sure to follow the restoration of confidence achieved at the recent election, and because its goods are becoming each year more widely known and more highly appreciated. It says that despite the " hard times " which have prevailed, its output fot 1896 is thirty per cent greater than for any previous year.

The Western Electric Company, of Chicago, has been given the agency for the complete line of Lundell power motors, which range in size from one-sixteenth of a horse power up to any size

required. These motors are completely encased, and are generally regarded among the trade to be among the best motors on the market. They can be readily connected to printing presses, ventilating fans; and are also used for blowing large organs, and wherever electric power is desired these motors are espeeially applicable.

The Berlin Iron Bridge Company, of East Berlin, has received the contract from Stone & Webster, engineers, of Boston, for the steel work in the power plant of the Brockton Street Railway Company, at Brockton, Mass. The Rhode Island Tool Company, of Providence, R. I., has also placed the contract for its new galvanizing room with this company. The Berlin Iron Bridge Company is also designing and will furnish and erect the steel work of the new power station of the Hyde Park Street Railway Company, of Hyde Park, Mass. The building is to have brick walls and the roof is to be supported by steel trusses. The boiler room is to be 44 ft. × 87 ft. long, and the engine room is to be 56 ft. × 115 ft. long.

Macartney, McElroy & Company, of New York, have recently received a very flattering letter from the Hamilton Radial Electric Railway Company. Thos. E. Leather, vice-president of the latter company, says, "We desire to express our entire satisfaction with the manner in which you have carried out your contract with this company for the construction of the overhead line work on our road between Hamilton and Burlington (eleven miles) during this season, and we have no hesitation in saying that we consider this one of the best pieces of similar work in the country; in fact, it has proved quite a revelation to some of the other lines, and is pronounced to be very superior workmanship. Should we extend our lines during the coming year, you may rest assured we will be pleased to negotiate a contract with you similar to that just completed, and wish you every success".

The Electric Launch Company, of Morris Heights, New York City, has recently published a handsomely illustrated catalogue descriptive of its electric launches. Since these were put on the market in 1892 they have met with great favor wherever electric current was available for storage purposes. Electricity seems to be the ideal motive power for small launches of this kind as the motive apparatus does not take up any space in the boat available for passengers, and there are no disagreeable fumes or heat as with a steam launch. The launches have proved exceptionally well adapted to pleasure parks served by electric railway companies, as, of course, there electric current is always available and a number of companies have used the launches with great success during the past season. We understand that the Electric Launch Company will make a specialty during the next year of electric launches for this service.

Fred. M. Locke reports that the patent insulator of which he is the manufacturer, is used by the following companies: Big Cottonwood Mining Company, Salt Lake City, 15,000 insulators; Riverside Power Transmission Company, Riverside, Cal., 15,000 insulators; Central California Electric Company, Sacramento, Cal., 15,000 insulators; Lowell & Grand Rapids Electric Light & Water Company, Lowell, Mich., 11,000 insulators; Big Creek Power Company, Santa Cruz, Cal., 11,000 insulators; Cumberland Mills Transmission Plant, Cumberland Mills, Me., 8000 insulators; Nevada County Power Company, Nevada, City, Cal., 5500 insulators; Southwestern Electric Light & Water Company, Joplin, Mo., 6000 insulators. The Locke design of insulator is also used on the Folsom (Cal.) Transmission Line, San Joaquin Electric Company, Fresno, Cal. and the Niagara Power Company, Niagara Falls, N. Y.

The American Engine Company, of Bound Brook, N. J., states that the list of machines shipped by it during November, 1896, includes the following: one 18 k. w dynamo to the Syracuse *Post*, Syracuse, N. Y.; one 50 k. w. dynamo to the *Evening Star*, Washington, D. C.; one 25 h. p. motor to the Springfield *Union*, Springfield, Mass.; one 12 h. p. motor to the New York *Tribune*, New York City; one 12 h. p. motor to the Peoria *Herald*, Peoria, Ill.; one 12 h. p. motor to the Duluth *News Tribune*, Duluth, Minn.; one 8 in. × 8 in. engine to the Leavenworth *Times*, Leavenworth, Kan.; one 10 in. × 11 in. engine and 50 h. p. boiler to the Chinese Government; one 25 k. w. dynamo to *The Morning News*, Savanah, Ga.; one 12 h. p. motor to the Chicago *Journal*, Chicago, Ill.; one 50 h.p. motor to the Boston *Daily Post*, Boston, Mass.; one 75 k. w. dynamo to the *Kansas City Star*, Kansas City, Mo.; one 12 h. p. motor to W. D. Boyce & Company, Chicago, Ill.; one 14 in. × 12 in. engine to the J. Harper Bonnell Company, Long Island City, L. I.

The Composite Brake Shoe Company, of Boston, Mass., has recently been developing the use of cork in combination with brake shoes in securing a higher co-efficient of friction than the ordinary metal brake shoes gives. The company has for some time been manufacturing a brake shoe made of cast iron, in which are inserted wooden plugs, in such a way that both the iron and the end fibers of the wood come in contact with the wheel. At recent tests, however made by the Master Car Builders' Committee on Laboratory Tests, at Wilmerding, Pa., it was found, that while these wooden plugs gave a somewhat higher co-efficient of friction, they were apt to char at the ends, and often contracted sufficiently from heat, to come out of the holes. To do away with this trouble the company is now using cork plugs, which are giving entire satisfaction. These plugs are found to expand with the heat, and also show a higher co-efficient than the wooden plugs. Cork also adapts itself to the rough surfaces of the iron, with which it comes in contact in the sockets of the shoe.

The McGuire Manufacturing Company, of Chicago, reports that it has had an unusually successful year, considering the dullness which has affected trade generally. The sales in this company's truck department exceeded the sales of 1895, which exceeded the sales of 1894 by about forty per cent. This company's sweeper department has been running full force since August, and the company has received a very large share of the sweeper orders this year. The sales of the Columbia heater, which is manufactured by the McGuire Manufacturing Company, have increased about fifty per cent over last year's sales, and in December, which is considered late in the stove business, about 400 stoves were shipped. This stove is extensively used, and is the standard on the Consolidated Traction Company, of Pittsburgh; the South and West Side railways, of Chicago; the Buffalo Railway; the Metropolitan Railway, of Kansas City; the Consolidated Traction Company, of Jersey City, and many smaller roads, and is used on over 200 roads in the United States. The company has done a very good business with its ratchet brake handle in the past year, considering the fact that this is a practically new specialty. The McGuire Manufacturing Company predicts a general awakening in the spring, and a corresponding increase in business.

The Joseph Dixon Crucible Company, of Jersey City, N. J., has received a report to the engineer of maintenance of way by the supervisor of signals, on a leading trunk line showing the satisfactory results obtained with a waterproof graphite grease manufactured by the Joseph Dixon Crucible Company. The report says, "At one point, from Oct. 1 to Nov. 28, ¼ lb. of the waterproof graphite grease was used on locks, cranks and compensations on outside, and on machine in tower. The cost of putting on, was found to be very little more than oil. The same test was made at another point on the road with the same good result. The supervisor found the waterproof graphite grease better than any other kind of lubricant as it can be applied quickly and stays where it is put. It is also clean, and the water has no effect upon it. Therefore the supervisor strongly recommends the use of this grease for all the places named above. As the graphite used in the manufacture of this grease is Dixon's pure flake graphite the lubricating qualities are easily understood, and if the waterproof qualities are all that the manufacturers claim and the tests seem to demonstrate, its economy and usefulness for all bearing and exposed parts of railway signals are very evident."

The Hoppes Manufacturing Company, of Springfield, O., reports a large increase in orders during the past few weeks, for its live steam feedwater purifiers and exhaust steam feedwater heaters. Among recent orders are the following: John Morrell & Company, Ltd., Ottumwa, Ia., repeat order for 500 h. p. purifier, also 350 h. p. exhaust steam feedwater heaters; Alcatraz Asphalt Company, Carpenteria, Cal., 100 h. p. purifier; St. Augustine (Fla.) Gas & Electric Light Company, 60 h. p. purifier; Louisville (Ky.) Railway Company, repeat order for 1250 h. p. purifier; Liggett & Myers Tobacco Company, St. Louis, Mo., three purifiers, 2250 h. p.; Northern Grain Company, Manitowoc, Wis., 200 h. p. purifier; Brooklyn, (N. Y.) Hygienic Ice Company, 500 h. p. purifier; South Dakota Hospital for the Insane, Yankton, S. D., 80 h. p. purifier, also 200. h. p. feedwater heater; Dayton Malleable Iron Company, Dayton, O., 200 h. p. purifier; Chattanooga (Tenn.) Light & Power Company, 500 h. p. purifier; Indianapolis (Ind.) Hospital, 200 h. p. heater; Milwaukee Sander Manufacturing Company, Green Bay, Wis., 75 h. p. heater; Rowland Hazard, Mine La Motte, Mo., 100 h. p. heater; Kupferle Brothers Manufacturing Company, St. Louis, Mo., 200 h. p. heater; Village of Clayton, Ill., 75 h. p. heater; Chas. G. Stifel, St. Louis, Mo., 150 heater; St. Louis Iron & Machine Company, St. Louis, Mo., 150 h. p. heater; Rochester (Minn.) State Hospital, 400 h. p. heater; Kansas State Insane Asylum, Osawatoime, Kan., 150 h. p. heater; P. H. & F. M. Root Company, Connersville, Ind., 100 h. p. heater; H. Guenther & Brothers, Owensboro, Ky., 100 h. p. heater, Acme White Lead Works, Detroit, Mich., 200 h. p. heater; California (Mo.) Electric Light & Power Company, 100 h. p. heater; Springfield (O.) Silver Plate Company, 75 h. p. heater; Alex. Balfour, Pencoyd, Pa., repeat order for 300 h. p. heater.

The Bethlehem Iron Company, of South Bethlehem, Pa., has recently invaded a new field with its hollow forged shafts. It has been introducing them on the Mississippi and Ohio Rivers for stern wheel steamers. A short time ago it closed a contract with the Pittsburgh & Cincinnati Packet Line, of Cincinnati, O., for a hollow forged, nickel steel, oil tempered shaft, 38 ft. 9 ins. long, 14 ins. outside diameter, with a 7 in. hole running through it. Such a shaft is 3500 lbs. lighter and 3½ times stronger than the shaft which ordinarily would be placed in such a vessel, which would be made of solid wrought iron. This company also sold a shaft recently to C. Jutte & Company, through Anderson, Shook & Company, of Pittsburgh, Pa., and it is also arranging to put a similar shaft into the new steamer which the Mississippi Valley Packet Company, of New Orleans, La., will shortly have built. In a paper recently read before the Western Society of Engineers, by H. F. J. Porter, general Western sales agent of the Bethlehem Iron Company, he spoke of these hollow forged shafts which he was introducing on the Mississippi and Ohio Rivers, and said that as compared with a wrought iron shaft 14 ins. in diameter and 30 ft. long, whose strength would be taken as unity, a solid steel shaft would be ⅓ stronger. A solid nickel steel shaft would be 1½ times stronger. A steel shaft of the same outside diameter with a 3½ in. hole through it and oil tempered would be twice as strong. A hollow nickel steel shaft of the same type would be three times as strong. A hollow forged steel shaft of the same weight, but of 22 ins. outside diameter and with a 17 in. hole through it, would be three times as

strong and if oil tempered 4½ times as strong. If made of nickel steel it would be six times and if oil tempered eight times as strong.

It is no wonder that boat owners on the rivers are glad to take advantage of this improved type of shaft in view of the great mortality in the past of solid wrought iron shafts which break after short service and when they break, the accompanying loss is usually very large.

New Publications.

THE STREET RAILWAY SPIRAL. By C. A. Alden, C. E., of Steelton, Pa. Seventeen pages. Price, single copy, fifty cents. Six copies $250.

This is a blue print reprint of an article by Mr. Alden in *Engineering News* and is of pocket size. Diagrams and a number of valuable tables for spiral curves are given, as well as the necessary rules for laying the rails.

BUILDING AND ENGINEERING TRADES DIRECTORY. Cloth, 306 pages. Price, $2. Published by F. W. Dodge, Boston, Mass.

This directory contains complete and accurate lists, properly classified and indexed, of contractors and builders, also of manufacturers and dealers in all the materials, apparatus and appliances used in the construction, furnishing and equipment of modern buildings and engineering projects, and all others identified with these interests in Boston and the surrounding cities. The work is supplemented by the official list of the building exchanges of Boston, together with the architects and engineers of New England.

THE NATIONAL ELECTRICAL CODE. By Pierce & Richardson. Flexible Leather. 222 pages. Price, $2. Published by Charles A. Hewitt, of Chicago.

This book explains in "ordinary language" the text of the Fire Underwriters' rules and regulations which must now be observed and which directly concern architects, builders, contractors, electricians and engineers. The aim of the authors has been to give an explanation of the Underwriters' Electrical Code in terms that will be intelligible to non-experts. The work is designed for the use of insurance companies as well as for firms engaged in actual construction work. A number of tables and curves are given showing the relations existing between the sectional area and the maximum safe carrying capacity of insulated copper wire.

Trade Catalogues.

X-RAY APPARATUS. Twenty pages. Published by the Central Electric Company, of Chicago.

CATALOGUE. Fifty-two pages. Illustrated. Published by McIntosh, Seymour & Company, of Auburn, N. Y.

CUTTERS, HEADS, ETC. Fourteen pages. Illustrated. Published by J. A. Fay & Company, of Cincinnati, O.

ELECTRIC LAUNCHES. Fifty-six pages. Illustrated. Published by the Electric Launch Company, of Morris Heights, New York City.

List of Street Railway Patents.

U. S. PATENTS ISSUED NOV. 24, 1896, TO DEC. 22, 1896, INCLUSIVE.

NOV 24.

ELECTRIC STREET OR STATION INDICATOR.—Herman Alwies, St. Louis, Mo. No. 571,738.

In an electric indicator, a line wire, a suitable web on which the names of the stations are disposed, rollers for said web, a series of circuit closing devices disposed in proximity to the line wire along the length thereof, a motor for advancing the web or turning the rollers on which the same winds, suitable mechanism actuated by the closing of the circuit under the action of the circuit closing devices, for arresting the momentum of the web and rollers carrying the same acquired during the advancing movement of the web, and intermediate connections between the momentum arresting device and the motor for alternately closing and breaking the circuit by which the motor is actuated.

CAR FENDER.—Charles F. Maisch, Philadelphia, Pa. No. 571,779.

CAR TRUCK.—John A. Brill, Philadelphia, Pa. No. 571,824.

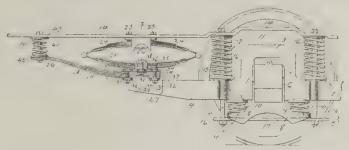
In a car truck, a compound spring located at each corner, said spring being composed of two unequal parts, a lower part attached to the truck frame, and engaging with the car body, and an upper part comprising two connected bow springs extending between the proximate frame end of said lower part and the truck chord.

ELECTRIC MOTOR RAILWAY TRUCK.—John A. Brill and George M. Brill, Philadelphia, Pa. No. 571,825.

In a motor truck, the combination with the axle box frame, of a motor sleeved at one end on one of the truck axles, a cross bar extending between the side bars of said frame, and a connection for the free end of the motor comprising a plurality of oppositely acting springs, and a vertical guide fixed to the cross bar, about which guide said springs are disposed, and between which springs said free end is interposed.

ELECTRICAL RAILWAY.—Rudolph M. Hunter, Philadelphia, Pa. No. 571,832.

In an electric railway two working conductors made in sections, the opposite conductors of two adjacent sections being electrically connected together, a closed circuit connecting two adjacent sections on the same side, an electromagnet in said closed circuit, an armature for said electromagnet, a shunt circuit connecting adjacent sections on the same side and adapted to be opened or closed by said armature, electric motors or locomotives electrically connected with said working conductors, and a source of electricity connecting with said conductors.



PAT. NO. 571,824.

CAR SIGNAL.—Horatio Phinney, Providence, R. I. No. 571,885.

In a car, the combination with the brake chain and two semaphone signals supported pivotally on a transverse rod above the roof, of a transverse shaft supported in bearings below the floor of the car, levers secured to the transverse shaft, connections between the semaphore signals and the levers on the transverse shaft, and connections between the levers and the brake chain, whereby on the setting of the brakes from the front brake handle two semaphore signals are set on the top of the car.

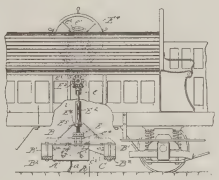
ELECTRIC RAIL BOND.—George H. Scott, Worcester, Mass. No. 571,888.

An electric rail bond comprising in combination a connecting rod and collars adapted to fit over the ends of said connecting rod and in the rail flange openings, said collars being tapered or conical shaped upon the outside, and their longitudinal openings cylindrical in shape about half way through from the smallest to the largest ends of the collars, and flaring outward, funnel shaped therefrom, to the larger ends of said collars.

CAR FENDER.—Morris Weisel, New York, N. Y. No. 571,938.

The combination with a car, of a fender carried thereby and adapted for depression until its lower edge is in contact with the ground, said fender being provided at its lower edge with a yielding cushion, and to the rear of said cushion with serrations adapted to bite into the clothing of a person who may have fallen on the track.

PAT. NO. 571,994.



PAT. NO. 572,939.

TROLLEY FINDER.—William J. Donahue and Ward B. Hausman, Philadelphia, Pa. No. 571,994.

A trolley finder consisting of a wheel having right and left hand grooves increasing in diameter toward the center and merging with the central groove on diametrically opposite sides of the wheel, and a suitable support.

DEC. 1.

CAR FENDER.—John A. G. O. Wolters, Philadelphia, Pa. No. 572,235.

SWITCH OPERATING DEVICE FOR STREET RAILWAY CARS.—David Rioux, Nelson C. Bushey and Napoleon L. Byron, Springfield, Mass. No. 572,313.

In switch operating devices for railway cars, a revoluble and vertically moving post supported in a vertical position on the car truck, containing two screw sections of reversely formed spiralities, a switch engaging wheel hung to rotate on the lower end of said post, two bifurcated levers engaging said screw sections, whereby simultaneous downward and revoluble movements are imparted to said post, and a spring for lifting said post and wheel, combined with two vertically moving foot posts in the platform of the car, and connections between said foot posts and said levers.

CAR FENDER.—Harold A. Webster, Haverhill, Mass. No. 572,389.

The combination of a frame or support projecting forward from the car platform, a primary fender pivotally connected between its

ends to said support, with its center of gravity forward of its pivoted point, and adapted to swing from an inclined position with its forward end in close proximity to the track, to a horizontal position with its forward end elevated, and a flexible supplemental fender affixed at one end to the dasher of the car above the primary holder and at its lower end to the primary fender below its center of motion, said supplemental fender being held yieldingly in a tense condition by the primary fender.

DEC. 8.

CAR BRAKE.—William S. G. Baker, Baltimore, Md. No. 572,518.

The combination with the truck frame of the brake shoes, the suspending links and springs held under compression at all times to produce a tension on the links.

CAR FENDER.—Jesse A. Graham, St. Louis, Mo. No. 572,601.

CAR MOTOR.—William Robinson, Boston, Mass. No. 572,685.

In combination, substantially as described, a motor, springs supporting one end of the same, and a series of levers supported on suitably arranged bearings or fulcrums formed independently of said motor and its journal boxes, said levers being arranged to distribute and equalize the pressure of said motor on said springs.

CAR TRUCK.—William Robinson, Boston, Mass. No. 572,686.

In a car truck, a lever pivotally connected to a portion of the truck extended outwardly beyond the journal box, said lever having one end flexibly connected to the main frame or car body and the other end supporting a spring or springs interposed between the end of said lever and said main frame or car body, said spring forming the only spring connection between said lever and car body.

ELECTRIC RAILWAY.—Rudolph M. Hunter, Philadelphia, Pa. No. 572,706.

In an electric vehicle, the combination of an electric motor mechanically connected to propel the vehicle, a reversing switch mechanically independent of the motor brushes to reverse the polarity of one of the elements of the motor, motor circuits on the car for supplying current to the motor from a source of electric supply, a switch for cutting the motor from a source of electric supply, and switch devices for short circuiting the armature and field magnets and maintaining them in series to make the motor act as a generator to arrest or retard the movement of the car.

CAR BRAKE.—Solon G. Howe, Detroit, Mich. No. 572,802.

In a car brake, the combination of a brake shoe, a knuckle lever engaged therewith, a rock shaft provided with an eccentric, and a flexible connection connecting the outer end of said eccentric with said lever.

STREET CAR BRAKE.—William G. Price, Chicago, Ill. No. 572,823.

A brake for street cars or the like comprising a brake shoe opposed to the car wheel, a disk in proximity to one of the car wheels, a projecting hub rigid with said disk and surrounding a sleeve keyed to the axle so that it cannot be moved away from said disk, two levers with bifurcated ends which engage said hub, said levers supported by the car so that they have a relative movement, a screw working in threads in one of said levers and bearing against the other lever, a connection between said screw and an operating handle, and an operative connection between said disk and the brake shoe whereby the brakes are applied by the movement of the wheel.

STREET CAR BRAKE.—William G. Price, Chicago, Ill. No. 572,824.

In a brake device the combination of a wheel with a disk adapted to be frictionally held against the wheel and when rotated to set the brakes, a fixed stop or collar on the axle, two movable parts interposed between the disk and the stop, and a wedge shaped device adapted to be inserted between the movable parts and to separate them, one of said movable parts provided with a projecting end which extends beneath said wedge shaped piece and acts as a bearing for the same.

STREET CAR BRAKE.—William G. Price, Chicago, Ill. No. 572,825.

A brake mechanism for cars comprising a friction disk opposed to a moving part of the car, two toothed parts associated with said disk, the teeth of said parts being in engagement, one of said parts provided with a stop connected with said disk, the other part being provided with a stop connected with some part of the car, whereby their lateral motion is limited, a split washer adapted to be inserted between one of said rings and the stop associated with the car, and a holding device for said washer adapted to hold the two parts in position, an operating handle connected with one of said parts so that they may be moved with relation to each other, one or more brake shoes associated with the wheels of the car, and connecting mechanism between said brake shoes and said friction disk.

VEHICLE BRAKE.—Charles B. Fairchild, New York, N. Y. No. 572,939.

In a vehicle brake, the combination of a brake brush, consisting of a rigid back in which are secured a plurality of brush teeth, said brush being maintained in contact with a suitable support, which is movable toward and from the roadbed or pavement, cam surfaces formed on said brush back and on said block or support, respectively, such that movement of said brush, longitudinally of said support, will operate to advance or retract said brush, relatively to said support, stops to maintain said support in permanent longitudinal adjustment, relatively to the car, stops to limit the longitudinal movement of said brush relatively to said support, means to maintain said brush, normally, at the limit of its retraction, relatively to said support, and means to lower and raise said support, to depress the free end of the brush teeth into and to raise them out of contact with the roadbed or pavement.

SUPPORT FOR TROLLEY WHEELS.—Christian F. L. Orth, New York, N. Y. No. 572,940.

The combination with the trolley arm of a trolley car, of a trolley yoke secured to the end thereof, the sides of which are downwardly curved, a trolley wheel mounted in said yoke, the shaft of which extends beyond the sides thereof, and a supplemental yoke mounted on said shaft, the end of which is connected with the ends of the sides of the trolley yoke, and the sides of which are directed upwardly, and provided at the upper ends thereof, with heads or wheels by which the space between said sides is closed.

DEC. 15.

CAR BRAKE.—Thomas Millen, New York, N. Y. No. 573,024.

In a self receding braking device, a brake beam, and guide brackets having inclined slots for the reception of the ends of the brake beam.

PIVOTAL CAR TRUCK.—William A. McGuire and Moses G. Hubbard, Jr., Chicago, Ill. No. 573,029.

In a four wheeled car truck, the combination with an upper frame and a centrally located bolster adapted to be pivotally connected with the body of the car, bearings on said upper frame and bolster adapted to bear upon the body of the car and keep said upper frame and car body substantially parallel, a lower frame, a pair of driving wheels, and a pair of guiding wheels journaled in said lower frame, of springs of greater carrying capacity mounted upon said lower frame upon the end carrying the driving wheels and bearing upon said upper frame, and springs of less carrying capacity mounted upon said lower frame at the end carrying said guiding wheels and bearing upon said upper frame.

ELECTRIC RAILWAY SYSTEM.—Bryon E. Osborn, Auburn, N. Y. No 573,033.

In an electric railway system, the combination of a moving vehicle, a concealed conductor for the passage of the main current, a conductor for conveying the main current to the vehicle, independently movable connecting pieces for connecting said conductors, electromagnets for operating the connecting pieces, additional electromagnets for governing the operation of the former electromagnets and means carried by the vehicle for controlling the operation of the additional electromagnets.

ELECTRIC RAILWAY CONSTRUCTION.—Geo. Westinghouse, Pittsburg, Pa. No. 573,066.

A structure for surface contact electric railways, comprising a switch box, a beam provided with contact supporting devices and extending laterally from said switch box beneath both track rails, and means for clamping both the switch box and the beam to the track rails.

CAR FENDER.—Mariano Sparmo and Louis Russo, New York, N. Y. No. 573,242.

DEC. 22.

SAFETY BRAKE FOR STREET CARS.—Bayard L. Kilgour, Cincinnati, O. No. 573,516.

The combination with a car body, of a supporting casing carried thereby, a box or nut provided with a threaded bore mounted thereon, a longitudinally movable brake provided with a threaded shank which passes through the threaded bore of said box or nut, and means for revolving the nut to raise or lower the brake.

CAR FENDER.—David O. Beckwith, St. Louis, Mo. No. 573,638.

CAR BRAKE.—Benjamin F. Jackson, Sutton, W. Va. No. 573,663.

In a car brake, the combination of wheels, brake beams having shoes engaging the wheel treads, springs connecting the brake beams and arranged to hold the same with their shoes normally engaging the car wheels, rods having their inner ends adjacent and having their outer ends connected to the brake beams, a drawhead, and a lever connected to and arranged to be moved by said drawhead, said lever having engagement with the inner ends of the brake bars, and being adapted when moved to actuate said brake rods to move the brake beams.

ELECTRIC RAILWAY.—Paul W. Leffler, Chicago, Ill. No. 573,819.

The combination with field magnets extending along the line of travel, of a series of co-operating magnetic sections, arranged longitudinally of the car, and a controller on the car for rendering said magnetic sections operative or inoperative, cumulatively in pairs, one on each side of the center of said armature.

ELECTRIC RAILWAY, ETC.—Paul W. Leffler, Chicago, Ill. No. 573,821.

The combination with a car or other traveling body, of field magnets extending along the line of travel, and a rotary magnetic body, carried by said car body, having one or more spirally arranged pole pieces subject to the action of said field.

We will send copies of specifications and drawings complete to any of the above patents to any address upon receipt of fifteen cents. Give date and number of patent desired. THE STREET RAILWAY PUBLISHING COMPANY, HAVEMEYER BUILDING, NEW YORK.

Street Railway Journal.

Vol. XIII. *NEW YORK AND CHICAGO, FEBRUARY, 1897.* *No. 2.*

THE BRIDGE TRANSPORTATION SYSTEM BETWEEN NEW YORK AND BROOKLYN.

Among the many difficult transportation problems which have had to be solved in New York City and vicinity, few are more interesting than that of taking care of a traffic ranging from 40,000 to 225,000 passengers per day, and of 1000 to 20,000 passengers per hour, which is offered to the railway line 6000 ft. long which crosses Brooklyn Bridge. The best engineering ability and experience has been devoted to solving this problem and to providing an absolutely continuous, regular and safe service to the public, and when it is stated that during the last eight years the total amount of time lost on the railway by delays from all causes has been but 48 hours 43 min. equivalent to almost exactly one minute per day, or of one second for each 1800 passengers carried, and that during the thirteen years in which this line has been operated, over 435,000,000 passengers have been transported, with an accident account showing but two fatalities and one severe injury to persons on the trains, it will be seen how thoroughly results have justified the engineering decisions made, and how profitable will be a study of how this marvelous record has been achieved. It is particularly fitting, too, at this time when plans for increasing the capacity of the Bridge Railway which were originally made several years ago, have now been carried into effect (with various modifications) to briefly review the history of the bridge as a transportation feature of the Greater New York, and to explain with some care the system as it exists to-day with all its improvements.

HISTORY.

The building of a bridge between New York and Brooklyn first took shape in 1867 as a private enterprise, but it almost immediately assumed a semi-municipal character, as the cities of New York and Brooklyn subscribed to about ninety per cent of the bridge company's capital stock and issued municipal bonds for the construction of the bridge The control of the enterprise remained for some time, however, in the hands of the private stockholders, but their stock was eventually purchased by the city. On May 23, 1867, John A. Roebling was appointed Chief Engineer, and on Sept. 1, of the same year, he submitted his first general report outlining the plan of the bridge substantially as it now exists. Mr. Roebling's death occurring soon after this time, his son, Col. Washington A. Roebling, was appointed Chief Engineer, and it was under his supervision that the construction of the bridge was carried through to completion. Construction commenced Jan. 3, 1870, the bridge was opened for pedestrians and vehicles on May 24, 1883, and the Railway was opened to passengers on Sept. 24 following. The cost of the bridge itself at its completion, exclusive of land, was about $11,500,000, and the total cost to Apr. 1, 1884, was $15,552,878, this amount including land and land damages, buildings, interest during construction and miscellaneous items.

ENGINEERING FEATURES.

The bridge is so well known as one of the world's great structures that only the briefest description of its engineering features is here necessary. The main span, which is, at its highest point, 135 ft. above high water mark, is supported from two masonry towers founded on caissons, 168 ft. × 102 ft. and 172 ft. × 102 ft., respectively, each weighing about 15,000 tons complete. The length of the river span between the towers is 1595 ft. 6 ins., and of each land span 930 ft. The length of the Brooklyn Approach is 998 ft., and of the New York Approach 1552 ft. 6 ins. The total length of the bridge structure between the curbs of Center Street, New York, and Tillary Street, Brooklyn, is 7580 ft. The entire structure, with the exception of the caissons underlying the two piers was built by day's work instead of by contract; competent workmen in the several departments being employed under the constant supervision of the engineers in charge. The results have been interesting in a number of ways to the student of engineering methods. For example, the two roadways for vehicular traffic are comparatively narrow, and are subject to constant wear over their entire

FIG. 1.—THE NEW YORK AND BROOKLYN BRIDGE.

surface, sometimes from loads bearing eight tons on a single wheel; nevertheless, they are still in good condition

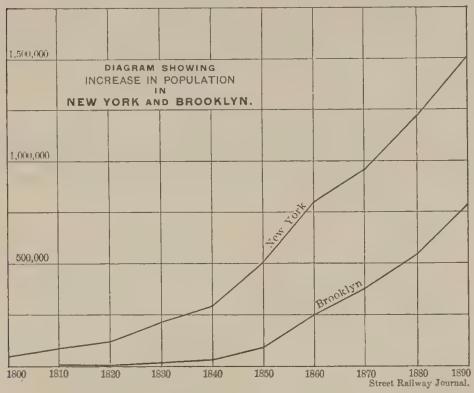


FIG. 2.—DIAGRAM OF POPULATION IN NEW YORK AND BROOKLYN.

after thirteen years of service, during which time there have been practically no repairs, while the city streets nearby on both sides of the river have been paved two or three times in the same length of time. The masonry of the bridge has been pronounced by competent engineers to be among the finest examples of good work in existence. After fifteen years of life it is as perfect (except in one place where a small crack has developed, and that of no consequence) as when first put up, while in one or two places where changes in design have made it necessary to take down portions of the structure, it has been found impossible to separate the stones without danger of fracture, except by chiseling away the mortar between them.

The floorings of the roadway at certain places where

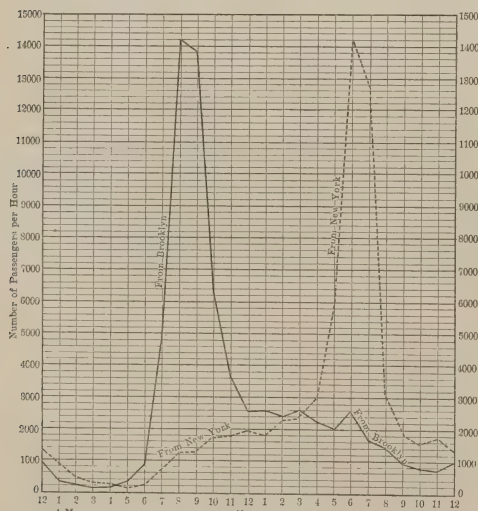

Number of Passengers per Hour
From Brooklyn
From New York
From New York
From Brooklyn
A.M.
Noon
P.M.
Railway Passengers from New York to Brooklyn, 62664 Max. per hour from New York, 14186
" " " Brooklyn to New York, 68617 " " " " Brooklyn, 14188
Total Passengers both ways for 24 hours 131281
Tuesday, October, 20, 1896.
Street Ry.Journal

FIG. 3.—SAMPLE TRAFFIC DIAGRAM.

such construction could be used have given remarkable service and form one of the best examples of intelligent engineering to be found in any similar structure. They consist of a series of parallel longitudinal brick arches of 3 ft. 6 ins. span and 3¼ ins. rise, laid between 9 in. rolled iron beams. The arches are of a single course of brick 4 ins. thick and backed with concrete 1¾ ins. deep at the crown. Over this are granite paving blocks 7 ins. deep, laid upon a ½ in. layer of clean coarse sand, and the total depth from the spring of arch to the upper surface of the paving is but 16½ ins. The under side of these arches is now as clean and free from cracks and leakage as when the masons removed the centers. A similar construction, but with brick arches 8 ins. in thickness, 4 ft. span and 6½ ins. rise forms the flooring for the car storage yard in Brooklyn which covers an area 595 ft. × 105 ft., or about 1⅜ acres. These arches are covered with a backing of concrete brought to a plane surface and then coated with asphalt, thus forming a smooth watertight

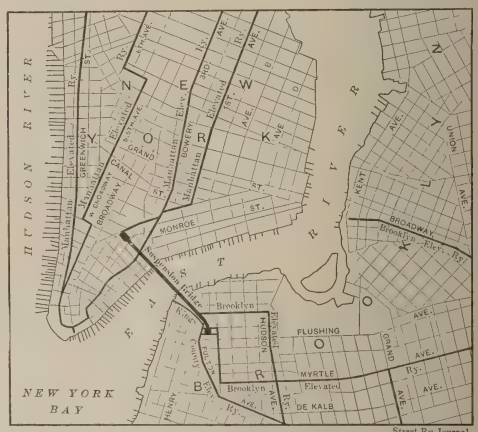


FIG. 4.—MAP SHOWING LOCATION OF BRIDGE AND ELEVATED RAILWAY SYSTEMS IN BOTH CITIES.

floor upon which are laid the long wooden stringers held together by plate iron ties.

The traffic features of the bridge are three in number; two roadways for vehicular traffic, each 18 ft. 9 ins. in width run across the bridge, the north side taking Brooklyn to New York travel, and the south side New York to Brooklyn travel; next to these roadways toward the center are two spaces, each 12 ft. 8 ins. in width, given up to the bridge railway which is built with gradients greater than the roadways; and in the center of the bridge is a promenade 15 ft. 7 ins. wide, for pedestrians, which is between the two towers of the bridge elevated above both cable railways and roadways.

CONDITIONS OF TRAFFIC.

The relative increase of population of the cities of New York and Brooklyn is shown diagrammatically in Fig. 2 from which may be obtained some conception of the transportation problems which will confront the two cities thirty or forty years hence when 5,000,000 people may be expected to find a residence in the two cities.

In an interesting map prepared in 1888 by A. M. Wellington, it was shown that in an area swept by a radius two miles long from a center at the New York City Hall, 4.1 sq. miles of New York territory, and 0.9 sq. mile of Brooklyn territory was contained, the former having an assessed valuation of $132,000,000 per square mile, and the latter but $73,500,000 per square mile; while in an area swept by a radius nine miles long from the same center, 17.4 sq. miles of New York territory was contained and 62.1 sq. miles of Brooklyn territory, the former having an assessed valuation of $52,600,000 per square mile, and the latter $5,479,000 per square mile.

In 1867 the ferries between New York and Brooklyn, then the only means of transportation, carried 40,000,000 passengers across the East River; to-day, the traffic between Long Island and Manhattan Island can hardly amount to less than 100,000,000 passengers per annum, of which nearly or quite 45,000,000 cross the bridge.

It is not, however, by the consideration of the gross traffic offered to the Bridge Railway that an adequate idea of the difficulties of the transportation problem can be obtained, nor by the average daily traffic throughout the year, but rather by an understanding of the *maxima* at different hours of the day and on special days of heavy traffic—moreover by the remembrance that provision of transportation facilities must be made, not for to-day nor yet to-morrow, but for twenty, thirty and even fifty years hence if waste investment is to be avoided. Consider, for example, the diagram of traffic in Fig. 6 on p 72. This engraving shows that during the last three years, when the traffic on other railroads has fallen off materially, that on the bridge has been well maintained. The normal annual growth during the years from 1886 to 1893 was about 3,000,000. It is not thought, however, by students of municipal growth that the future increase will be an equally high percentage, even if there should be no additional bridges. The growth of Brooklyn is largely on and along its easterly margins, and from this any increase in traffic over the Bridge and ferries, being saturated. Hence, since the crosstown railways in Brooklyn, electrically equipped, well and rapidly operated, deliver passengers at the foot of Broadway, from which they may speedily move to points above Union Square, New York, the overflow of traffic will be in that direction.

Fig. 6 shows the way in which the traffic varies from month to month, certain months having considerably more than others, and in Fig. 3 is shown an example of the way in which the traffic varies from hour to hour in a twenty-four hour day. Here we see that over 14,000 passengers must be taken care of in the hour from eight to nine o'clock in the morning, and the same number of passengers from six to seven o'clock at night, and this at present by four-car trains having a total carrying capacity, sitting and standing, of 600 passengers.

FIG. 4.—NEW YORK TERMINAL FROM BROOKLYN SIDE.

FIG. 5.—BROOKLYN TERMINAL FROM BROOKLYN SIDE.

OPERATION OF THE CABLE RAILWAY.

The Bridge was opened for foot passengers, May, 25, 1883, but the cable railway was not put in operation until Sept. 24, 1883. While similar to an ordinary cable railway in many particulars, the location on an elevated structure made possible the employment of certain features which were not ordinarily a part of a surface line and which have materially increased the efficiency of service and the life of different parts. The problems to be solved in the operation of the line were the regular transportation of a very much larger number of passengers than had ever before been attempted by a cable line, render-

Railway as well as over the Union Ferries (South, Wall, Fulton and Catherine Streets) must come, if it comes at all. Wellington's map, already referred to, shows that the trend of movement is towards upper New York, the lower portion, that part of Brooklyn reached by the Bridge

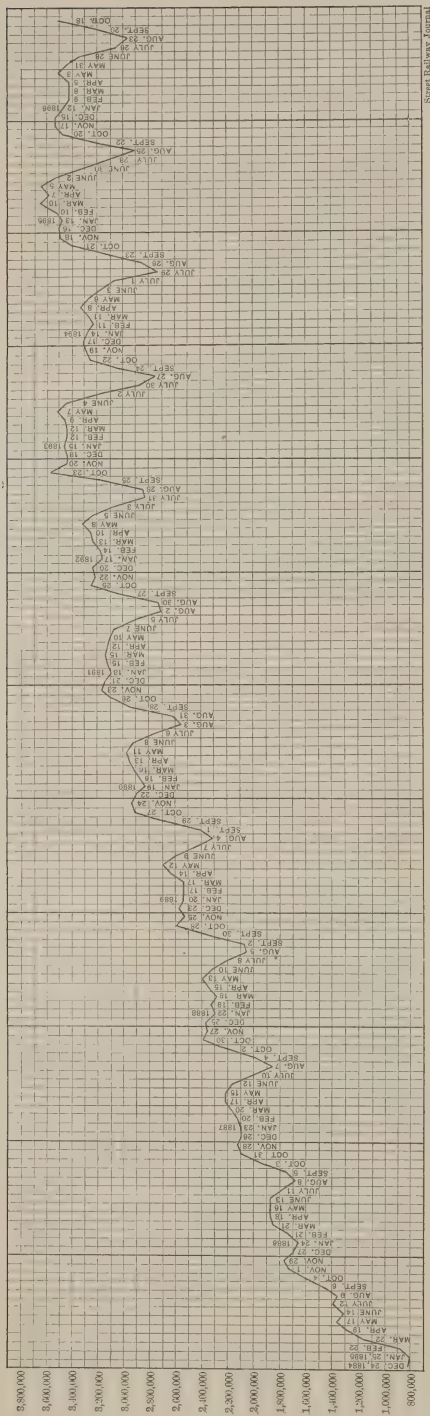


FIG. 6.—TRAFFIC DIAGRAM BY WEEKS SINCE OPENING OF BRIDGE.

ing necessary the use of more commodious and consequently heavier cars, the hauling of these cars over steep slopes, and terminal stops at elevated platforms, involving the necessity of perfect control over the car movement. That these conditions were successfully overcome is amply shown by the fact that during the history of the Bridge Railway up to Dec. 1, 1896, or for a period of $13\frac{3}{8}$ years, 435,150,309 passengers have been carried with unparalleled regularity and safety. During this period there have been but two accidents which have resulted in severe or fatal injury to a passenger.

When new the cables are $1\frac{1}{2}$ ins. in diameter and of an ultimate strength of over 114,000 lbs. The section of the cable is, of course, somewhat reduced by use, and when removed the diameter is about $1\frac{5}{16}$ ins. The following table gives the cable service on the bridge railway:

CABLE SERVICE ON THE BRIDGE RAILWAY.
To Dec. 1, 1896.

Cables in Order of Service	State of Service	Term of Service Days.	Total Distance Hauled, Miles.	Total Passengers Hauled.	Total Ton Miles Hauled.	Average Loads Hauled, Tons.	Average Ratio of Live to Dead Loads.
No. 1	Removed	1,140	228,329	49,002,442	22,142,706	97.	6.
2	"	607	120,232	47,840,262	25,492,892	212.	7.3
3	"	393	82,099	36,941,884	20,395,073	248.4	7.6
4	"	356	74,111	34,134,409	18,923,469	255.3	7.6
5	"	520	111,116	56,287,452	33,857,669	304.7	8.3
6	"	509	109,475	58,071,052	35,149,894	321.1	8.4
7	"	511	111,136	59,815,950	35,932,894	323.3	8.3
8	"	446	100,268	53,047,435	30,950,941	308.7	8.1
9	In use.	241	57,529	29,713,397	16,582,656	288.2	7.6
10	"	92	21,599	10,286,026	6,079,239	281.4	8 2

A large factor in the life of the cables has been the roller grip which was designed especially for this service. This grip holds the cable by means of two pairs of horizontal wheels having grooves lined with rubber and leather. The action of these grip wheels is supplemented by a pair of short solid rubber lined jaws which grasp the cable after the speed of the car has been brought up to that of the cable or nearly to it by the roller grip. Tests show, however, that the wheels without the solid grips have equal or greater traction than with them. In other words the solid grip attachment is practically unnecessary. The cable is lifted into place in the grip by external means. The pressure for holding the cable is transmitted to each grip wheel from the car platform by means of handwheel and rods through the medium of a wooden brake shoe applied to the inner surface of the rim which is flanged for this purpose. This brake shoe serves the double purpose of applying the pressure and checking the motion of the wheels until they cease to turn, when the car will travel at the same speed as the rope. The grip is attached to each car of the train. To further abate the wear on the cable the carrying sheaves are also packed with leather and sheet India rubber, so that the cable is in contact with iron only in the grooves of the winding drums.

The cars are fifty feet in length from center to center of drawbar and have four doors, one at each end and one at the middle of each side, for easy ingress and egress of passengers. They are fitted with two rows of longitudinal seats, one on each side. The cars weigh nineteen tons each.

The power station is located in Brooklyn close to the Brooklyn terminus. A plan of the driving machinery is given in Fig. 8. It is arranged so far as possible in duplicate, there being four sets of driving drums and four engines, one of 1000 h. p., one of 750 h. p., one of 500 h. p., and one of 250 h. p. The engines are directly connected by means of friction clutches to the main driving shaft, which is in several sections, or by gears. The shaft revolves at seventy revolutions per minute. Any or all of the engines can be cut out of connection with the shaft, so that any one may be used to operate the machinery alone. Generally for a considerable interval during a full day each engine is used, and during heavy loads two or more can be employed for furnishing necessary power, but so far they have not been required. Any set of driving drums can also be cut out if desired.

The driving drums are 12 ft. in diameter and are each fitted with four grooves for driving the cable. To provide for a possible unequal division of work between the two driving drums of a pair, power is not transmitted to them from the main shaft directly, but by means of a differential device illustrated in Fig. 7. The pinions which mesh into the driving drum gears are not keyed to the main shaft, but are mounted on sleeves. They are actuated by three small beveled gear wheels 120 degs. apart mounted on shafts, fast to the main shaft and radial to it. These beveled gear wheels mesh into the sides of the pinions driving the main drums. By this means one drum is at liberty to travel faster or slower than the other as the distribution of strains may require. In service the aggregate number of revolutions day by day of the two drums are about equal. In spite of the fact that the line is in continuous service, a recent examination of the wearing surfaces of the gear teeth showed the original tool marks, indicating very little wear during their long service.

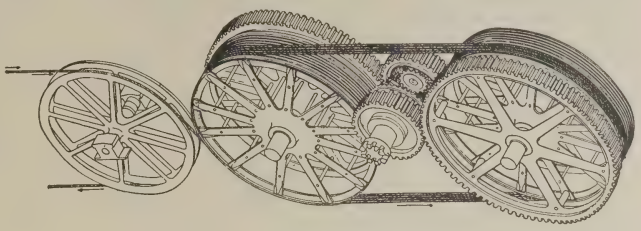


FIG. 7.—METHOD OF CABLE DRIVE.

from the reservoir in the shaft of each pinion through small oil holes in each bearing.

The steam generating equipment of the power station consists of eight Babcock & Wilcox boilers, two of which have recently been added. The boilers are of 104 h. p. each, i. e., they are guaranteed to evaporate per minute not less than 3120 lbs. of water at a temperature of 100 degs. F., under a steam pressure of 70 lbs. The boilers are set in batteries of two boilers each, and each battery has a heating surface of 2388 sq. ft.

THE ADOPTION OF ELECTRICITY AS AN AUXILIARY POWER.

The Brooklyn Bridge Railway is in many respects an ideal line for cable equipment. Indeed, so well is the cable fitted for this work that while electricity has been adopted for certain service, as will be described later, the Trustees of the bridge property are confident that it will never replace the cable for the work of heavy through transportation. The following are some of the principal advantages of cable power for the Bridge Railway:

The absence of grade crossings permits the employ-

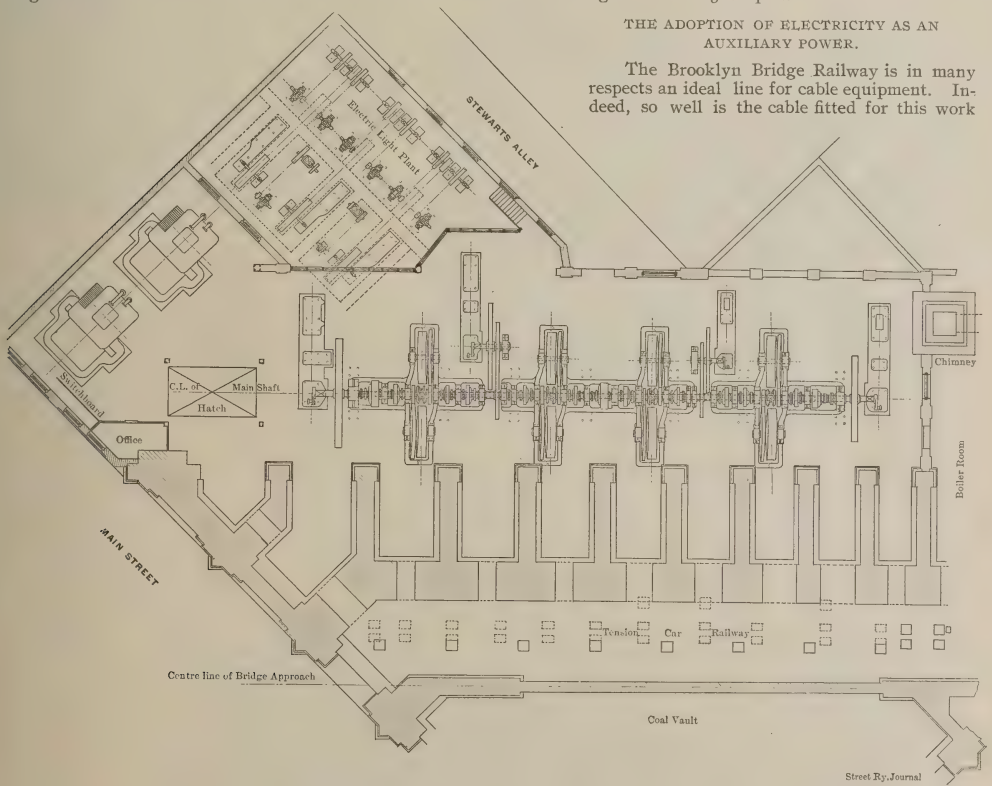


FIG. 8.—PLAN OF MACHINERY, POWER PLANT.

All journals run in hard brass bearings capable of adjustment in either direction. Various means of lubrication are employed. The journals of the direction sheaves are supplied with a prepared grease about the consistency of lard, from a reservoir conveniently placed and connected with the pillow blocks by small pipes. The small beveled pinions in the drum driving gears are lubricated by oil fed

FIG. 9.—ENTRANCE TO BROOKLYN TERMINAL.

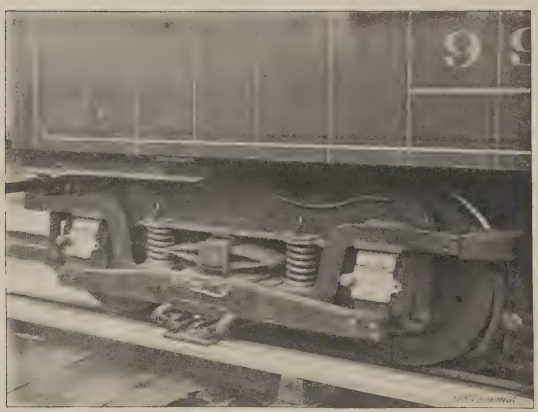


FIG. 10.—SHOE AND THIRD RAIL.

FIG. 11.—TRAIN LEAVING BROOKLYN TERMINAL.

ment of a surface cable, avoiding at the same time the expensive construction of a conduit, and permitting the easy inspection of the cable and sheaves and the employment of wear saving devices like the roller grip.

The route is short and straight and the traffic very heavy; conditions particularly favorable to high efficiency of cable apparatus.

The grades are steep and the descending load

FIG. 12.—CURVES AT ENTRANCE OF BROOKLYN TERMINAL

balances the ascending load, reducing the power required from the cable engines to a minimum.

The uniform speed given to the cars by the cable and that the cars, while attached to it, are spaced at regular intervals, eliminate from the operation of the trains a personal factor which might tend to accident from end collisions.

For switching the trains at the terminals, steam locomotives have, until recently, been used as well as to operate trains during the early morning hours when the amount of traffic was not sufficient to warrant the operation of the cable. The objections to these locomotives and the reasons which induced the Bridge Trustees to try as a substitute for them electric power, were described in full in the STREET RAILWAY JOURNAL for March, 1896. The electric equipment has since that date been in process of installment, and is working under test.

The generating plant for the Bridge Railway is located in an extension to the building containing the cable driving plant and the engines are supplied with steam from the same boilers that supply the

cable engines, so that if any accident disables the cable or its driving mechanism the steam is at once available for the load thrown on the dynamos.

FIG. 13.—PASSENGER PLATFORMS, BROOKLYN TERMINAL.

There are two 400 k. w. Walker generators direct connected to two simple non-condensing vertical engines of the Porter-Allen type. The engines operate at 100 r. p. m. and are guaranteed to give at an initial pressure of 100 lbs. and at ¼ cut-off not less than 600 h. p. each. As the electric equipment was designed principally to replace the locomotives in switching service at the terminals, the load is necessarily rapidly fluctuating between overload and no load and for part of the twenty-four hours will be practically nothing.

The switchboard is of the standard Walker construction with two feeders on each of three panels, two generator panels and one equalizer panel.

In considering the distribution of power through the feeders it is necessary to understand the conditions of bridge service. The major portion of the work is done on the Brooklyn end of the line since, in addition to the regular switching operations of the main line, the yards are located there and as from one-half to two-thirds of the trains are taken on and off before and after the rush hours and all are changed for cleaning during the day there is considerable yard switching. All this requires power. The next greatest demand for power comes from the New York Station, and ordinarily the Bridge itself takes no current except for lights and to supplement occasionally the grips on the car.

From the station, six feeders, each of 500,000 c. m. capacity, lead by the most direct path to the railroad track and so far as possible are parallel to and visible from them. Two feeders run to the New York Station and terminate there on a switchboard from which lead the taps to the different sections of rail. By means of taps to form the feeders to another switchboard located at the tilting sheaves, the track from the Station to the New York anchorage is supplied. Two more feeders run parallel to the tracks from anchorage to anchorage and are tapped in as shown in Fig. 20. They are made symmetrical because one side is as likely as the other to be used for shuttle trains at night or during blockades. The last two feeders supply the track from the Brooklyn station to the anchorage as well as the station itself and the yards. It will be observed that a number of switches, over forty in all, are used outside of the station. This enables a section to be readily cut off in case of derailment or trouble of any kind and when it is necessary to repair the track or the cable work. The principle has been observed that since the system was installed for railroad work, it should be put in the hands of the railroad men, and the switches have been placed in convenient places, and usually the track switch and the electric switch for that track are practically side by side, so that a man can throw both at once.

The third rail is bonded with two No. 0000 Chicago bonds at every joint. The bonds are bent downward after coming out two inches from the web so as to hang slightly below the rail to allow the removal of fishplates or tightening of the bolts. As the cable was located in the center of the track, the third rail is placed on one side or the other, and its head is five inches above that of the running rail. Tracks on the main lines are 5¾ ins. between centers of rails, the third rail is 16 ins. center to center from one rail and 21¾ ins. from the other. Where there is single track, the third rail is ordinarily placed 19 ins. center to center with the nearest running rail. This dis-

FIG. 14.—SANDS STREET ELEVATED RAILWAY STATION, BROOKLYN TERMINAL.

tributes the wear over the entire face of shoe. At the end of each section of rail, a cast iron end piece was fastened with ordinary fishplates, having its upper face sloping from the rail head to the point. At eight places in the third rail, there are "dead sections", consisting of two rail lengths supplied in each case from the nearest feeder through a separate switch and insulated from the neighboring rails at both ends. These are placed at each end of a section that it may be desirable to cut out so that the current cannot pass through from one live section to another section from which the current has been cut off through the front and rear shoes of the car as it passes over. For example, if workmen are on the north track on the suspended part of the bridge, the switches at the dead sections of both anchorages on that track are pulled as well as that on No. 4 feeder. Then a car in coming from Brooklyn has one shoe on the anchorage section and one on the dead section, then both on the dead section, since that is 60 ft. long and the shoes are 32 ft. apart between centers and then one on the center section and one on the dead section. It, of course, makes the dead section temporarily alive, but this section is so short that no one can be hurt, as he must necessarily have gotten out of the way of the train.

FIG. 15.—EXIT FROM BRIDGE CARS TO ELEVATED RAILROAD, NEW YORK TERMINAL.

The rail used for the conductor is the old four inch rail taken up last summer. At the time the track was relaid, the fishplates were not taken off the old rail except every 200 and 300 ft. In re-erecting it for electrical use, it was raised by hand and laid on the ties; owing to its flexibility it could be handled in any length. The insulators were then put on the bottom flange of the rail between the ties for the length of a section. The rail was again raised by hand or a lever over the running rail and an insulator slid along until it was over its tie, the rail was lowered and the next one similarly placed. Two men followed and gauged the rail and fastened the insulator to the tie. It was bonded after erection and no insulators were broken by the method of raising or by the riveting of the bonds.

Seven rail lengths, 210 ft., were connected, forming a standard section, and an inch space left between the sections to provide for expansion. At the dead sections a four inch air space was left, no fishplates being used.

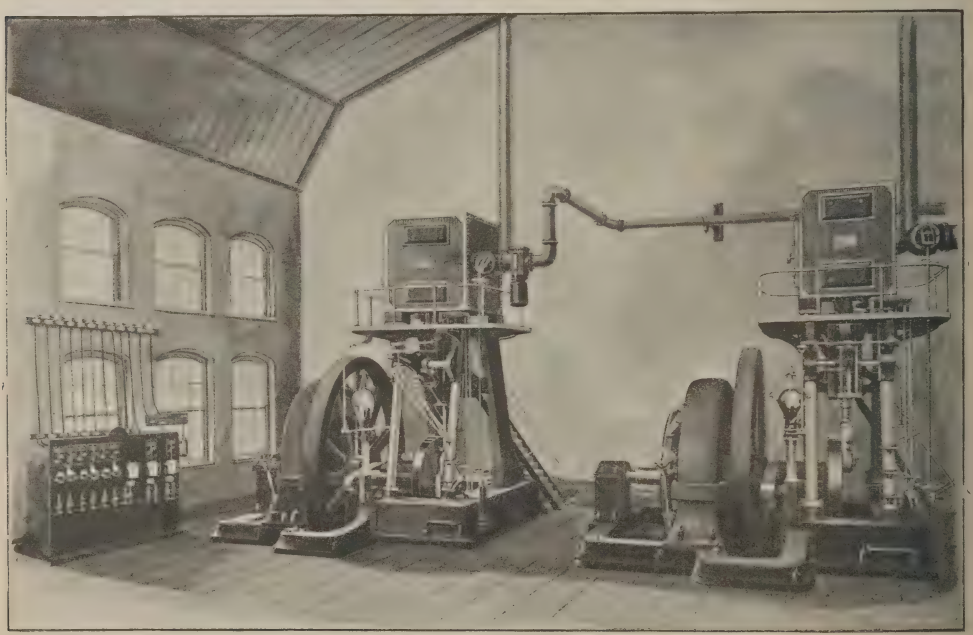


FIG. 16.—ELECTRIC RAILWAY PLANT.

The motor equipment of each car consists of four Gen-

eral Electric 50 motors, which are capable of continuously exerting a horizontal effort of 1200 lbs. when mounted on a thirty-three inch wheel running at ten miles per hour. The motors are completely encased, and are watertight and dust tight. The armatures are slotted, each coil lying in its own slot, and the method of winding followed allows of the removal of any coil, with very little disturbance to the others. Each motor is provided with a roller which will come directly over the cable and prevent it from abrading the motor or injuring it in any way and from being injured itself.

Each car has also two K 14 controllers which are similar to the standard K type of controller, but adapted for four motors.

The method of contact adopted is clearly illustrated in Fig. 10, which shows one of the shoes, of which there are four to each motor car, two on each side. These are suspended from a support set between the journal boxes of each truck.

The cars have been lighted by electricity for several years, the current being taken from an overhead wire by means of a trolley of special design.

The trucks employed are of the McGuire L type and were designed especially for this class of work. Double equalizing bars spring supported on the journal boxes are used. On these equalizers are mounted two cross sills, from which are suspended the electric motors, so that the wheels, axles, equalizers and motors move together independent of the truck frame and car body. The brakes are located inside the wheels and surround the motor without interfering in any way with it. Two types of brakes are used, the Eames vacuum and hand brakes. Each is inde-

FIG. 17.—SWITCHING TRACKS, NEW YORK TERMINAL.

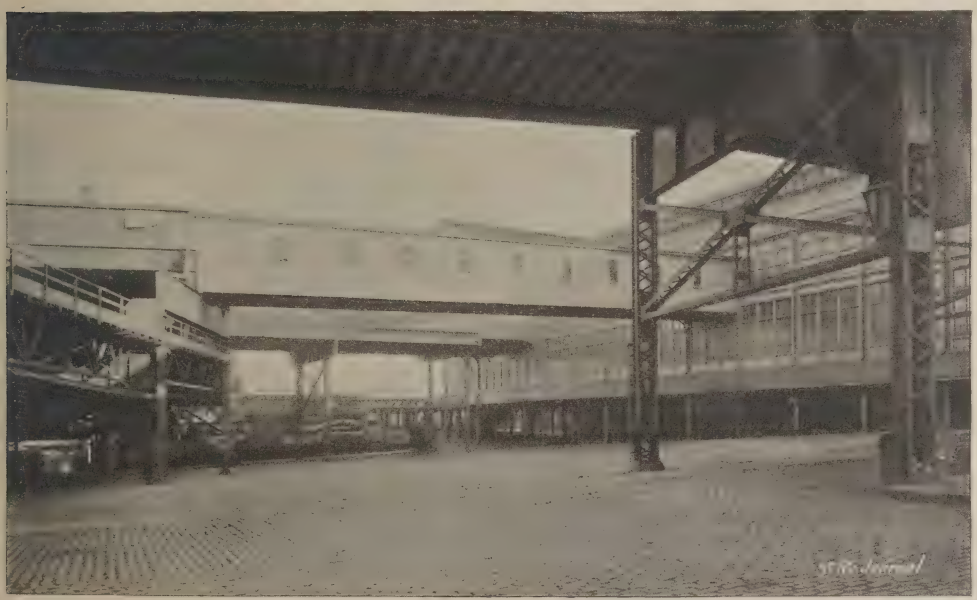


FIG. 18.—BROOKLYN TERMINAL, SHOWING ARRANGEMENTS OF ELEVATED RAILWAY TRACKS.

pendent of the other, so that in case of accident to the vacuum brakes the cars can be controlled by the hand brakes. Further particulars of these trucks were published in the STREET RAILWAY JOURNAL for February, 1896.

The motor cars, of which twenty are now is use, measure 39 ft. 3½ ins. over end sills. They are finished inside in mahogany with ceilings in light color decorated with gold. The cars have four doors, one at each end and one at the middle of each side. They are fitted with longitudinal seats having spring seats and backs covered with rattan. The trimmings are of solid bronze and the cars are heated with small hot water Baker heaters.

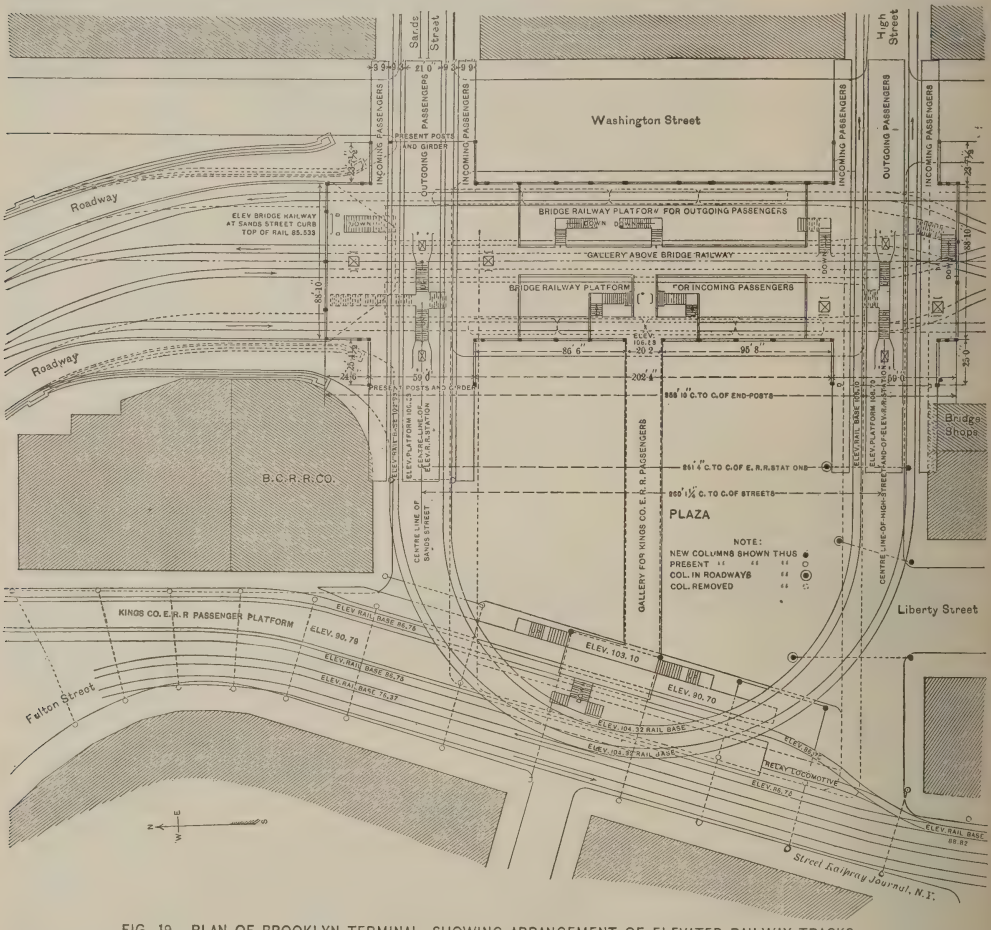


FIG. 19.—PLAN OF BROOKLYN TERMINAL, SHOWING ARRANGEMENT OF ELEVATED RAILWAY TRACKS.

TERMINAL FACILITIES.

No account of the New York & Brooklyn Bridge would be complete without a description of the carefully planned and elaborate system of terminal facilities recently completed on both the New York and Brooklyn sides. In considering these terminal arrangements it should be borne in mind that a large proportion of the traffic across the bridge comes from New York business men who have homes in Brooklyn, and that the New York terminal is at about the center of the New York business district and within easy walking distance of the destination of most of the passengers. Greater care was therefore paid to the transfer of passengers from the Bridge Railway to the surface and elevated lines at the Brooklyn end than in New York.

In Brooklyn the bridge entrance is the main terminal of most of the Brooklyn transportation systems, both surface and elevated, and the plan of the new Brooklyn terminus is shown in Fig. 19. The elevated railroad systems in Brooklyn are two in number: the Brooklyn Elevated Railroad and the Kings County Elevated Railroad. The trains of the former run on a double track loop entering by way of Sands Street, and departing by way of High Street. There are two stations in the bridge structure with separate platforms for outgoing and incoming passengers, one on each street. During the time of heavy traffic it is intended that every other elevated railroad train on this line shall stop at the Sands Street station, and every other one, running over the second track, at the High Street station. During the hours of light traffic, the Sands Street station is not used. Each of these elevated railroad stations is just above the Bridge Railway platforms from which they are reached by flights of stairs.

The Bridge cars are run out from two platforms and the incoming trains discharge passengers at two other platforms, as shown, the empty cars being switched from the incoming to the outgoing platforms. The station of the Kings County Elevated Railroad is on Fulton Street, mid-

way between Sands and High Streets, and is connected with the Bridge Station by an inclined gallery. Passengers from the trains of the Kings County Elevated Railroad pass horizontally along this gallery for about 230 ft. to the third floor of the Bridge Station, which is at the same elevation as the platforms of the Brooklyn Elevated Railroad stations, whence they descend by stairways to the center of the bridge railway platforms.

Passengers for the surface lines can either take their cars on Washington Street or on Fulton Street. Application has been made for terminal surface tracks on the Plaza shown in the engraving, and if this be granted the transfer of bridge passengers to the surface railways will greatly facilitated.

The new improvements at the New York terminal have been chiefly to facilitate the despatching of trains, the capacity of the terminal being practically doubled by the changes made. Formerly the cars discharged the passengers at one platform and were then switched to the outgoing platform. Two center platforms are now used, as shown in the engraving (Fig. 20). The entering trains discharge alternately on each side of the incoming platform and are then switched alternately to either side of the outgoing platform. Incoming passengers who wish to take the Third Avenue trains of the Manhattan Elevated Railway pass directly to the station of that railway without descending to the street, while there are also several entrances to the cable railway platforms.

FINANCIAL RESULTS.

The receipts of the Brooklyn Bridge from all sources for the year ending Dec. 31, 1896, amounted to $1,404,318.47 and the total expenditures to $1,640,490.24, the latter figure including heavy charges to construction account together with interest on certain New York City and Brooklyn bonds. A careful inspection of the items

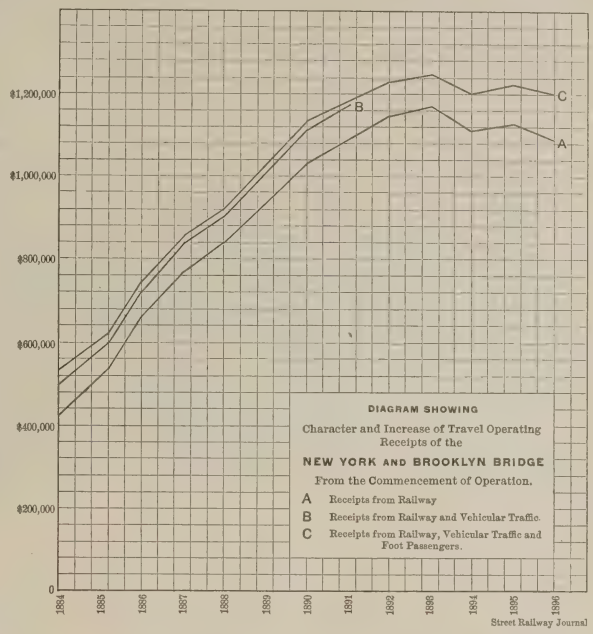


FIG. 21.—DIAGRAM OF RECEIPTS.

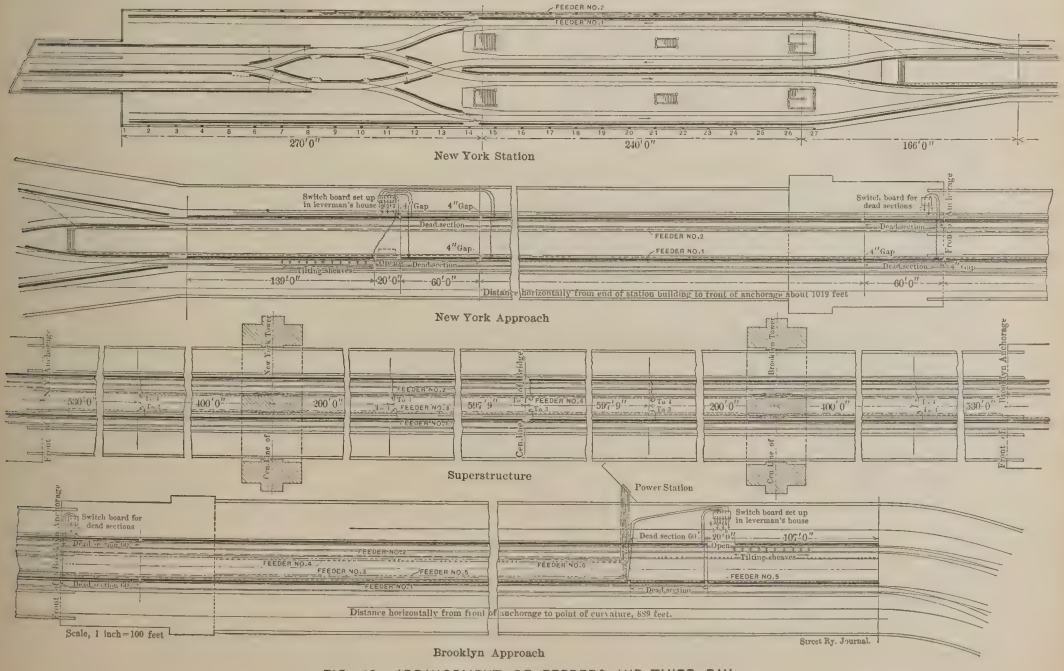

New York Station
New York Approach
Superstructure
Power Station
Brooklyn Approach
Distance horizontally from end of station building to front of anchorage about 1019 feet
Distance horizontally from front of anchorage to point of curvature, 839 feet.
Scale, 1 inch=100 feet
Street Ry. Journal.

FIG. 20.—ARRANGEMENT OF FEEDERS AND THIRD RAIL.

both of receipts and expenditures shows that the difference between the true operating receipts and the true operating expenses amounts to a sum equivalent to a return of about 2.3 per cent upon the original cost of the Bridge with its land, buildings, etc., assuming this cost to be in round numbers $15,0000,000. This is not, to be sure, a large return, but certainly, considering the great value of the Bridge as a public work, it is gratifying to find that it is even measurably self-supporting and not a serious burden upon the finances of the two cities.

Heavy Electric Railway Service in California.

It is not alone in the East that the application of the electric motor to steam line traction has been favorably considered and adopted, and while our attention is concentrated upon the improvements effected and contemplated upon such important roads as the New York, New Haven & Hartford Railroad and the Baltimore & Ohio Railroad, similar action in the far West is apt to be overlooked. Yet a very interesting adaptation of the electric motor to the steam car has recently been made on a railroad in California.

FIG. 1.—ELECTRIC TRAIN OF THREE CARS—CALIFORNIA RAILWAY CO.

The California Railway Company, operates a short line of road some three miles in length, which runs from the junction of the Southern Pacific Suburban Railroad, to Leona Heights, passing on the way Mills Seminary, the California equivalent of Vassar College. The road serves both Alameda and Fruitvale, which are both located just across San Francisco Bay opposite San Francisco itself.

The motor equipments consist of four G. E. 1000 motors of the standard type. Two motors are mounted upon each truck.

The controllers are of the K type and are provided with the magnetic blow-out. Each car is fitted with automatic circuit breakers and resistances, and the interior is lighted by incandescent lamps in groups of three. The illustration of car No. 11, shows the form of vestibule used.

Motor car No. 21, which is shown coupled to its train, is also a composite car and is similarly equipped so far as its electrical apparatus is concerned. It is not vestibuled, however, and was one of the first to receive its electrical equipment.

The track is of standard steam railroad construction bonded for the return. The overhead line is suspended from iron brackets swung from round poles for part of the way; for the balance of the distance it is suspended from span wires.

The general character of the equipment of this road is similar to that in operation on the New York, New Haven & Hartford, with the exception of the motors, and it will be recalled that the cars of this latter line and their equipment have served as models, both in the design of car and the arrangements of the motors, for heavy electric railway construction elsewhere.

FIG. 2.—ELECTRIC MOTOR CAR—CALIFORNIA RAILWAY CO.

The General Electric Company, which carried out the equipment of the California Railway Company, through its Pacific Coast office, will shortly equip another locomotive for use on the Alameda and Fruitvale line, using however, two or four G. E. 2000 motors instead of G. E. 1000 motors as on the other cars.

The cars used are standard steam railroad cars. The motor cars of the trains, of which one is shown run out, for the purpose of being photographed, are composite baggage and passenger cars. Motor car No. 11 is vestibuled at each end and carries on each hood an electric headlight. It takes current from an overhead wire by two trolleys, one of which only is in contact during operation. Each motor car is fitted with an automatic air pump to operate the brakes and the chime whistles of which there are two, one on each hood.

Remarkable presence of mind was shown by one of the motormen of the Buffalo Railway recently in a trying situation. At a steam crossing the conductor had gone ahead and signaled the motorman to proceed, but when directly upon the steam tracks the trolley wheel left the wire, and the car came to a standstill with an approaching locomotive in sight. The motorman at once perceived that there was not time for the conductor to return to his car and replace the trolley, so he set the controller at the starting point, left the car and went back and replaced the trolley, when the car immediately started of its own accord, and barely escaped the approaching train.

The Street Railway System of Geneva, Switzerland.

Geneva, which is the largest city in Switzerland, is located at the lower end of the beautiful Lake Leman where it narrows almost to a point and pours out into the River Rhone. This river divides the city into two portions and is crossed by several bridges. The city, which is an extremely attractive one with handsome residences and quays along the banks of the lake and of the Rhone, is very ancient and has played a prominent part in history, not only in the early Roman times and in the Middle Ages, but also during the Reformation and in modern times.

It is famous for its manufacture of watches, and its inhabitants have always been noted for their intelligence and enterprise. It is not therefore surprising that the advantages of the application of electricity in its various industrial forms should have been early appreciated in this metropolis of the Swiss, and that among other applications of electric power, that to railway service should have been made early in this city. The city is well situated for electric railway service. The system has been well developed by the General Swiss Tramway Company which owns not only the entire system at Geneva, but also another road at Bienne, a smaller town, not far from Bern.

There were originally some experiments made with the storage battery system in Geneva, but the overhead system was later adopted, being first installed in 1894 on a new line. Originally there were several criticisms on the part of the public, from an æsthetic standpoint, upon the use of overhead wires. These had no effect however upon the decision taken by the authorities of the city to permit the use of it, and as great care was taken to make the overhead construction tasteful in every way, by the use of ornamental poles and house rosettes and in other ways, all objections were soon forgotten. The service given by the cars was so far superior to that which would have been supplied by horse cars that any possible disagreeable impressions first produced by the appearance of overhead wires soon disappeared and the system is being extended not only in Geneva, but throughout all Switzerland.

The results to the railway company from a financial standpoint have been very satisfactory. The saving in cost of operation per car mile has been 3.3 cents, or about 8 cents in place of 11.3 cents which was the expense formerly when horses were used. This would result in an economy of operating expenses of about $4000 a year, except that a considerably higher number of car miles are run now than formerly. This new service joined with the advantages which result from electric traction has been followed by an increase in receipts which are estimated at $12,000 a year. The increase in earnings would have made a showing very much more favorable than that given, except that the most important line belonging to the system was up to now operated by both steam locomotives

FIG. 1.—STREET SCENE.

FIG. 2.—STREET SCENE.

in conjunction with horse cars, so that the variations in the traffic could be cared for very well.

The first application of the electric system to any part of the line previously operated by horse power was in the early part of 1896.

The total receipts in 1894 (exclusive of the Saconnex-Champel line) were $127,000, per mile of line $13,200, per train mile 30 cents. The expenses per train mile were 21 cents. In 1895, the total receipts were $160,000 in round numbers. The length of line operated is about 12½ miles.

FIG. 3.—TROLLEY WITH SHOE CONTACT.

FIGS. 4 AND 5.—HOUSE ROSETTES.

The number of cars or trains in service is as follows:

Five trains operated by locomotives (two or three cars).	
Twenty-one electric cars (with or without trail cars).	
Four horse cars.	
Cost of traction per car mile by steam locomotives	14.5 cents.
Electric traction	8 "
Horse traction	11.3 "

Current is generated by water power owned by the city of Geneva and supplied to the railway company in the form of electrical energy. The price paid is 2.5 cents per kilowatt hour. This price includes maintenance of generators, lubrication, interest, sinking fund on the capital required in the installation of the power station, etc. The generators used are of the Thury type illustrated in Fig. 6. They are of 150 K. W. each and directly connected to Alioth rotary converters which are themselves driven from the turbine station by Thury alternators.

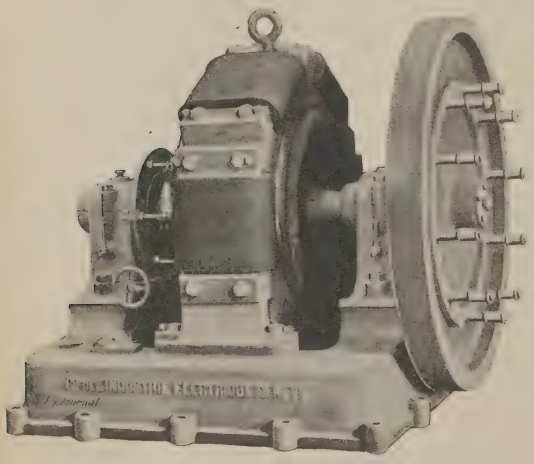


FIG. 6.—GENERATOR.

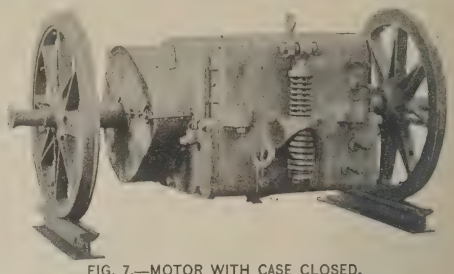


FIG. 7.—MOTOR WITH CASE CLOSED.

The motors are those of the Compagnie de l'Industrie Electrique of Geneva and are illustrated in Figs. 7 and 8.

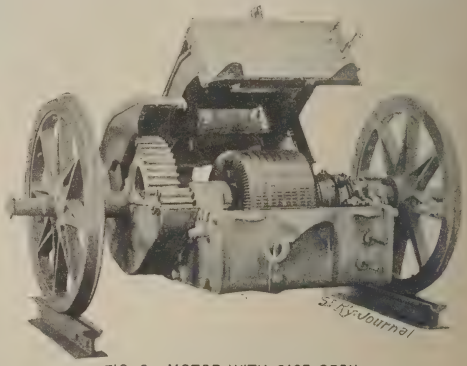


FIG. 8.—MOTOR WITH CASE OPEN.

They are of twenty-five horse power each with four poles, two of which are not wound, and with armatures of the Gramme ring type. The cars run at a speed of 8½ miles an hour in densely populated streets and 12½ miles per hour in the suburbs.

The cars are of Swiss make and have a length over all of 23½ ft., width 7 ft., and a capacity of forty passengers. The wheels have a diameter of 31½ ins.

The overhead wire is of tempered bronze, fed every 1200 ft. or 1500 ft. by feeders which are carried under the ground. Underground return feeders are also used. The feeders are protected by double lead sheathing and steel casing and are laid directly in the earth in a bed of sand.

Figs 4 and 5 show the form of rosettes used to attach the span wires to the houses where poles are not employed. They are respectively of the eyebolt and ratchet type.

Where poles are employed they are tubular and of metal. The trolley is of the sliding type with shoe. The head of one of these trolleys is illustrated in Fig. 3. The company is experimenting, however, with a wheel trolley. The overhead line appliances are of the Anderson type using Aetna insulators. The cars run 1240 miles per day, of which 124 miles are covered by trail cars.

The West End Company, of Boston, having had a number of years' experience in operating long cars, has decided that the advantages overbalance the disadvantages and all new cars are to be of this type. The standard body is 25 ft. long, and the wheels are of uniform size. The trucks are manufactured in the company's shops.

The Street Railway System of Zanesville, O.

The system of the Zanesville Railway & Electric Company was put in operation by electric power in 1890, and has been in active and successful operation ever since that time. It is, therefore, one of the oldest electric railways in this country, and possesses many interesting features. The road is about ten miles in length with no grades of any account. The rails are 48 lb. girder and 48 lb. Johnson T rail well laid on ties 5 ins. × 7 ins. × 7½ ft. with 3 in. centers. Brick paving is used on most of the streets occupied by the company's lines.

The overhead construction is very substantial, the

FIG. 1.—PASSING LOW BRIDGE.

wires being supported on 30 ft. wooden and iron poles. No. 4 copper wire is used for the trolley wire and No. 000 copper wire for the feeds. An interesting problem in overhead construction was encountered while building this road as there were three long wooden bridges to be crossed, two of which are covered; these covered bridges are but fourteen feet in the clear. This necessitated wooden trolley poles and unusually small trolley wheels. In the place of wire, the trolley runs on an iron plate and when passing over the bridges the trolley pole is nearly parallel with the top of the car.

Power for the electric railway is leased from the electric light station, which is controlled by the same company. The power house is a substantial building 60 ft. × 100 ft. built of iron, brick and terra cotta, with stone and brick foundations. The stack of the power house is 122 ft. high. The power house has recently been improved by the addition of considerable modern machinery. Russell engines and engines of local manufacture are used as follows: two 125 h. p.; one of 125 h. p., and one compound four valve engine of 330 h. p. The engines are all connected to a center jackshaft as shown in Fig. 3. Three 100 ampere and two 80 ampere Western Electric generators which run 1500 incandescent lights, 216 street lights and 107 arc lights are employed. The boiler room is 75 ft. × 50 ft., and contains eight boilers of local manufacture.

The car house is of wood and iron and is 170 ft. × 75 ft. The rolling stock consists of nine open and eleven closed motor cars and seven open and four closed trail cars. The motor cars are sixteen feet in length with hard wood inside finish. The cars are equipped with Sprague No. 6 motors.

FIG. 2.—CROSSING THE CAUSEWAY.

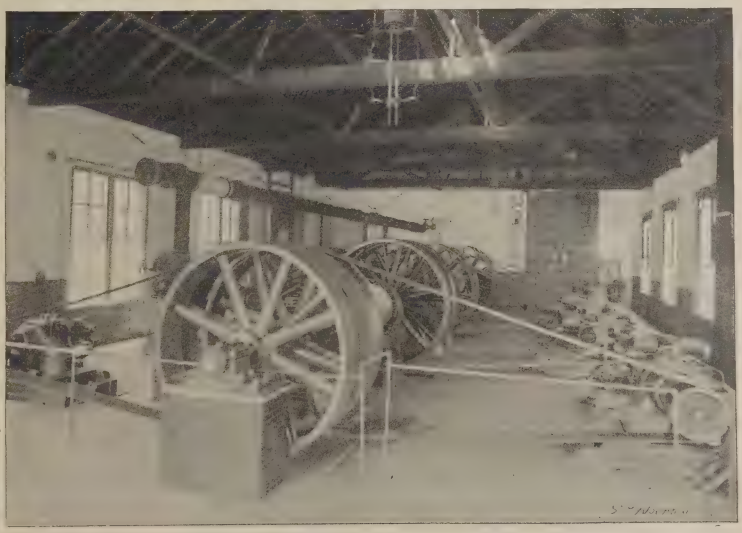


FIG. 3.—INTERIOR OF POWER STATION.

The company rebuilds all its own cars and also makes

all its general repairs at its own repair shops. The shops are divided into an armature winding room, which is 20 ft. × 30 ft., a carpenter shop, 20 ft. × 50 ft., and a blacksmith shop 20 ft. × 30 ft.

The company's lines extend to two parks, Gant Park and Maplewood Park, and the pleasure traffic induced by

FIG. 4.—CAR APPROACHING CAUSEWAY.

these two parks comprises a large part of the company's business. Mr. Newkirk, the general manager of the company, has devoted a great deal of attention to this traffic feature and is a firm believer in the value of parks as inducements to street railway travel. A view in Gant Park and full particulars in regard to the average expenses and returns from these parks are published elsewhere in this issue.

The authorised capital stock of the company is $500,000, and $500,000 in five per cent bonds have been issued. During the last fiscal year 1,250,000 passengers were carried or about 4.01 passengers per car mile run. The average number of car miles run per day was 100 miles, and the total operating expenses were twelve cents per car mile. The cost of motive power, which is leased, was two

FIG. 5.—INTERIOR OF CAR HOUSE.

cents per car mile. The officers of the company are: John Hoge, president; W. Bateman, vice-president Geo. Stewart, treasurer; K. B. Conger, secretary, and Henry R. Newkirk, general manager.

The Hamilton (Ont.) Radial Electric Railway.

The system of the Hamilton Radial Electric Railway Company embraces twelve miles of track, the power house being situated nine miles from the Hamilton terminal. It is the intention of the railway company to extend its lines in the direction of Toronto early next season, and it is not at all unlikely that the company will push on to Parkdale and connect with the Toronto Suburban Railway system, Toronto and Hamilton being forty miles apart. The company was organized in May, 1896, and has been in operation since Sept. 1.

The track and roadbed have been constructed in a very thorough manner. The rails are sixty-five pounds in weight, with six hole angle bars put down with the Goldie patented point spike. The best obtainable cedar ties are used on the main line and oak ties on the crossovers and turnouts with two inch centers between them. The rails are bonded with Brown's plastic rail bond, and at a recent test made on this road it was found that in 9½ miles of single track the drop due to the bonds alone was within three volts of the theoretical drop due to rail resistance.

The line construction is said to be the heaviest and most substantial in Canada, for a suburban road. On the span wire work the poles are set 100 ft. apart and where bracket construction is used the poles are 90 ft. apart. Double trolley wire of No. 00 copper has been used in order that the cars may run at a high rate of speed, and that there will be no delay in passing turnouts. With this construction a car can pass a switch or turnout at the rate of twenty-five or thirty miles an hour.

The pole brackets are of a special flexible make, and were all designed by the contractor's engineer. The overhead material was furnished by the Ohio Brass Company.

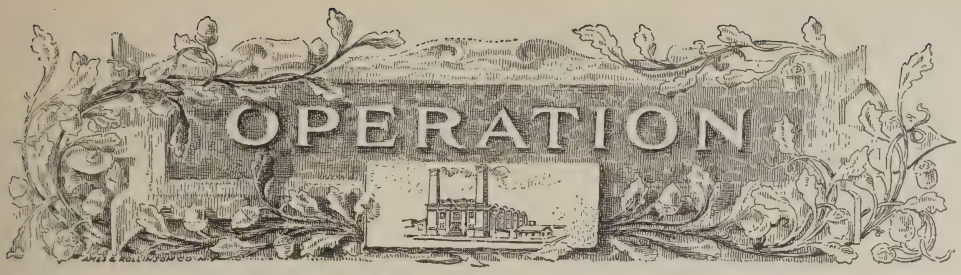
The road crosses the Burlington Canal on a swing bridge, where special precaution has been taken to prevent a car going over the draw. On the north side the draw is approached on a grade of three per cent and on the south side by a curve. The bridge is swung by power received from the railway company's wires. Another precaution has been taken to insure absolute safety: the trolley wires on the bridge are fed by a submarine cable from the terminal house. These bridge wires interlock with wires on the shore and when the bridge is closed feed a shore section of 700 ft. on each side. As soon as the bridge is swung six inches or more, these sections become dead and a car entering one of the sections when the bridge is open would receive no power whatsoever. The grade and curve on the opposite side would kill whatever momentum the car might have.

The power house is situated near the Brant House; it is 103 ft. × 63 ft. and is of pressed brick, with brown stone coping and slate roof. The smokestack is 120 ft. high and of brick. The power house contains two tandem compound condensing engines of 250 h. p. each, and one battery of three boilers of 600 h. p. There are two Canadian General Electric Company's generators, multipolar type, 200 k. w. each. The power house has been designed to accommodate about twice its present horse power capacity.

The cars are of Canadian manufacture. Each car is 51 ft. long, double truck equipment, with two General Electric 50 h. p. motors and fitted with the Standard Air Brake Company's brakes.

The officers and directors of the company are: president, Alexander Turner; vice-president and managing director, Thomas E. Leather; treasurer, William A. Wood.

Thomas E. Hillman was chief engineer of the road Mr. Macartney, of Macartney, Mc Elroy & Company, assisted by W. R. Scott, his line superintendent, directed the overhead construction. When in active operation, Wm. Sweet will be chief engineer, and Percy Dimville electrical engineer.



The Discussion of the Proper Shape of Wheel Flange.

By C. F. Uebelacker.

There are nearly as many different shaped wheel flanges as there are different patterns for wheel centers. The standard followed by many founders seems to be mainly a kind of combination of steam road practice and guesswork. We can find flanges of all slopes from that of the Master Car Builders' standard to a flange which, even when new, is vertical. We have them of all thicknesses and of heights varying from ⅜ ins. to 1 in.

The purpose of the flange is to retain the tread of the wheel on the rail. That the flange has a further function, namely that of centering the car on the track might be open to some discussion. It is, however, beyond question that any flange with a reasonably long fillet aids in preventing the side motion of a moving truck and consequently increases the smoothness of running. The question as to whether this work of keeping the truck straight on a tangent should be left entirely to the flange fillet or whether this fillet should be assisted, so to speak, by slightly coning the treads of the wheels is one that has been much discussed.

Steam road practice as exemplified in the Master Car Builders' standard wheel seems to have abandoned the idea of the coned tread as used for this purpose. the coned portion of the tread being more an allowance for the wear of the straight portion. On the narrow tread wheels used under street cars, however, practice still calls for a slight cone, ordinarily about 2 degs. or a difference in diameter on a 33 in. wheel of in the neighborhood of $\frac{1}{16}$ in. on a 2½ in. tread. It would certainly seem that if we cone the tread of the wheel, we should pitch the height of the rail to fit this cone, as with the coned tread, the wearing surface of the rail must gradually wear toward a pitch to correspond with the coning of the wheel. It seems to the writer, however, that this coning of a narrow tread wheel is unnecessary and in some respects even undesirable in view of the fact that the long filleted flange which will later be shown necessary would perform all of the duties of the coned tread.

This discussion of the shape of the tread is, however, somewhat aside from the purpose of this article which is mainly intended as a demonstration of a shape of flange which our present practice in track laying would call for. It is to the point only as showing an additional advantage of the shape which will later be worked out.

The absolute dimensions of the flange for any service, such as the height and thickness are independent to a great extent of the proper shape; for instance, the height of a flange is a matter in which we are governed purely by experience. The extent to which this is true may be judged from a remark credited to George Westinghouse, who said in effect, that if the question of the proper height of flange for a speed of sixty miles an hour should have been presented to him as a mathematical problem, without reference to previous experience, he certainly would not have thought one less than six inches in height safe.

Street road practice seems to vary from the ⅝ in. flange used in Buffalo and Pittsburgh to ⅞ in. Neither Buffalo nor Pittsburgh seems to have any trouble from derailment which is assignable to the flange, while roads using the ⅞ in. flange do not seem to experience much trouble from breakage due to the extra length. As a general proposition, however, it would be desirable both on account of the special work and on account of the additional strength of the flange to keep the height as small as possible. This would also be desirable on many roads with a view to allowing the tread to wear well into the chill before the flange bore on the tram of the rail.

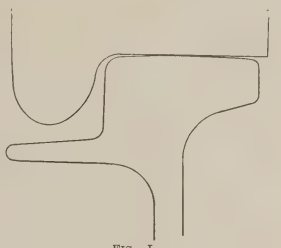


Fig. I. Street Ry. Journal

The older rails which when laid had a distance of $\frac{1}{16}$ in. or 1 in. between the bearing surface and the tram, have worn down to such an extent that now a ⅞ in. flange will nearly strike the tram, which leaves those responsible for the condition of the equipment to face the dilemma of either removing unworn wheels or permitting the trucks to ride very roughly over this older rail. The general run of chilled wheels will last until the diameter is reduced from ¾ in. to 1 in., and while the tread is thus being reduced, the flange will lose about half of this amount, or we get, when the wheel is well toward the end of its life, a flange from $\frac{3}{16}$ in. to ¼ in. higher than it was when the wheel was new. Or, if we start it with a new wheel having a ⅝ in. flange, this flange will, when the wheel is worn, bear on the tram of any rail which has a smaller distance than $\frac{1}{16}$ in. between the tram and bearing surface. However, as most of the girder rails to-day are rolled with this distance equal to 1 in. or $1\frac{1}{16}$ ins., I have assumed in laying out the diagrams later on a ¾ in. height for the flange.

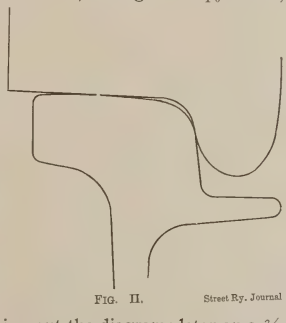


Fig. II. Street Ry. Journal

The thickness of the flange on any road is governed entirely by the position of the guard rails and by the design of the special work in use. The flanges must leave sufficient clearance between insides to fit the gaps left in the special work; aside from this question, it is, of course, desirable that the flange be as thick as possible in order to gain strength.

This much having been said, we are now free to discuss the proper shape of the flange face.

A wheel rolling on the rail should present a perfectly

cylindrical surface, that is, a surface all the diameters of which in contact with the rail at a given time are equal (Fig. 1). If this is not the case and dissimilar diameters are presented to the rail as when the fillet of the flange fits the head of the rail (Fig. 2), one or all of these diameters must slip more or less and consequently produce undue wear and consume power. It is desirable then that the flange should touch the rail only in the perpendicular plane in which lies the axis of the axle and further that it should touch the rail in this plane only at one point. This condition can be met by simply making the fillet of the flange of a larger radius than that of the rail head, as long as the wheel is on a tangent. When however we run into a curve the axle is no longer at right angles with the rail, but the leading side of the flange is brought nearer to the gauge line, and a corresponding allowance must be made in the outline of the

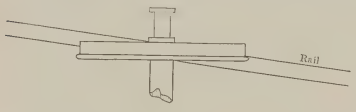


FIG. III. Street Ry. Journal

flange or it will touch and cut in advance of the perpendicular plane through the axis of the axle (Fig. 3). According to Wellington, who has made extensive experiments on this subject, the position naturally assumed by a rigid four wheeled truck in rounding a curve is such that the leading outside wheel has its flange in contact with the rail and the rear axle is in line with that radius of the curve which would pass through it (Fig. 4). This would necessarily bring the flange of the rear outside wheel away from the gauge line of the outside rail and thus increase the angle which the leading wheel made with the rail. That this proposition is true, is verified by the well known fact that if the gauge of the curve be wide and that of the rear pair of wheels be sufficiently narrow, the outside rear wheel will drop off of the rail. However with the length of wheel base ordinarily in use and curves set reasonably close to gauge, this condition cannot exist, owing to the forcing over of the rear axle by the flange of the inside rear wheel bearing against the gauge line of the inside rail

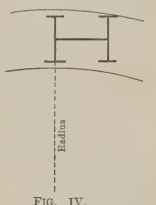


FIG. IV. Street Ry. Journal

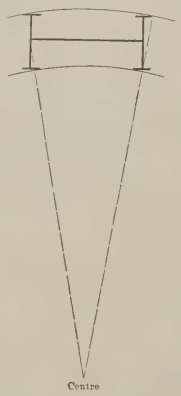


FIG. V. Street Ry. Journal

(Fig. 5). Accordingly in laying out the flange it has been assumed that the flanges of both outside wheels come in contact with the rail.

Under this condition a seven foot wheel base truck on a curve, the radius of whose outside rail is thirty feet, would force the leading wheel to make an angle of 6 degs. 42 min. with the gauge line of the rail as shown in Fig. 5.

Let us now consider the shaded area, B A C (Fig. 6), to represent the intersection with the flange of an horizontal plane tangent to the tread, let the line, L F, represent in plan the vertical face of the rail head shown in cross section and let the line, M C G, represent the junction of the fillet and tread of the rail head. In order that the flange when rounding a 30 ft. radius curve shall touch the rail head only in the vertical plane which passes through the axis of the axle, as was earlier shown to be desirable, the face, O′ C, in the figure, B A C, must make with the lines, L F and M C G, an angle greater than 6 degs. 42 min. when the axle is at right angles to the gauge line of the rail. This angle in the figure has been assumed at 7 degs. Assuming

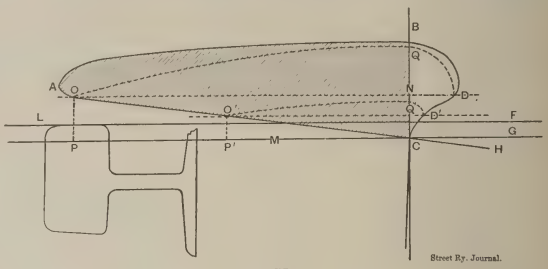


FIG. VI.

the distance, B C, equal to the maximum allowable thickness of the flange and the height as ¾ in. we can lay out the portion of the outline, B A C, which lies between B and A as seems most desirable to secure proper strength for the flange. The question of obtaining the cross section of the flange from the figure, B A C, now resolves itself into a simple one of projection. Through points, O and O′, draw lines parallel to L F. Through these same points, O and O′, describe arcs, O Q, O′ Q′, from centers on the line B C produced, whose radii are equal to the distance from foot of perpendiculars, O P and O′ P′, to a point on B C produced distant from C, a length equal to the radius of the wheel tread. Swing the points, Q and Q′, 90 degs. The intersections, D and D′, of the heights thus obtained with the lines, O D and O′ D′, will be points on the outline, D D′C, of the flange desired. In other words we have assumed a suitable form for the lozenge shaped area which would be produced by planing off a section of the flange down to the tread of the wheel and have then proceeded by a process of projection to determine from this the cross section of the equivalent flange.

In Fig. 7 an approximation of this flange is shown laid out by combining arcs of circles and straight lines which nearly coincide with the theoretical shape obtained by projection. Scaling from the drawing, the angle which the face of this flange would make with the horizontal, gives us 64 degs. 30 mins. for its value. This, then would be a minimum inclination for any flange which would round a thirty foot radius curve in a seven foot rigid wheel base truck without making contact well out toward the point and in advance of the perpendicular plane passing through the axis of the axle. If now, we consider that the tendency of such a rigid wheel base truck in rounding a curve is, as before shown, to bring the flange of the leading outside wheel alone in contact with the rail, it is evident that this one flange must take the entire work of forcing the truck around the curve. It must accomplish several motions, the most important of which is throwing the two front wheels sideways. If then, this flange touches at a point directly under the axis of the axle, the force tending to break it will be merely a shearing strain equal to the amount necessary to move the two wheels as stated. If, however, the flange has less inclination than that given as the minimum allowable, it will in rounding a thirty foot radius curve touch the rail at some point, O′, and the pressure exerted to break it will be that required to move the two front wheels, as above stated, multiplied by the ratio of the height, N D′ (Fig. 6), at which this contact takes place to the gauge of the wheels (approximately), in other words, if the height of this point above the tread be ½ in. the strain on the flange

will be 113 times as great as though the wheel touched only immediately under the axis of the axle. The exact amount of this strain could hardly be accurately calculated as our knowledge of the coefficient of friction at very low speeds is uncertain. Leaving now, the question of the strain tending to break the flange, and turning to the question of wear on curve rails, we have just seen that the flange of the leading outside wheel must do all the work of turning the two leading wheels in rounding a curve, and if the gauge is at all slack, it must materially assist in turning the rear ones. This being the case the greater

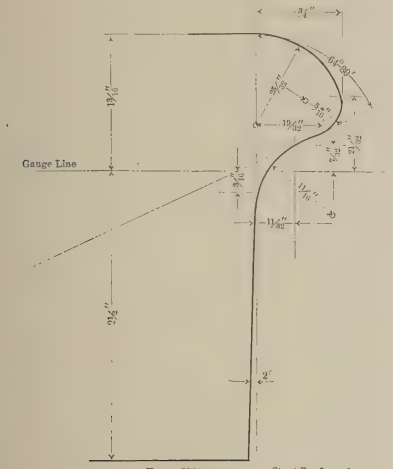


FIG. VII. Street Ry. Journal

the surface of the flange in contact with the outside rail, the greater will be the difference in the diameters of the wheel bearing on this rail and consequently the slip and cutting of both rail and flange. The effect of this cutting action of the flange is plainly seen in Fig. 8, which is taken from Wellington's "Economic Theory of Railroad Location" and shows that the tendency of the outside rail is to wear to the shape of the flange.

In view of the two conditions just demonstrated, namely, those of strain and wear, and of the fact that in

16° Curve (358' radius) after carrying traffic of 6,000,400 tons.

FIG. VIII. Street Ry. Journal

street railway service the rail is continually covered with grit which grinds between the flange and rail, it would seem very important that on any given road the flange should be laid out with a view to meeting the conditions there existing.

THE saw mill of the American River Land & Lumber Company, which is located close to the power house at Folsom, Cal., of the Folsom-Sacramento Power Transmission, was started successfully on Dec. 1. The current is three phase, taken from the power house at Folsom and the motors are all of the induction type, the installation having been made by the General Electric Company. The motors employed are one of 75 h. p., one of 50 h. p., both running at 720 volts, three of 30 h. p. and one of 5 h. p. operating at 200 volts.

The Irregular Wear of Wheel Treads and Flanges—The Causes and Some Remedies.—I.

BY H. S. COOPER.

The matter of the uneven and irregular wear of single flanged, chilled car wheels running on metal tracks has only of late years been given by street railway men the attention that it merits. It is an evil of long standing, dating back to the days of unchilled treads and strap iron rails. Steam railroad men have therefore always had to cope with it, and it is to-day one of their problems. But owing to their more even conditions of speed, traffic and stopping points, to the generally better adjustment and standardizing of their tracks, trucks and wheels to these conditions, and to the greater care given to the inspection, adjustment and repair of these, this problem is one of minor importance. To the street railway superintendent, however, with his tracks in—and part of—a dirty and "un-get-at-able" street, with frequent curves, heavy grades, constant and irregular stopping and starting, and the thousand-and-one other irregular and unstandard conditions of roadbed, cars and traffic, the problem is one of the major ones.

I say "major" advisedly, as the evil is a many phased one, of which the mere shortening of the life of the wheel—while it is a considerable item—is not by any means the only one, nor is it always the gratest one, either in effects or in pecuniary loss. The items of loss may be arranged about as follows:

1. Direct loss of life of wheel due to running only on part of the whole running and wearing surfaces, as is the case with false, double, round or hollow tread.

2. Indirect loss of life of wheel due to "grinding out" the false or double tread and, perhaps, "grinding down" the flange.

3. The expense of labor, tools etc., in grinding.

4. The *extra* expense of labor, tools, etc., in taking out and replacing wheels more often than if they ran their full life.

5. The loss of the use of the car or trucks during the above time.

6. The undue injury to, and wear of body and truck caused by running on imperfectly worn and badly running wheels.

7. The waste of power in propelling those cars which have abnormal wheel wearing surfaces, and which do not "run free."

8. The injury to track and track fittings.

The real and most important items of loss are generally considered to be the first seven, probably because they are so frequently forced on the notice, but I am inclined to think that in many cases the real, large item is the eighth—the injury to the rail, curves and turnouts.

No two pieces of metal can work together without friction and consequent wear and the softer metal will wear the most. Even with the harder metal of the new makes of rails, the chilled surfaces of the wheels are many times harder; they are not malleable at all and do not retain the impression of a blow as does the softer metal of the rail; moreover the metal of the wheel—being in motion—acts as a milling tool on the rail, cutting and abrading it as well as rolling and disintegrating it. It is therefore pretty certain that under normal conditions, with perfect wheels and a good "working fit" between them and the rails, that the latter suffers most, not only in kind, but in degree. This normal wear of the rail is a very important item and one that swells the depreciation account perceptibly. When these conditions are changed, when the wheel no longer fits the rail in any position and, instead of working with it, works against it, the wear on both is increased. The rail still suffers more however, for the wear, instead of being on broad surfaces, is made up of little narrow "cuts." A wheel distorted in one way shears off the infinitesimal ridge left by some other imperfect wheel, or throws up its own tiny furrow for the following wheel to cut or hammer or shear away. The

evil is also a reflex one, as the wear of the rail due to imperfect surfaced wheels is not a wear that makes it retain its original contour, but is an irregular wear and one that distorts and destroys its original contour. As a result the rail is no longer a fit to new and perfect wheels, but instead, is of a shape that tends more quickly to wear the wheels irregularly. Unluckily, the effect on the rails may, and generally does, go on for a long time unsuspected. The wear is spread out over so large a surface and one that is so hard to get at for comparative examination that it often passes unnoticed until the damage is irreparable and then—the scrap heap and a new issue of bonds! The wheel is an entirety, can be viewed as a whole at any time, is easily comparable with a new wheel or with its own original dimensions. Moreover it has a very peremptory way of calling attention to itself when its condition is very bad. The ordinary urban rail has generally from one-half to seven-eighths of its surface buried out of sight, perhaps under stone or asphalt which is difficult to remove. The surfaces that are in sight are not in position for comparison for "surface" or irregular wear without considerable trouble and expense. The rail, therefore, can be, and *is*, greatly injured itself and made capable of injuring good and perfect wheels, long before such a condition is suspected.

The uneven wear of wheel wearing surfaces causing thin or sharp flanges and false and double treads, their resulting and reflex injury to the rail, and their injurious effect on the body, truck and motors were brought very forcibly to my attention quite a number of years ago. Realizing their importance I have, since then, in every possible way, made experiments in regard to it and have obtained from observation, conversation and correspondence all the facts obtainable from outside sources.

At the time the matter was first taken up, there were three good reasons why actual data were not to be obtained.

1. There were none.

2. The isolated facts obtainable were generally negative in their testimony.

3. Actual data and positive facts could only be obtained from a road that had what were at that time ideal conditions; such a road did not exist.

However, the isolated facts soon began to come along, by mail, by word of mouth, by observation and by dearly bought experience, and upon full analysis the causes and remedies resolved themselves into the following:

I. Defects in track or rails.

1. Straight track not level, i.e., one rail or the other continuously higher than the opposite one.

This causes the weight on the wheels to continually force those on the lower side against that rail, especially if the speed is slow; and will tend to wear the flanges of the hugging wheels thin, and to cause false tread on them and double tread on their axle-mates. This defect is found now, principally on suburban and interurban roads, especially where the track is laid to one side of the carriageway. The remedy is obvious.

2. Tipping, tilting or spreading of one or both rails, due to giving way or loosening of chairs, tie-rods, bolts or spikes, rotting of ties, paving too tight between rails or all combined.

This will cause the tread of the wheel to run on the inside corner of the tread or head of the rail, and, if the rail is a grooved one, or a tram rail that is shallow from tread to tram, it will cause the flange of the wheel to run more or less on the tram of the rail. If the rail is a tee or a tram type with much greater depth from tread to tram than the depth of the wheel flange, the only effect will be that the wheel flange will run on the inside edge of the rail head. In this case it will wear it unduly, shearing it off with its flange and wearing the tread of the wheel into a concave, generally close up to the flange, which also wears sharp.

If, however, the rail is a tram type with a lip or upward curve in its tram, or if the distance from tread to tram is the same, or less, than the depth of the wheel flange, there will then be the added effect of the inside of the wheel flange wearing against the lip or groove of the rail or of the wheel running partly or entirely on its flange. If both rails are evenly tipped or spread and of equal depth from tread to tram throughout their whole length and if the flanges of the wheels on both sides are of equal depth, the car will "run hard" as if heavily loaded, but will run evenly, and the wheels will wear as stated above. As such even conditions of spread and depth of wheel flange rarely prevail, since it is more than probable that rails on one side or the other will be more tilted than their opposites, and as the flanges of used wheels will vary in depth, the car under these latter circumstances will "weave" or have a wavy or sinuous motion from side to side of the track. Such motion is, of course, destructive to body and truck, very annoying to passengers and very wasteful of power. The wear of the wheels will be much increased above normal and will be very irregular, the tread and flange assuming most extraordinary shapes. The cause, owing to the "weaving" motion of the car and the blunt or rounded appearance of the wheel flange, is easy to determine. A partial remedy is to use a wheel with flange of less depth, but the only and proper cures are to straighten up the rail and keep it vertical, or scrap it and put in new rail. Luckily, such rail is not now greatly in use. It is generally a legacy from horse car days or is one of those unhappy experiments like the Lewis & Fowler box girder, a type now happily extinct.

3. Rails set to "too wide gauge". This is liable to cause double tread, even if the track is perfect in every other way, and it is certain to continue it and increase it if it once starts from other causes.

4. Rails set to too tight gauge. This is certain to cause false tread and sharp flange, and, unless the track is perfect in surface and alignment, it will be hard on both trucks and body, since there is no lost motion between the wheel flange and the rail to cushion the oscillation at places where the track is out of surface or out of line. In any event the destruction to wheel flanges and to the inside of the head of the rail is very great when wheels are new, and the use of power is greatly increased.

5. Contour of the tread and the inside of the head of the rail not being a fit, or not being adapted to the contour of the tread and the outside of the flange of the wheels. Of this cause I have had no personal experience, nor have I been able to find anyone who can say positively that he has. Theoretically it is a certain fact that for every shape of rail head there is one certain shape of wheel wearing surface that will, under the local conditions of speed, traffic, etc., wear both itself and the rail less than any other shape. The question of what is the best general shape of rail head is one on which there are too many opinions and too little actual data for me to venture to discuss it, but something more will be said on this subject in connection with the "defects of wheels."

6. Curves incorrect, warped, of wrong gauge, elevation of the outside rail incorrect, guard rail in wrong position or guard rail space or groove of improper shape for the flange of the wheels, length of the wheel base or radius of the curve. The action of two wheels of equal diameter, rigidly fixed on one axle and compelled to turn a curve radially, is of necessity more destructive to both wheels and rail than when running on straight track, as one wheel of the pair must slip or skid in order to keep their centers radial to the curve, thus introducing sliding as well as rolling friction between the wheel and the rail. When two such sets of wheels are arranged to be held with their axles rigidly parallel, as in any ordinary truck, and are run around a curve, the wear on each pair is much greater and more complicated. This extra wear on a curve over that on a straight track is a fixed fact, and under the most favorable conditions must be expected and allowed for and called normal. When wear goes beyond this normal, when the wheels squeak, chatter and grind in rounding the curve, when, instead of a smooth sweep around, the motion is a set of nerve-destroying jerks, when the guard rail is sheared off in scales and chips, and when the inside of the wheel flange wears unduly and double treads

on one wheel and false treads and sharp flanges on the other appear, then the curves are wrong in some one or more of the above mentioned ways, and no change of wheels or wheel shapes will be of permanent avail. No one thing will eat up the power, rack the bodies, distort the trucks, strain the motors and unduly wear the wheels as will a series of "bad" curves, especially if the cars are run on them all one way and the curve is run "dry," or unlubricated.

II. Defects of wheels.

7. Chill not even or regular across tread and flange. This is a defect that is now seldom found among wheels of reputable makers, but it is none the less an aggravating one, as its proper determination can only be made by breaking or drilling the wheel. If all other causes have been eliminated or found and the trouble continues, a fine file of extra quality applied to various portions of the tread and flange may locate the difficulty.

8. Imperfect chill sometimes known as "ghost-chill." This, like the above, is now seldom found in wheels of reputable makers and needs but slight attention, as any large maker of wheels will be only too glad to replace all such wheels free of all costs.

9. Wheel tread coned for flat top rail. Theoretically a wheel with coned tread is of the correct shape. It keeps the wheels central on straight track and enables them to turn curves more radially, and, under certain conditions, more easily than if the tread were flat or at right angles to the plane of revolution. Its use is almost universal on steam-railroads and will probably become so on all suburban and interurban electric roads whose lines will allow them to follow steam railway track construction and practice, especially if the rail head or tread is rolled with a bevel to conform to the cone of the wheel tread. Where no traffic comes on the rail other than that of the car wheels themselves, and where coned wheels only are run, a slightly coned wheel running on a rail bevelled to match it will be both theoretically and practically the most economical as to wear and power and will run more pleasantly under the car, both on straight and curved track, as it keeps the axles at right angles to the track and keeps the wheels central, i. e., wheel flanges at same distance from inside of each rail. Theoretically, it should have a few compensating disadvantages, such as a tendency to spread the rails, a difficulty in rounding curves at anything but the "critical" speed for the elevation of that curve, and it also should take more power to propel it on straight track than a flat tread wheel and rail would. But, unluckily for theory, actual practice does not find these disadvantages.

On urban roads however, with the rails set in—and perhaps partly below—the paving of the street, subject to the constant and heavy traffic of wagons and trucks and often covered with mud or dust, the case is different, or at any rate the *results* have been different, as I have invariably found that on such rail the nearer flat the tread of wheels could be obtained and kept, the better were the results as regards their life. Coned tread wheels have, on such rail, invariably worn irregularly much sooner than those that were flat tread or nearly so. Owing to the necessity of draft on the wheel pattern and the chill, it does not seem possible for the wheel makers to give a wheel with absolutely flat tread, but this matter has been improved of late years and a little insistance on the part of the buyer will obtain it.

10. Wheels on same axle not of same diameter. This is a defect not often found in new wheels of the same pattern and from the same maker. It sometimes happens in new wheels of the same pattern but made by different firms. It often occurs in wheels of different patterns although of so-called same diameter. Its most frequent occurrence is, of course, among partly worn or reground wheels. It is a defect that is not easy to locate unless its existence is suspected, as it produces all sorts of irregular wear, depending on whether one axle or more of a car or truck is afflicted in this way and in the latter case whether the larger diameters are on the same or opposite sides or corners of the same car or truck.

This defect should never be allowed to occur to any considerable extent where there is "barn inspection," as it is very easy to "size" the wheel and the diameter and wear of the wheels should be one of the regular points of inspection—as much so as the motors or the bearings.

The diameter of a wheel should never be attempted, it is very difficult, in fact almost impossible, to measure accurately a car wheel under a car with calipers or beam compasses. The circumference should always be taken—not only because it is easier and more accurate, but because the difference between wheels of different diameters will be made more noticeable and more liable to be checked if multiplied by 3.1416.

To determine actual or relative circumferences of car wheels, a brass, bronze or German silver tape at least one-half inch wide and quite thin, should be used. This is preferable to a steel tape as it will not rust and will not cling to a magnetized wheel as will a steel tape, a rather important item in free and accurate measuring in these electrical days when nearly every used wheel is a magnet. The wheel to be measured, if not on an axle, should be held *vertically*, as most of the wheels will be measured in this position and the men should be trained to do their work in the way that it will most frequently come to them. This position is also the best for accurate measurement as the tape will hang vertically and in line with the tread.

Three measurements should be taken of the wheel, one at edge of tread, one at center and one as close as possible to the flange. Care should be taken in the last two measurements to see that the edge of tape is the same distance from the edge of tread all the way round. This may easily be done by the use of a small double-ended "stop gauge" made and kept for the purpose.

To enable the wheels to be measured while under the car it is only necessary to insert in the car barn inspection track two lengths (one on each side, opposite one another) of tram rail, that is very shallow from tram to tread. On this the wheels will run on their flanges, thus lifting their tread from the rail head and enabling the tape to be slipped under. If no such rail is available the tram of any tram type rail may be raised by a bar of flat iron longer than the wheel base, riveted on top of the tram.

Too much importance cannot be laid upon the necessity of locating this defect; it is one that comes under the most favorable running conditions, it is insidious, it is very wasteful of power and it is self-increasing—the smaller wheel constantly wearing itself proportionally smaller, as it has to stand not only its share of the regular wear, but also the sliding friction caused by its constant "skidding" in its efforts to keep opposite its axle-mate and at right angles to the line of track.

This defect will often cause the apparent paradox of the best and hardest wheel wearing the faster, a fact that has puzzled many managers.

As to the amount of difference of diameter that should be allowed between two wheels on same axle no exact hard-and-fast rule can be given, since it depends on diameters of wheels, shape of rail head, normal speed and various other conditions. For 33 in. wheels a safe rule is that not over 1/8 in. difference in diameter (3/8 in. in circumference) should be allowed if it is easily possible to change them, and that when the difference is 5/8 in. or 3/4 in. in circumference the wheels should immediately be changed or ground to even size.

III Defects of running gear, trucks motors, or in adjustment of same.

Among these defects are four which will be considered in a group together, their effects being in each case to prevent "tracking" of the wheels on one or both sides, i. e., they prevent the front or back wheel or wheels of a car or truck from running in the same path or line as those in front or behind them, when on straight track.

These four defects are fully as much the cause of irregular wear of flange and tread of wheels, as any other

one thing, while at the same time their effect on the rail is a bad one, tending to continually shear off the inside of the head. They cause one wheel of truck or car to continuously hug or crowd one rail while the diagonal wheel is hugging the opposite rail, invariably producing thin flange on the hugging wheel and double tread on its axle-mate.

The four defects spoken of are as follows:

11. Axle bearings cramped by journal brasses; journal brasses held too rigidly in journal boxes; journal boxes held too rigidly in "arch" or "jaws" of truck frame; truck frame attached too rigidly to body; all tending to prevent the axle having a lateral motion independent of the truck and body. This defect is especially noticeable in those journal boxes which use a "brass" that has a collar, lug or projection fitting into a circumferential slot or groove in the axle journal. This, combined with a brass fitting tightly in its frame, will so cramp an axle that it cannot move laterally independent of the truck, whereas, it should have a free lateral movement—independent of everything—of ¼ in. to ½ in. to enable it to respond quickly to inequalities of gauge or alignment of track, to misalignment of truck or to any "lead" that the other axle may have. Even where track is perfect as to gauge and alignment it is unwise to confine the axles too rigidly in this direction as, on curves, the same truck with play to the axle will run easier than if the axle were rigid. Moreover, it is impossible to so build and maintain a truck with rigidly fixed axles that its wheels will always track. Therefore, for all reasons, the mechanism of the truck box should be so arranged that the axles will have from ¼ in. or ⅜ in. to ½ in. or ⅝ in. lateral motion, independent of anything except themselves.

12. In electric motor cars, if the motor is rigidly fixed laterally and not enough play or lost motion allowed between the motor axle bearings and thrust collars and gear on the axle, it (the axle) will be too rigidly held laterally and somewhat the same effects will ensue as in No. 11.

13. In electric motor cars, gear driven, if the pinion shaft of motor is not in line (parallel) with the car axle on which the gear wheel is fastened, the tendency will be for the pinion on the motor to continually press the axle towards one side of the track no matter which way the car runs. This defect is generally due to bad adjustment of all the motor bearings; it is easily determined, as it shows plainly on the gearing, the teeth of which will be much more worn on one edge of both gear and pinion than on the other.

14. Wheels not pressed on axles of same truck or car to the same gauge; or if of same gauge, not pressed on to same distance from each end of axle; or perhaps both of these defects in one car or truck.

The effect of these defects is the same as in Nos. 11 and 12, only more varied and irregular, as it may happen in this case that the wheels on one side may track perfectly for long distances while they are not doing so on the other.

On roads using various makes of trucks having interchangeable axles of same diameter, but of slightly varying lengths, this defect is very apt to occur, especially if the pressing on of the wheels is not standardized. In fact until very lately it has been a defect of many of the best roads and those using only one length of axle—the importance of accuracy in this one item not seeming to have been appreciated. Usually a stick sawed off "a little slack to gauge" has been used as a measure, the pump has been stopped "a shade" too soon or too late, no measurements were taken from center or ends of axle to gauge line of each wheel, perhaps one was taken from end of axle to hub of wheel—and after all this, everyone connected with the wheels was much surprised when they wore "all sorts of ways".

As a matter of exactitude and good operation, three measurements should be made when wheels are pressed on, and for all similar wheels and axles these measurements should be made standard gauges. They are as follows:

A.—From end of axle to outside of wheel hub; it being understood that all wheels should be ordered with hubs faced both sides at a standard distance from gauge line of wheel, i.e., the point or line where the tread ends and the flange commences. The additional cost of this double facing is very small if done by the wheel maker, and if properly done it has three advantages over "one rough side," in that it makes a standard depth of hub, facilitates the accurate gauging of the wheels on the axle and shows up any blow holes or other surface defects in the hub.

B.—From center of axle to inside of hub; it being understood that a center-punch mark is put deeply at exact center of length of axle when same is first made. This measurement is to check the previous one.

C.—From gauge line to gauge line of wheels. This is to check the wheelmaker's work and for gauge's sake.

With these three measurements carefully made, not by rules or tapes, but by well seasoned and painted wooden gauges, metal shod, and the wheels brought standard to them if they vary, there need be no fear that the wheels will not track from this cause. Of course, for the best results it is absolutely necessary that the wheels be set at a proper gauge for the track and rail on which they are to run, but—as Kipling says—"that is another story".

The above are the four causes spoken of as preventing wheels from tracking, and so far as I know they are the only ones.

15. Axles not parallel in truck or under car. This is a common defect where care is not specially taken to avoid it or remedy it, as it may come from any one of several causes, i. e.:

A.—In some single trucks the frames are so built that any very heavy strain or blow—such as a derailment in an unpaved place or a slight collision—will tend to lengthen or shorten the distance between wheels on one side.

B.—Almost any truck, and especially such as the above, in being repaired or rebuilt may be so put together as to make the distance between axle centers less on one side than on the other.

C.—Repairs or renewals, such as journal boxes or journal brasses, may not be cast, machined or bored so as to be symmetrical with respect to the correct location of the axle location, and when put into place may throw that axle out of parallelism with the other.

D.—The wear or lost motion in all movable parts of the truck may be such that the application of the brakes may force the axles out of parallelism and keep them so while they are applied.

The above causes being somewhat hard to find, the best cure is the proverbial ounce of prevention, taking the form of careful inspection and measurement. No new or rebuilt or repaired truck should be put under a body until it has been proved that the axles are parallel to each other, both under brake and running free, and also that they were at right angles to the truck. The first measurement can easily be made where the end of the axle can be reached, the lathe-center holes being the points to be gauged to. All renewals and repairs to journal boxes or bearings should be carefully examined and tested to see that they are symmetrical and concentric to the axle.

The defect is a bad one as it causes the truck to tend to "run in a circle" on straight track, wearing both wheels and track unnecessarily and needlessly using up power. A very slight difference, or rather lack of parallelism of the axles, even as little ¼ in. in a 7 ft. wheel base, will, while running, make a vast difference in the useful life of the wheels, in the wear of the rail and in the power absorbed.

16. Bore of wheel not true, i.e., not perfectly parallel with tread.

17. Axle bent close to inside of wheel hub. Both of these latter will cause an irregular wear of the wheel. They will, however, occur but seldom, and should be quickly noticed by the inspector or by the motorman, gripman or driver.

(*To be continued.*)

Repair Shop Hints.

BY C. B. FAIRCHILD.

One is astonished that so much neglect prevails in the street railway practice of to-day in the care, or rather the want of care, given to the roofs of repair shops, car houses and other buildings. From observation, a tight roof over this class of buildings is the exception and not the rule. In stormy weather the workmen are frequently driven from their benches or from their job by the incoming rain while the building and sometimes the stock and tools are subject to decay and danger.

A poorly equipped repair shop and a neglect of the repairs which would materially add to the life of the buildings, rolling stock and apparatus of an electric railway company is not always chargeable directly to the inefficiency or carelessness of the superintendent or manager, but is often the result of a policy on the part of the moneyed interests that control the operations. This policy may be a supposed economical one, but more frequently it comes about from an effort to present a favorable monthly statement. As a result many repairs are neglected and put off from month to month till a corresponding expense can be cut down in some other department. In the meantime much damage has been done and this will eventually come up for adjustment. This constant effort for a monthly showing or a large temporary dividend works against the best interests of the property in many ways.

Frequently managers or superintendents are found to be chafing under these limitations, because they regard it as a short-sighted policy, and when this is the case, their efficiency is restricted in many ways. With the introduction of labor saving devices the results of the policy are still more apparent, for the time consumed in doing by hand what can better be done by machinery is a constant expense which at times increases in a geometrical ratio. Some repair shops even of large systems are not provided with power shears or punches, the work of cutting up rods and bars being performed by the blacksmith and his helper with a large expenditure of coal and muscle. In some shops a power bolt cutter is wanting. Its absence is excused on the ground that bolts can be bought cheaper than they can be made. This is true for standard sizes, but odd sizes are always in demand for car repairs and are usually wanted in a hurry. In some cases a substitute for a regular bolt cutter is found by placing the die of a hand cutter in a lathe by means of a chuck and a cup shaped holder in the follower for receiving the bolt head, and, when a long bolt is to be threaded, a steady rest is also employed.

The policy referred to above gives rise to the practice of varying the number of men employed in the repair shops. The overhauling of summer or winter equipment is frequently put off till about the time the cars are wanted for service. Then a lot of men are employed and an effort is made to rush the business through. Every foreman knows that he can get much better results by having a uniform force of men well trained in their various duties, so that each man can virtually boss himself and do his part of the work on a car in harmony with his fellow workmen, than with a lot of new men who are constantly in each other's way and all requiring close supervision lest they do more harm than good.

The policy referred to is not always limited to the damage to property or loss of time, but in some cases leads to a disregard for the health and comfort of the employes. A case in point is where a defective draft exists in the blacksmith shop, so that every time the fires are started, the room and adjoining departments are filled with smoke, foul gases and soot to such an extent some days that the workmen have to leave their forges until the fires are well under way. It is a well known fact that men cannot do their best work where they are required to expend part of their energies in resisting annoyances of any kind, especially when they realize that their health is being undermined.

The draft problem for blacksmith forges, although easy of solution, is regarded as a bugbear in many cases. To secure a good draft above a forge the initial flue should be smaller than the trunk flue where an exhaust fan is employed. A six inch stove pipe flue above the fire will carry the smoke and gases better than a three or four foot funnel shaped hood. With tapering hoods the heated currents converge at the neck, choke the passage and roll downward, instead of passing into the flue or chimney. As a general thing the blacksmith department receives less attention from the management than any other department, and it is usually run with less system, but there is no department in which order and system will give better results.

The position of foreman of the blacksmith department of a large system is not usually an enviable one for the reason that the heads of all the other departments dump their repair work into the shop at all hours, and each seems to expect that his work shall be done before that from any other department. Rush orders from the track department conflict with those from the truck department and in case the foreman of an outside department fails to complete a job in time he is sure to give as an excuse that he was delayed by the blacksmith department, thus making the foreman of the blacksmith shop a scapegoat for the short comings of all the others. This condition of affairs can be remedied to a certain extent by having all orders for work emanate from a single head and all filled in rotation except in emergency cases. It is also a good plan to provide for an inspection of all work as it leaves the blacksmith shop or before any machine work is done upon it. Otherwise after being partly finished it may be found to be imperfect as to dimensions or quality of the metal, and so a double loss of time will be sustained, that of the blacksmith and machinist. In no department of street railway work is the value of the personal equation of the individual workman more important than in the blacksmith shop and this a foreman should realize. His men can be wasteful or economical in the use of fuel, can get a proper heat or burn up the metal, can make a fit the first trial or do their work over and over again. The use of correct drawings, or still better, of metal templates for all new work and these preserved for future use will promote economical results in this department.

The foreman of this department should be a good judge of the quality of metals and insist upon having the best. He is supposed to stand as a guard between the seller and the purchasing agent, and when an inferior article is delivered have the courage to reject it. A foreman of the blacksmith department who is fertile in resources and able to devise bending tools, swages and dies for the production of many pieces after the same pattern is a valuable acquisition for any company. The aggravating part of street railway repairs is that of doing the work over and over because of careless fitting or poor workmanship and the doing of work at a disadvantage. When a manager can eliminate the *duplicate work* his repair account will assume reasonable proportions.

The arrangement of pits, tracks, transfer tables and elevators in a car repair shop has much to do with the relative economy of repairs. When only a few cars stand on a single track little time is consumed in shifting, to get out a car that is finished before others in front of it on the same track, but with long tracks and a number of cars much time and labor are uselessly consumed. A power transfer table with ropes and reels is a desirable equipment for a repair shop, while modern types of jacks and hoists are indispensable in securing economical results. A drill press, a band saw and emery wheel located in the repair department, where this is separated from the iron and wood working department, will be found convenient for the individual workmen. On these they can do small jobs for themselves when otherwise they would have to stand and wait for some one else to do it in the machine department proper.

The care of belts and machine tools in the iron and wood working department is also a subject worthy of seri-

ous attention. Generally these matters are left to chance and if a belt breaks the foreman sends some one for a ladder and directs possibly that the best man in the shop shall leave his job and lace the belt. Should it be driving one of the main shafts all the tools driven from this shaft are stopped and all the men stand idle while repairs are being made. Possibly it is the belt driving the blower for the blacksmith forges; in this case the men at the forges stand idle till the blast is again turned on. It is not uncommon for this to occur in a shop twice or three times a week. A safe plan is to appoint a belt inspector and repairer whose duty shall be to go over all the belts and tools after working hours and make all necessary repairs. This practice would obviate the breakdowns. The appointee for this position may be one of the regular shop hands and his hours for coming on duty can be so arranged that he shall not be required to work more than the regular number of hours. In no particular does "a stitch in time" count for more than in this matter of belt repairs. Again, should a belt from the main shaft persist in running off every time it is shifted to start up a machine, it would seem the part of wisdom to have a suitable guard provided, but if no one takes the responsibility to make the necessary repairs, the trouble may continue for months before the attention of the master mechanic or superintendent is called to it. It is sometimes a good plan for these officers to stand about a shop and watch. They will ofttimes discover things of this kind that are not reported by the foreman. It is not a good plan for a foreman to allow the frame or table of a jig saw or other tool that is not in constant use to become loaded down with dust and odds and ends, so that when it is wanted for a job, it takes considerable time to dig it out, more time perhaps than it takes to do the job.

Visitors should always be welcome in a shop, especially if they be street railway men. They often drop valuable suggestions; besides, a foreman while showing visitors through his department becomes accustomed to see things with their eyes or with a more critical eye than when on his ordinary rounds. Again where visitors are expected more care is had in keeping the floor clean and tools and material in order. A foreman can sometimes detect a tendency to idleness or skylarking among his men better when he seems to be engaged with visitors than when alone and known to be watching for irregularities. Boys and sometimes the men in a shop will take advantage of the absence of a foreman to annoy each other by throwing bits of metal or by spraying one another with the oil can. Such practice can usually be detected if a foreman is sharp by coming in at odd times and from unexpected directions. These things if not checked grow into serious abuses, resulting frequently in the injury of man or tools.

A room for storing small tools and keeping them in order is a generally recognized adjunct to a well-regulated shop. The tools may be checked out to the individual workmen as they apply, or better, delivered to the workmen by a boy who is notified by a system of call bells, from push buttons near each machine. It is also desirable to have drills and other tools kept in order by a single man skilled in the work of properly sharpening and repairing tools of this character.

It is good policy for a manager, superintendent and master mechanic to be on familiar terms with the foremen of the different departments and encourage them to make suggestions as to the best means for regulating the affairs of the shops with a view to economy. Suggestions from subordinates should always be received with consideration and when practical adopted. If not put in service at once they should be recognized and some appreciation of their merit shown. If suggestions are persistently ignored the men will cease to make them, and the company, in the long run, will be the loser.

The manager, superintendent and master mechanic will find it of great advantage to hold consultations with the heads of departments at frequent and stated intervals, say, for an hour every Saturday morning. These subordinates can be organized into a supervisory board, and so designated. When in session the chief should preside, but the proceedings need not be confined to giving instructions merely. They may embrace the details of the business, the requirements of supplies in each department and each member should be called upon to make suggestions relative to the introduction of new methods and the use of labor saving devices. These suggestions being fully discussed by each of the others, may be adopted by the sanction of all or by a majority vote. This practice gives opportunity to each member of the board to learn something of the duties and responsibilities of the others, as well as what share each is to have in the execution of any particular job. This practice tends to harmonious relations between the members of the board, and gives the management an opportunity to take advantage of the accumulated experience of each and put it in practice. It also encourages the individuals composing the board, to think and plan for the best interests of the company.

The foreman of any department, if he is skilled in reading character, knows how to distribute his men, so that each will have work suited to his abilities. Among a lot of men in every department there will always be found some of exceptional ability—"geniuses." They seem to be deft in the handling of tools, quick in movement and fertile in resources. Such men should be encouraged and retained whenever it becomes necessary to reduce the force, and the time will, doubtless, come when the wages of such men will be in proportion to their worth. It is always of advantage to a company to recognize the worth of such men by giving to them such increase of wages as shall tend to hold them and make them contented and still more efficient. It is bad policy to ignore talent of this kind for fear, if recognized, an increase of wages will be expected. Men of this stamp cannot always be promoted as a recognition of their ability, for very likely they will lack the essential characteristics of a good foreman, but unless some recognition of this factor of individuality, so essential to manly development, be given to employes in street railway affairs, skilled artisanship will be swept away from this industry as it has already been from some great manufactories in other lines, where the principle of the interchangeability of parts is applied to the workman as well as to his products, and where thousands of human beings are employed in simply working a treadmill or turning a crank.

It is needless to speculate on the effect upon the street railway industry, which a like dispensing with intellect and the substitution of monotonous muscular labor will produce in course of time. The remedy is suggested above, and in this matter, as in the matter of repairs, "a stitch in time" applies.

New Road at Portland, Me.

Construction on the Portland & Yarmouth Electric Railway will shortly be commenced. The company's charter gives it the right to build from Monument Square in the center of Portland, to and into the town of Yarmouth, a distance of about twelve miles. A little more than two miles is to be substantial city construction, the balance being high grade country work. In leaving Portland the road will cross the new iron bridge now being built by the city of Portland between Portland and Deering, then turning sharply to the east it will run almost due east following the entire coast of Casco Bay, at a distance from the shore line varying from a few feet to three-quarters of a mile. The entire length of line is thickly settled by permanent residents, while the coast is lined with cottages occupied in summer only. There are several natural attractions; several attractions also, such as are usual at street railway resorts, are contemplated.

The officers of the road are T. Quincy Browne, of Boston, president; W. G. Wheildon, of Boston, treasurer; and these gentlemen with F. C. Boyd, of New Haven, will compose the board of directors.

Street Railway Parks and Pleasure Resorts.—I.

The rapid increase in the number and size of parks and pleasure resorts owned by street railway companies and operated by them as traffic promoters has been one of the striking developments which have accompanied the introduction of electricity upon street railway lines in this country. Some roads, it is true, operated parks in the days when horses were used as motive power, but their number was small, compared with those which are now engaged in the business. It is estimated that nearly one-half of the present operating lines in the United States have now properties of this kind, while in some instances a great deal of money has been invested in this way.

The general opinion of street railway managers who have had much experience in this direction seems to be that such pleasure resorts, when properly managed, tend to increase the traffic on any particular line from ten per cent to thirty per cent.

It has, however, also been found that, where the conditions and class of people to be served have not been carefully studied, parks owned and operated by street railway companies have barely paid their own expenses, and have not returned interest, in any form, on the capital invested. In order to determine just what the experience in this line has been throughout the country, inquiries have been made of every street railway company in the United States and Canada that were known to have owned one or more pleasure parks. Some of the results of this canvass are given below; other information will be printed next month.

As will be seen, the verdict is that pleasure parks, as a rule, pay, and that by a judicious selection of amusements and entertainments, a park can be made to double and sometimes triple the ordinary traffic; in fact, two or three roads have reported that branches that have been operated at a large loss have been made good dividend payers by a small sum invested in a park provided with good attractions. Just what constitutes a "good attraction" must be determined in each particular case by local conditions. Attractions may range all the way from a small brass band to an elaborate electric fountain or a high priced theatrical company, and it is evident that where a small brass band brings out all the probable traffic, it would be foolishness to install a more expensive attraction. On the other hand, too much conversatism in fixing up a park and securing attractions may ruin the entire project.

A number of street railway companies make a special feature of Sunday School picnics, providing amusements suitable for such excursions and prohibiting the sale of intoxicating liquors on the grounds, while other companies find it advantageous to fix up their parks as beer gardens for a German fun-loving population, and provide light vaudeville entertainments and dances.

One of the best features that can be introduced for stimulating pleasure riding is a pond or lake, natural if possible, but artificial if necessary, and provided with good clean boats. These boats may range from rowboats to electric launches, depending on the number and class of people to be served. A lake has the additional strong feature, in suitable climates, of being a good attraction in winter as well as summer, as it can then be utilized for ice skating. If this is done a comfortable house should always be provided for the skaters, and it will generally be found that light refreshments and hot drinks of some kind will usually be in demand.

The following list shows the experience with parks in a number of cities, and a report on a number of other cities will be given in the next issue of the STREET RAILWAY JOURNAL.

NEW HAVEN, CONN.

The Winchester Avenue Railway Company owns a park situated at Savin Rock, West Haven, on the seashore about five miles from the city. The park proper

PARK AND ELECTRIC FOUNTAIN—WINCHESTER AVENUE RAILROAD CO.

faces Long Island Sound and is very tastefully laid out with band stands, electric fountain and seats. At the rear of these grounds there is a large grove, with dancing pavilion, restaurants, a covered stage with seats, and other buildings; and at the rear of this grove are the ball grounds provided with a grand stand having a seating capacity of 2000. These grounds are used for ball games, etc., and here the company gives, quite frequently during the summer season, very fine exhibitions of fireworks. The railroad tracks run directly into the grove, making it very convenient for visitors to the park. No admission fee is charged to the park, but the car fare is ten cents, which enables the company to run the park in first class style. The company provides a number of different kinds of attractions including free fireworks and electric fountain, balloon ascensions, free band concerts, and entertainments of various kinds on the stage in the grove. The company states that free fireworks make about the best attraction that can be provided. One exhibition is given every week, and all the fireworks are manufactured at the park by an expert who is hired for the season. A first class exhibition costs the company about $50. The electric fountain is in operation every afternoon and evening, and in the evening is lighted by electric lights showing different colors, and giving the same effect as the fountains at the World's Fair in Chicago. The entertainments on the stage at the grove usually last for an hour and a half in the afternoon from 2:30 to 4 P. M., and from 8 to 9:30 P. M. 400 seats are provided for which five cents apiece is charged which pays the costs of the entertainments. Balloon ascensions are given occasionally together with nov-

elty entertainments from time to time. Riding galleries, a maze and swings are also in operation at the park. These latter privileges together with all restaurant privileges are leased to one party who sublets them. The Winchester Avenue Railroad was originally built for summer or seashore traffic, and about one-half of the entire business done by the road is derived from the traffic done in the park.

ASHLAND, KY.

The Ashland & Catlettsburg Street Railway Company serves two parks, one of which it owns. One of these parks is near the center of the city and the other is about two miles distant. No admission fees are charged except upon special occasions. The company provides boating, fine concerts and, on special occasions, fireworks. Political meetings are often invited to the parks. Swings and riding galleries are provided at times and the company finds that the increased traffic gives good returns on the investment. Ice cream, soda water, etc., are sold on a percentage basis. A special point is made of inviting Sunday Schools to hold picnics, etc., at the park.

LEAVENWORTH, KAN.

The Leavenworth Electric Railroad Company serves three parks, all of which are owned by private parties. The street railway company, however, often furnishes attractions at these parks at its own expense. The owners of the park frequently rent the park to organizations for picnics, etc. They also maintain row boats, dancing pavilions, bathing houses, shooting galleries and bowling alleys. The owners of the park are said to usually clear about $800 a season. It has been the experience at this city that fireworks, on account of their small cost, pay very well, but that theatrical companies as a rule are not profitable. It has been found that parks as an attraction, without any special features, increase traffic about twenty per cent, and with special features thirty per cent.

SCHENECTADY, N. Y.

The Schenectady Railway Company owns Brandywine Park, which contains four acres of ground, and a lake of about the same area. The company bought the park in February, 1896, and now operates it. The park is about 1¾ miles from the center of the city and the entrance is one block from the street railway line. The company rents the park to societies, etc., for picnics, field days and excursions, and charges a small admission to concerts, etc. Dances and minstrel shows are frequently given. The company provides refreshments not as an investment, but as an accommodation, but thinks that this branch of the enterprise can be made to pay. The company states that the increased traffic last year barely paid the park expenses, but this, however, was due to a number of unfortunate conditions and circumstances which the company intends to change this year, and it hopes to make the park a success financially. A letter from H. S. Cooper, superintendent of the Schenectady Railway Company, giving details of a plan for an "Entertainment League," will be found in another column of this issue.

NILES, O.

There is no pleasure resort of the line of the Mahoning Valley Railway Company as yet, but the directors are considering the matter of putting in a pleasure resort on the line of that company now running between Niles and Girard. The company would like to correspond with parties who make a specialty of, or who would care to establish, a park of this kind. This park would have a very desirable location as the car lines running to this point have a tributary population of 60,000 people.

ZANESVILLE, O.

The Zanesville Railway & Electric Company serves two parks, both of which it leases. One of these (Gant Park) is thirty-seven acres in extent, and the other (Maplewood Park) is fifty acres in extent. Both of these parks are situated about one and one-half miles from the center of the city. The company operates a winter casino at Gant Park where vaudeville shows are given five times a week. No admission is charged to the casino, but all passengers that buy return tickets from the conductors on the street cars are given a ticket entitling the holder to admission to the theatre. These return tickets are sold for ten cents. The average expense of running the casino is about as follows:

Good vaudeville companies to play five times a week, at $20 apiece or about $100 a week; piano music, $9 per week; fuel and light, $15 per week; employes such as stage manager, property man, general utility man and bowling alley attachés, $30 per week; lease, rent, etc., $20 per week; total, $175 per week. The company operates a bowling alley which has proven a very profitable investment. It costs little to operate and maintain, and has netted the company about $4 per day besides the income from increased riding which has been attracted by it. Regulation prices for bowling games are charged. The novelty of these attractions in a park during the winter is very taking. When the company opens the park for the summer season it intends to place in operation a carousal, pony liveries, swings, shoots and electric launches, and will lease these privileges together with refreshment privileges on a percentage basis. The company will also place a zoological garden in the park to which no admission will charged. The company thinks it is a better plan to sell coupon tickets entitling admission to the park, with each round trip ticket, rather than charge admission to the park, and thinks it is a good plan to give all the attractions free that it possibly can and make the profit on the increased riding.

GANT PARK—ZANESVILLE RAILWAY & ELECTRIC CO.

JAMESTOWN, N. Y.

The Jamestown Street Railway Company owns a park and pleasure resort situated 2½ miles from the center of the city on Chautauqua Lake. The resort, which is called "Celoron," is one of the finest summer resorts, pleasure and amusement grounds in the United States. Celoron is fitted up with a large number of special attractions, among

which are a Phœnix wheel, imitating the Ferris wheel which was in operation at the World's Fair, a very fine electric fountain and electric column, one of the finest auditoriums in the state, a strong searchlight, etc. The company also has in operation a rather novel toboggan slide. The toboggan slide is designed for bathers who seat themselves on small flat cars, and after a swift ride down the slide are shot out on the surface of the lake. The launches, riding galleries, etc. The income from these sources is about 25 per cent of the gross receipts. The company frequently gives exhibitions of fireworks, and states that exhibitions of this kind together with theatrical performances have proven very good drawing cards. The restaurant privileges at Celoron are leased for 25 per cent of the receipts, and the privilege of selling popcorn on the grounds for 35 per cent of the receipts. The company

VIEWS IN PARK OF THE JAMESTOWN STREET RAILWAY CO.

slide has three ways the center one of which will throw a rider 250 ft. into the lake from the end of the chute. There is a large theatre on the grounds which will seat 8500 people, and where entertainments of a high grade are given at frequent intervals. Near the theatre is a large band stand where good music is provided. There is a long dock reaching 800 ft. out into the lake, and along the shore for a distance of 4800 ft., the company has built a board walk. The park is supported by a percentage from the sale of sundries and by the leasing of steam thinks that fully 90 per cent increase in railway traffic comes from its park. Electrical apparatus of the Keystone Electric Company, is used to drive the pumps and furnish electric lights.

NEW ORLEANS, LA.

The New Orleans Traction Company, leases from the Parish Corporation a certain amount of ground located on Lake Pontchartrain, about five miles from the center of the city and upon this ground and the shore abutting the

same, has erected piers, grand stand, a hotel, and amusement pavilions. The custom of the company is to lease privileges for hotel and restaurant purposes and places for the sale of refreshments, etc., and at its own expense to maintain a music platform and pavilions and to provide music during four months of the summer. Two years ago the celebrated Ballenberg-Bellstedt Band of Cincinnati was engaged from June 1, to Sept. 1, and this year the United States Band of Chicago is to play, with forty men, every evening from May to July, and a large local orchestra and band with soloists from that time until September. In addition to music the company provides other entertainments, such as tight rope walking, balloon ascensions and fireworks and vaudeville performances. C. D. Wyman, general manager of the road, writes as follows:

"As regarding the income netted by this enterprise, I can only say that the line belonging to the company, going to this resort, would not be worth anything practically, were it not for the resort, and therefore it is fair to say, its entire income, which is barely sufficient to pay its running expenses, is derived from the amusements provided. There is not much profit in it, since, during the winter, the few cars it is necessary to operate to preserve the chartered rights of the company upon the line in question, are operated at a loss. Just how much business is brought to the other lines which feed the line in question, it is impossible to say.

"My own opinion of the whole matter has been expressed in print somewhat frequently, but I venture to restate it as follows:

"The primal business of a street railway company is to carry passengers of a city, who must needs have some method of transportation. Now, while local conditions, such as the building up of some particular section of a city, or the helping of some special line with a view to inducing people to settle upon it, in which case some special attractions, such as music or something of that sort, may be with profit provided, I do not believe that when the original cost of amusements is reckoned, and the special cost for an increased number of cars to be used only a short time during the year, and the massing of cars for taking a large number of people away in a very short time, is added, that there is a very great amount of profit in what is known as providing amusements by railroad companies.

"It is the regular everyday business of a street railroad that has to be depended upon for income, and these sporadic attempts on the part of companies to increase their receipts, by buying parks and becoming purveyors of public amusements, I do not believe, as a rule, pay. Where a public park is located on a line such as a city park for example, and the people need to be educated up to take outings, of course it is not improbable that some music or attractions can be profitably placed at such resort by the company, but it is a matter that has to be very carefully handled. The tendency always in matters of this sort seems to me to be to overdo it. The amusement busi- is a very risky one; a bad season, unpropitious weather, and many other risks are always to be run by the manager."

Decorated Cars.

It is interesting to note in connection with street railway parks and pleasure resorts, that railway companies are beginning to institute novel parades, consisting of specially decorated cars.

In Fig. 1 are shown five very handsomely decorated cars which were used on the San Diego Electric Railway in the McKinley parade in San Diego, Cal., during the recent political campaign. The cars were designed by Joseph A. Flint, general manager of the railway company, and the decorations were the work of a Grand Army post of San Diego. The train consisted of one motor car and four trail cars, all of which were gracefully draped with yellow, with rosettes of red, white and blue, and bunting of the same colors. A number of yellow, and red, white and blue incandescent lights were also used in the decorations. On the front platform of the motor car was hung a large portrait of Mr. McKinley, framed with yellow incandescent lights and draped with smilax, which was also wound around the trolley pole and around the words, "McKinley and Hobart," which were placed on the top of the car. The cars were filled with ladies, attired in white dresses, with yellow trimmings, and young ladies also acted as motormen and conductors.

FIG. 1.—ELECTRIC CAMPAIGN TRAIN.

On the top of the motor car was placed a mimic throne, covered by a canopy which was tastefully decorated with electric lights and bunting. On the throne was seated a Goddess of Liberty and behind her stood a young man representing Uncle Sam. On either side of the goddess stood sentinels, one uniformed as a soldier and another as a sailor, representing the army and navy defending liberty.

In Fig. 2 is shown another car which also created a great deal of excitement when it appeared on the streets. This car was called "Santa Claus" and was designed by Warren Y. Soper, of the firm of Ahearn & Soper. The car was used on the street railway tracks at Ottawa, Ont., and made its first appearance on the afternoon before Christmas. For some days before Christmas the company caused letters to appear in the newspapers dated at various

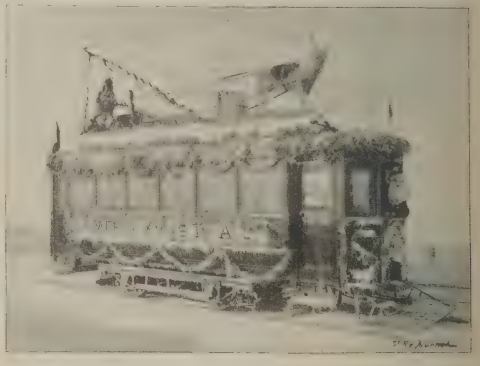


FIG. 2.—CHRISTMAS CAR.

points between the North Pole and Ottawa. These letters stated that Santa Claus with his reindeer would appear in Ottawa on the afternoon before Christmas and were signed by Santa Claus himself. The result was that an immense crowd gathered along the street railway tracks at the stated time and the car met with an enthusiastic reception. The car was covered with imitation snow and ice, and on the top was placed a representation of Santa Claus with his reindeer and sleigh filled with toys of every description. The car was filled with various kinds of toys. The motorman and conductor were dressed as Icelanders and an Eskimo stood beside the motorman and played on a cornet throughout the trip. As the car proceeded oranges were thrown to the children along the way.

LETTERS AND HINTS FROM PRACTICAL MEN.

An Amusement League.

SCHNECTADY RAILWAY COMPANY.

SCHENECTADY, N. Y., Dec. 21, 1896.

EDITORS STREET RAILWAY JOURNAL:

The matter of attractions for pleasure parks of street railway companies, is a serious one in small towns like this, as it seems difficult to obtain clean, low priced companies for short dates, say one or two days, or to obtain even higher priced ones that would, or could, give sufficient change of schedule to make them draw for a week or more.

We have been contemplating the idea of getting all the smaller roads which have pleasure parks and which lie within fair distance from us and each other—within a radius of say 300 to 400 miles; to combine in an "attraction league". Our idea was to make contracts with a number of attractions of different kinds for the entire "park" season; say from May 1 to Sept. 1, and to let these attractions make the rounds of the railways in the "League" in rotation to be agreed and determined on, each member of the league to pay pro rata the expense of each attraction for the season, the rate to be determined by the length of time it used the attraction.

By guaranteeing a full season's employment the different companies or attractions could doubtless be obtained for much less rates than for single engagements by separate railways, and if it is possible to arrange a "circuit" for them among railways or parks which are reasonably close together, the traveling expenses and lost time could be reduced to a minimum.

I am aware that there are a host of "theatrical agencies" and "bureaus" that are supposed to do this same thing, but our experience has been that they are not a success for small railways and parks. Their available attractions are not suitable either in character or price, and they have not, or do not seem to have, a personal interest in the matter, as the railways themselves would have.

With a league as outlined, only such attractions need be booked as are known to be suitable and with properly drawn contracts and the fact that the parties dealt directly with the railways and that these railways were in direct touch with one another in this enterprise, any unsuccessful features could be eliminated, and the experience of one road in the success or failure of any attraction or the improvement of it, would be to the advantage of all the others in the league.

The above is a rough draft of a new idea that we are preparing to put in shape; it could, we believe, be made successful in many sections. We would be pleased to receive any suggestions through your paper or otherwise, to aid us in this idea or in any way in regard to amusements and attractions for small country railways and parks. The larger towns and cities, with a much greater proportion of floating and amusement seeking population have entirely different conditions, and can individually work out their salvation in this respect, but we little "five-to ten-car" roads will have to do differently if the "park" or "attraction" business is to be a success with us, and some such idea as the above seems to us to be at present the only available way

H. S. COOPER, Superintendent.

Weight of Cars.

NEW YORK, Jan. 18, 1897.

EDITORS STREET RAILWAY JOURNAL:

The present tendency in the modern electric car is toward greater capacity. The reason, of course, is a diminution of running expenses, the wages of motorman and conductor being spread over a larger number of fares, while the cost per passenger for repairs is also reduced. I cannot attempt to discuss this policy in general. There is one feature, however, against which I wish to protest. It is the reckless disregard of weight by railroad men and car builders as they increase the unit.

One of the weak points of steam railroading is the fact that good time cannot be made on lines when the stops have to be made at frequent intervals. This is generally accepted as inseparable from steam service, even by steam railroad men themselves. In this, however, they are mistaken. It is a part of the present practice only and results from an untirely unnecessary increase in the weight of rolling stock. This was brought about primarily from the separation of the departments of car building and motive power. At present fashion and practice have gone so far that the steam roads can never get back to a point where they can compete with the small independent motor car.

The electric railway people are forgetting, or perhaps not seeing, the lesson and are accepting the heavy car as a matter of course. Many consider it a matter of necessity. The objection to the increase of weight is that the inertia becomes so great in stopping and starting that speed is out of the question. There is no necessity for greatly increasing the weight of cars as their capacity is enlarged. The ratio between the weight of the load and the weight of the car can be as easily kept down in electric street cars as it was on the old horse cars. The difficulty is not in the construction nor in the necessities of the work, but in the entire neglect of the problem. The weight of the car is not taken into consideration by the general manager, superintendent or draftsman. No one thinks of calculating the work which any stick or rod in a car has to sustain. All that is thought of in getting up specifications in the office of the company is to produce "a good one," which will pass muster at the car building establishments as well.

Now the car builders can give light cars if the superintendents ask for them or care about them. The light cars will be much more durable than those which are heavier from the fact that better material and better construction are both necessary. The lighter car has less weight to help in its own destruction. I might quote facts, to prove my points, from the experiences of several well known steam roads. These figures might be contrasted with the 90,000 lb. parlor car with its dead weight of 3000 lbs. per passenger.

The freight car to-day weighs about half as much as its load. This can be approximated in the street car. The street car may be built without the heavy draw and buffing strength called for in a steam car. It does not have a saloon, its heating apparatus is light and its curved sides impart great stiffness with a small weight of material. The street car can and does have a quality of workmanship entirely unknown in steam car work. It may with safety therefore be built much lighter. The only element necessary to insure a great reduction in the weight of our larger street cars is for general managers to wake up to the necessity of the matter. When light cars are wanted they can easily be had. Nearly all of our car shops can turn them out. All of those who have in the past been considered as first class builders have turned out such cars and can again do so.

The light cars will secure advantage in operation requiring a little less power for operation and punishing the track very much less than the heavier cars, while the increase in durability will perhaps be quite as large as the other gains. D. E.

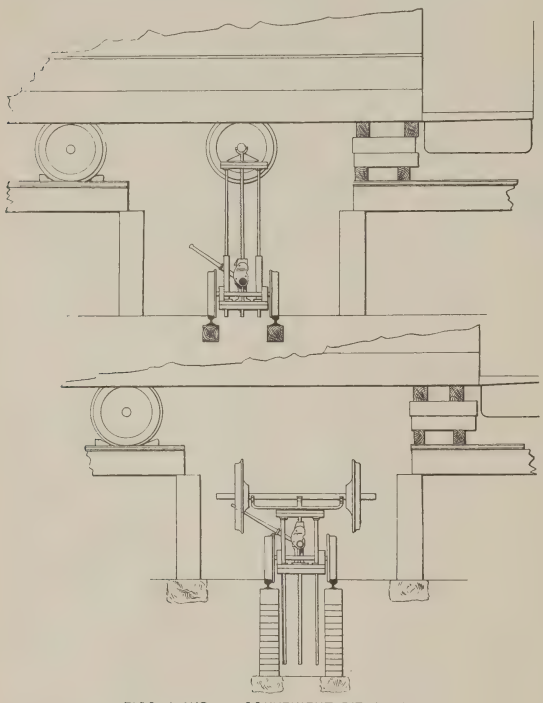
Convenient Pit Jack.

Middletown Street Railway Company.

Middletown, Conn., Dec. 17, 1896.

Editors Street Railway Journal:

All railway companies have occasion to renew their car wheels for one reason or another, and the way they accomplish it can best be described by the managers themselves. Some of the larger companies are equipped so that the matter of replacing wheels does not amount to much, but in the average street railway shop it is a task that the shop hands find disagreeable, and the manager, often expensive. I think the usual way is to jack up one end of the car until it stands nearly on end and then roll out the old wheels and roll in the new ones.



FIGS. 1 AND 2.—CONVENIENT PIT JACK.

The writer had occasion to make some changes in the pits of a certain car house, and determined that the problem of replacing wheels should be considered. The road in question has no shop, and all the work has to be done over and in one pit in the car house. No facilities were at hand to help the work necessary to be done, and as the road is a small one with but few cars it would not do to go to any great expense, and it was quite necessary that some inexpensive way should be provided to handle the motors and wheels. To start with, I had a short but ordinary pit, bricked up the same as in most car houses, but wider than the track on one side, to allow of hoisting anything out of the pit with the car standing over it. Over this pit, outside of the track, I had fastened an 8 in. I beam with a traveler and chain falls. Running across the main pit I had another pit dug and bricked up, so that when finished it was 2 ft. wide. On top of these brick walls were placed two 8 in. × 8 in. timbers, and on top of them, spiked with reverse point spikes, were placed rails with 2 ft. 6 in. gauge. I obtained some second-hand trucks of the same gauge, with boxes, to use on this track; then with some planking I had a platform made, 4 ft. long by 2 ft. 3 ins. wide, and bolted to the boxes; then I bolted four 2 in. pipe flanges, with a piece of 2 in. pipe, 20 ins. long, screwed into them, to the platform. Inside of the 2 in. pipes I put as many pieces, 6 ft. long, of 1½ in. pipe with flanges on the top, and to these flanges I had bolted a double plank platform, 2 ft. square. It was necessary to provide some way to raise and lower this small platform, to which the 1½ in. pipes had been attached, and which were to slide up and down through the 2 in. pipes. Having two "Barrett" No. 2 ratchet jacks, it was an easy matter to remove the regular rack from one and substitute a rack 6 ft. long, and my pit jack was ready for lowering and raising the motors under the cars. The next and all-important thing was the easy removal of the wheels. Having finished my jack for removing the motors, it was an easy matter to provide an attachment that would fit the axle after the motor was removed. Removable timbers and rails are first placed in the track, so that the center of them comes over the center of the jack, and the car body is then raised sufficiently so that its weight is taken off the car wheels, and is blocked in position. After then removing the parts necessary on the truck, and taking out the removable rail under the wheels, the axle and wheels are lowered. After having lowered them on the jack they are turned a quarter around, and the jack is pushed from under the car to the chain falls, and with these the wheels are lifted out of the pit. The new set of wheels is then easily put in place the reverse of the way the old ones were removed.

It was thought that when the jack was raised to its full height it might be liable to tip over, but when finished and raised it was found sufficiently rigid to dispel all fear on that account.

The accompanying sketches will show the make up and method of using more clearly than any written description. Fig. 1 shows the body blocked up, with the removable rail taken away and the jack in position for lowering a set of wheels. Fig. 2 shows the jack lowered and the wheels turned around. The cost of the rig, aside from the pits and removable rail, was about $50.

It is not expected that this way of removing wheels would be of use to the larger roads, equipped with more modern shops, though I have seen some good sized street railway shops that still follow the old way, but to those that have poor facilities, or none at all, it is hoped this article may be of service.

E. W. Goss, Superintendent.

Commutator Troubles and their Remedies.

Wilmington City Railway Company,

Wilmington, Del., Jan. 15, 1897.

Editors Street Railway Journal:

The sound of squealing brushes is to the trained ear of a well informed motorman the language which speaks in mechanical poetry of a good condition of brushes and commutators under his car. By "squealing" is meant the screech made by carbon brushes on a glazed commutator. The squeal pleases the motorman because he knows what the sound signifies. When the brushes are silent he naturally suspects that it means "a calm before the storm." The silence indicates most probably that the commutator is cutting or blackening and if the motorman pays no attention to it, the next noise will be a clicking or rattling which will soon consume the brushes and culminate in flashing and motor bucking at high speeds of the car.

The audible evidence of good commutators is the more reassuring because with few exceptions it means good order of the motor throughout, as usually mechanical or

electrical defects show up on the commuator, causing sparking and all the evils that follow bad commutation.

With the excellent machinery that has been in the market in the past few years, it is probably safe to assert that the largest percentage of commutator troubles is due to the faulty design of the commutator itself, and not to the design of the other parts of the motor.

To those fortunate people who have "prairie levels" to work their cars over, the question of commutators will have little special interest. A machine will work fairly well with them even if it is not quite first class, in view of the fact that their motors are seldom taxed to their capacity and therefore develop few faults. On a heavily graded road the maintenance of commutators consumes a great deal of time and money. Many builders of this specialty may get good results on prairie roads, but as soon as their product is made to work over hills, it is found sadly lacking in endurance; the commutator will then not do the work it is designed for; it blackens in spots or entirely; the commutator does not wear out in legitimate service, but is consumed by the turning lathe in the machine shop.

The prime motive of almost all commutator builders seems to be "good insulation" and they strive so hard on this point that they lose sight of other essential features. The fact is that the insulation seldom breaks down. Short circuits are nearly always due to careless lathe work.

The essential feature of a good commutator is as much in the quality and quantity of separating mica as in the kind of metal used. Hard white mica is unfit for this purpose and the practice of sticking together the mica sheets and the sheets to the copper with shellac is a useless expense. It does more harm than good. We fill our own commutators and find it profitable, considering both the first cost and the subsequent service; we use the Billings & Spencer drop forged segment and the Canada amber mica which is soft but not brittle. Each mica segment is separated into as many thin sheets as possible; these sheets are put together to gauge $\frac{30}{1000}$ in. set up without shellac and built in the usual way. The minute separation of the mica sheets seems to insure a more even wearing of the commutator than any other one feature; the mica then assumes its proper function; it is an insulator only, not a wearing surface. The wear is all between the carbon and the copper with a consequent great saving to both; the copper takes on a high polish and retains it, the carbon is always in good contact with the copper and will carry the current demanded by the motor.

Those in the business of commutator refilling no doubt strive to turn out a good article, as is shown by their willingness to guarantee results and they are greatly surprised when the old trouble crops out again as it usually does; the trouble will continue to crop out until they use an insulating segment softer than the metal.

White India mica has an extensive field of many uses without encroaching upon the domain of commutator construction and causing blame to the man who furnishes the copper bars or the carbon brushes of the machines. Hard separating mica, like cast bars, has had its day, especially now that slotted armature cores are almost universally used and increase so greatly the destructive effect of any sparking that may occur.

An old style smooth core armature may spark vigorously all day and be dressed down at night with sandpaper in good shape for the next day's run, while the same amount of sparking on a modern machine would necessitate the use of a turning lathe. The supply man will make the statement that he builds commutators under specification and must confine himself to the kind and quality specified by the purchaser. It would seem that the most plausible answer to that argument is to "turn the order down," if the specifications are bad; it is difficult to find adequate reason or excuse for deliberately constructing a defective piece of work.

Aside from trade journals and personal experience, the supply man is the greatest educator we have. In his travels he gets the experience, hears the discussion and observes the practice of hundreds every year; his mind becomes a reservoir of information, provided he is a man of sufficient mental capacity to retain and descriminate. Most supply men have this capacity; a few have not; it is well to allow them to explain themselves, especially if they wish to substitute the cheaper amber mica in commutators instead of the hard white mica.

C. F. HUTCHINGS.
Superintendent.

Clearing Snow From Tracks.

NEW YORK, Jan. 18, 1897.

EDITORS STREET RAILWAY JOURNAL:

The experiences of many street car lines during some of the severe snow storms of last month well illustrate the lack of proper precautions, or lack of management of such as are available, for the efficient operation of the said lines during a very bad snow storm. One of the large trolley systems in northern New Jersey kept up its service with the best possible regularity, and scarcely any delay, during the worst of the storm which blockaded so many lines. The matter of operation under such conditions may look complicated, expensive and possibly clumsy, but it is so simple and easily made very effective with only a little judgment and resource.

For this purpose the requirements are briefly stated as follows:

First, the obviously necessary snow sweepers, whose number will depend on the number of miles of track to be kept clean. The moment the snow begins to fall, out they should go. They should be kept in readiness for service at a moment's notice at any time; during the spring, summer and autumn there should be the most complete overhauling and repairing of them, so there is no excuse for their being out of order or unready when the critical time comes. There should be about one snow sweeper to something like every six miles of street covered by the railway system, together with a small number of extra sweepers as a margin for any possible accident to one in service.

Second, in addition to the snow sweeping cars, there should be auxiliary appliances added to each passenger car. This arrangement can be indicated in general terms, briefly as follows:

1. In front of the leading pair of wheels, and behind the rear pair to serve when the car returns, there should be a pilot, popularly called a "cow-catcher," but of much simpler construction than the locomotive's device of the same name. It need only be of two planes, vertical or so inclined that the bottom is a little ahead, meeting in the center plane of car and track, making an angle of about 45 degs. or less with the vertical center plane through the car.

2. As auxiliaries to this pilot, there should be brushes of steel having strong lugs, and so placed as to completely clean the rail after the pilot has removed the greater part. It might be advisable to place in front of the brushes some cutters for the removal of ice films; these could easily and perhaps best be serrated wheels with sharp contact edges.

3. Alongside of the car on a level with the pilot should be placed a hood so as to keep drift snow under the cars away from the motors. This additional precaution is recommended to save labor in cleaning the motors afterwards.

All these precautions combined are not expensive and could be supplied for less than $10 per car.

To make this work more effective, every car that could be spared from the barn should be turned out and kept going, at the same time making sure that in no case are such means omitted for track cleaning. This too will better accommodate the public at the most critical time; they being sure of efficient service will ride on errands that are now neglected for want of assured transit then.

JAMES H. BATES.

LEGAL NOTES AND COMMENTS.*

Edited by J. Aspinwall Hodge, Jr., and George L. Shearer,
of the New York Bar.

Making Change on Street Cars.

An opinion has just been delivered by the highest appellate court in New York, in what seems to be a case of first impression, except for a single decision by the highest court in California which is overruled.

A passenger on one of the principal street car lines in New York tendered a $5 bill to the conductor for his fare. The conductor refused to make change and ejected the passenger from the car. Suit was brought for the assault, which, however, was a purely technical one, since no violence was used.

The Court of Appeals holds that substantial damage was sustained and could be recovered, provided that a $5 bill was not an unreasonable tender for a five cent fare on a street car. (*Barker* v. *R. R. Co., 151 N. Y. 237.*) Upon considering that question the court holds that it was not even a question necessary to submit to the jury, but as a matter of law it was an unreasonable amount to expect the conductor, upon demand, to change.

The California case (*Barrett* v. *Ry. Co., 81 Cal. 296*) is distinguished by the suggestion that in California at the time of the decision in 1889 the $5 gold piece was the smallest piece of gold in circulation and bills were not in common use.

It is well accepted law that the debtor has to tender to the creditor the exact amount of the debt and the creditor is not obliged to give any change whatever. The only rule that intervenes to alter this doctrine in the case of the street car company is the fact that it is a common carrier, and courts have held that it is due to the public to offer reasonable change when bills of small denomination are presented, and this case holds that five dollars is above the limit.

The decision opens some field for speculation as to what size bill is beyond the limit when offered at Elevated or Underground Railroad stations for one or more tickets and what is unreasonable to offer at stations of suburban and trunk lines of steam railroads.

It would appear too that the cabby, as truly a common carrier as the corporation operating the most extensive system of railroads in the country, would be obliged under this ruling to change a bill up to a certain amount, but it can hardly be said that because the tender of a $5 bill in payment of a five cent fare is unreasonable, that the tender of a like amount for the payment of a fifty cent or a dollar fare is unreasonable.

Finally, the decision of the Court of Appeals does not justify the conclusion that that ruling make it obligatory upon the conductor of all lines in all circumstances to change even a $2 bill. It would not be in conflict with the decision of the Court of Appeals if, in some circumstances, that question was left to the jury. H.

Damages for Injuries Caused by Fright.

It has long been the law that where injury to the person caused by the tortuous act of another results in pain, suffering, fright and mental anguish, these mental disturbances, incidental to the actual injury to the person, are proper elements to be considered by the jury in awarding damages. A somewhat different question is presented, however, where the only injury resulting from the tortuous act is mental suffering, and, except, perhaps, in Texas, the law seems to be well settled that no recovery can be had in such cases.

There is another class of cases in which fright is an element. As, for example, where a boy, through a threatened attack, which never resulted in person violence, rushes into a cellar, and in tumbling in the dark, loosens the tap of a wine cask. The wine runs out, and the owner of the wine sues the man who frightened the boy, and recovers on the ground that his act was the proximate cause of the loss of the wine, and while he did nothing but frighten, yet the natural result of what he did was just what happened. Boys, when chased, must be expected to run, and if they run into wine cellers are apt to do the damage this boy did.—(*Vandenburgh* v. *Truax, 4 Denio 464.*)

A somewhat novel case involving fright has just been decided by the Court of Appeals, in New York. The facts can be briefly stated. Through the negligence of the driver of one of the defendant's street cars, the plaintiff, who was rightly upon the crosswalk, suddenly found herself between the heads of two horses attached to the street car. She does not appear to have been touched by either of them, but was for an instant in a position of great apparent peril. The fright she experienced was shown upon the trial to have, subsequently, caused a miscarriage. In her action against the company for damages, she was non-suited at the trial, but the learned judge, upon considering the case more carefully, granted an order for a new trial on the ground that error had been committed, citing the wine case above referred to as one which "establishes the prin-"ciple claimed by the plaintiff." In his opinion, the learned judge seeks to distinguish the cases which lay down the rule which has been referred to above, that where fright only results from the tortuous act a recovery cannot be had, by seeking to show that the case at bar rather came under the head of those cases where the tortuous act, without injuring the person of the plaintiff, caused him to take some sudden and involuntary movement, which movement was, in fact, the cause of personal injury. In this way he reasons that in the case at bar there was a serious physical injury, the result of the tortuous act, caused, it is true by the fright of the plaintiff, but nevertheless, closely enough connected to enable the court to hold or jury to find that the tortuous act was the proximate cause of the miscarriage.—(*Mitchell* v. *Rochester R. R. Co., 25 N. Y. Supp. 744; 4 Misc. 575.*)

This reasoning, however, has just been overruled by the Court of Appeals in the same case. (*45 N. E. Rep. 354; 151 N. Y. 107.*) But we confess to some confusion of thought resultant from the final sentence of the opinion of that learned appellate court. It read as follows: "These considerations lead to the conclusion that no re-"covery can be had for injuries sustained by fright oc-"casioned by the negligence of another where there is no "immediate personal injury." What would have been the decision of the Court of Appeals, then, if the miscarriage had occurred immediately, instead of some time after the occurrence on the street?

Manifestly, at best, the case is a border-line one. The appellate division affirmed the decision of the judge below without an opinion, but the two views that may be taken of the matter are clearly presented in the opinion of the trial judge and in that of the Court of Appeals, both of

*Communications relating to this department may be addressed to the editors, No. 32 Nassau Street, New York.

which we have cited. They form an interesting chapter upon a much debated question.

The *argumentum ab inconventienti* is acknowledged to be in favor of the ruling by the Court of Appeals, and the strength of that argument in that court has been frequently demonstrated by expressions contained in their opinions; their reasoning in this case being that "if the "right of recovery in this class of cases should be once "established, it would naturally result in a flood of litiga- "tion in cases where the injury complained of may be "easily feigned without detection, and where the damages "must rest upon mere conjecture or speculation." The learned judge sitting at the trial considers the same line of reasoning and concludes his opinion by remarking of the argument *ab inconventienti* that "it is never of much force "and least of all when it is invoked to avoid a necessary "legal conclusion." H.

CHARTERS, FRANCHISES, ORDINANCES, ETC.

SOUTH CAROLINA.—Petitioner was incorporated as a street railway company under an act by which it acquired the franchises, and assumed the duties of its predecessors, whose charters contained provisions making the running of the cars subject to the regulations of the city council; and, when petitioner applied for leave to operate its cars by electricity, it presented the draft of an ordinance which, inter alia, declared that the council reserved the right to regulate the manner of operating such railway, and to amend the ordinances relating thereto, as the public welfare should demand. Acts 1871 (14 St. at Large, 569), § 10, authorized the city authorities to make, by ordinance, such regulations relative to streets as were necessary to preserve order and safety. *Held*, that the authorities had power to ordain that petitioner's cars should not be operated without a conductor in charge thereof.—(State v. Sloan, 25 S. E. Rep. 898.)

ILLINOIS.—Under the city and village act of 1872 (1 Starr & C. Ann. St. art. 5, par. 63, subd. 90), providing that the consent of the owners of more than one-half of the abutting property is a condition precedent to the laying of street railway tracks in any street, a street railway company, in consideration of the consent of an owner to the laying of a single track along the street, executed a bond conditioned that it would not thereafter build any other track along said street without the consent of the obligee first obtained. *Held*, that the bond was void as against public policy. 51 Ill. App. 353, affirmed.

In view of the fact that the consent of the owners of only more than half of the abutting property is required, the bond cannot be justified as compensation for damages.

The agreement by the company not to lay a second track without the consent of the obligee was invalid as a limitation upon its duty to the public under the provision of its charter.—(Doane v. Chicago City Ry. Co., 45 N. E. Rep. 507.)

NEW YORK.—The penalty for refusal to give a transfer to "any passenger desiring to make one continuous trip" between any two points on a street railroad system (Laws 1892, c. 676, § 104) cannot be recovered by one who demanded a transfer with the sole object of recovering for refusal.—(Meyers v. Brooklyn Heights Ry. Co., 41 N. Y. Supp. 798.)

EJECTION OF PASSENGERS.

WASHINGTON.—In an action for an ejection from a street car for non-payment of fare, plaintiff cannot be asked, on cross-examination, whether he had not been put off of a Northern Pacific car for non-payment of fare.

In a trial for ejecting plaintiff from a street car for failure to pay his fare, where the conductor testifies that plaintiff had not paid his fare, he cannot be further asked for the reason which led him to come to the conclusion to which he had testified.

Where plaintiff was ejected from a street car for an alleged failure to pay his fare, under the definite charge of the conductor that he was attempting to beat his way over the road, he was not required to use another street car ticket, in his possession, to avoid expulsion, in order to reduce the damage as much as possible.—(Sprenger v. Tacoma Traction Co., 47 Pac. Rep. 17.)

NEW YORK.—If the facts are undisputed and not susceptible of different inferences, the question of the reasonableness of a rule of a carrier of passengers is one of law, and should not be submitted to the jury.

A common carrier is not required to bring home to each passenger a personal knowledge of any reasonable and just rule which it is seeking to enforce.

A rule of a horse street car company in a large city, requiring its conductors to furnish change to passengers to the amount of $2 is reasonable, and a tender, by a passenger, of $5 to be changed for a five cent fare is unreasonable and need not be accepted, but the passenger may be lawfully ejected from the car.—(Barker v. C. P., N. & E. R. R. Co., 151 N. Y. 237.)

LIABILITY FOR NEGLIGENCE.

CONNECTICUT.—Plaintiff's servant was driving a horse and wagon along defendant's street car track. A car approaching from behind rang its gong when about 125 ft. distant. The driver looked back and saw the car. Instead of turning directly off the track, the driver took a long, slanting turn, continuing with the wheels of one side between the rails for about ninety feet before the hind wheel passed off the track. The motorman, knowing that the driver had seen the car, did not check its speed until he arrived within fifteen feet of the rear of the wagon. Then, seeing that the wagon was not entirely out of the way, he attempted to stop the car. The wagon was struck by the side step of the car, and overturned. *Held*, that the driver was guilty of contributory negligence precluding recovery.—(Morrissey v. Bridgeport Traction Co., 35 At. Rep. 1126.)

KANSAS.—In an action against a street railway company by a person engaged in grading the street for a paving contractor, to recover for injuries received while working between the rails, where it is uncertain, under all the testimony, and findings of the jury based thereon, whether he was guilty of culpable negligence contributing to his injury or not, and where the jury were erroneously instructed by the court that, in order to recover, the plaintiff must show that defendant was guilty of gross and wanton negligence. A finding as follows: "Question. Was the plaintiff guilty of negligence which contributed to his injury? Answer. Yes; to some extent,"—is insufficent, when opposed to a general verdict in favor of the plaintiff, to require that judgment be entered for the defendant. There being doubt whether the jury meant to do more than find the plaintiff guilty of slight negligence, instead of directing judgment on the special findings, a new trial will be ordered.—(Pittsburgh El. Ry. Co. v. Kelly, 46 Pac. Rep. 945.)

NEW YORK.—No recovery can be had for injuries resulting from fright, caused by the negligence of another, where no immediate personal injury is received.

Where a miscarriage results from fright caused by the negligence of another, such negligence is not the proximate cause of miscarriage. 25 N. Y. Supp. 744, reversed.—(Mitchell v. Rochester Ry. Co., 45 N. E. Rep. 354.)

ILLINOIS.—The concurrent facts of the happening of an accident to a passenger on a street car and the exercise by the passenger of ordinary care do not raise a presumption of negligence against the carrier, so as to shift the burden of proof on it to show that it was not guilty of negligence, where plaintiff's evidence shows that the accident was due to a wagon driven so close to an open car as to strike plaintiff's foot. 62 Ill. App. 550, reversed.—(Chicago City Ry. Co. v. Rood, 45 N. E. Rep. 238.)

NEW JERSEY.—Where the trial judge charged that it was the duty of the managers of a car operated by electric motors, at a high rate of speed, to give audible signals of the approach of a car, the non-performance of which duty was evidence of negligence, which, if the proximate cause of the injury complained of, was actionable, *held*, that the charge was free from error.—(Con. Tr. Co. v. Chenowith, 35 At. Rep. 1067.)

LOUISIANA.—The fact that a child may not be capable of contributory negligence does not always render the defendant liable upon the mere proof of the act causing injury.

No liability for sudden act of a child.

If the defendant's employe was not careless or negligent, it cannot be rendered liable.—(Culbertson v. Crescent City R. Co., 20 South Rep. 902.)

NEW YORK.—The fact that a foreman of a street car company had at previous times notified an employe, when giving him a pass, that "he had to ride at his own risk, and that the company was entirely blameless," is not notice to the employe of a claim by the company of exemption from liability on all subsequent occasions on which he used the cars without pay.

A laborer employed by a street railway company, when returning home after a day's work, free of charge, on one of the company's cars, is not a fellow servant of the conductor, so as to preclude recovery for injuries received by falling through a gate on the car, left unsecured by the conductor's negligence.—(Pendergast v. Union Ry. Co., 41 N. Y. Supp. 927.)

NEW YORK.—Where a passenger was thrown from her seat as the car rounded a curve, and there was evidence that at the time of the accident the car was being run in the usual manner, a question if similar accidents had occurred at the same place was competent as relating to the structural condition of the road.

The fact that persons are not ordinarily thrown from their seats in a car in rounding a curve does not justify the presumption, where a person was so injured, that the injury was chargeable to the want of care of defendant.—(Wilder v. Met. St. Ry. Co. 4 N. Y. Supp. 931.)

NEW YORK.—Where a passenger was injured by the breaking of a brake chain in a street car, but there is no evidence that any other or safer appliances were in use, it is error, in an action for the injury, to charge that "the appliances used by defendant must be the best that skill and science have contrived, and which are in practical use." Williams, J., dissenting, on the ground that the instruction referred to the condition of the chain.—(Wynn v. C. P., N. & E. R. R. Co. 41 N. Y. Supp. 595.)

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THE city of New York during 1897 will, for the first time in its history, present a scene of great electric railway activity. Every other city is this country of over 50,000 inhabitants and nearly every one of half that population, is employing electric power on lines extending through prominent streets. New York only, through no lack of enterprise on the part of its street railway managers, however, has made no application of electric power for railway service in or near the central portion of the city. The commencement of construction by the Third Avenue Railroad Company upon an extensive trolley line in the northern part of the city and the decision of the Metropolitan Street Railway Company to equip two of its longitudinal lines in New York with the underground conduit mark the conclusion of a long and important discussion on motive powers for these lines. No event of transportation interest in New York City has occurred of such importance since the construction of the elevated railroads, not even the cable railway on Broadway, because the new lines involved in the underground conduit plans comprise in length more than three times that of the original Broadway cable road. The question of the most desirable form of motive power for use on the crosstown lines yet remains, and this will undoubtedly soon receive the attention of the directors interested.

A CALL has been issued by the accountants of several street railway companies for a conference of street railway accountants to be held in Cleveland March 23-24. The object of the meeting is to consider the different forms used in conducting the accounts of street railway companies and to determine if possible upon one standard form, so capable of both elaboration and condensation, that it shall be suitable for the needs of both large and small roads. This is an important work and one which we hope will be successfully accomplished. To many companies whose own methods of accounting have given seemingly good satisfaction in the past, the advantages of employing a standard method in common with other railways, does not seem important. On the contrary, any change, involving as it necessarily would, new blanks, new methods with which an entire force must become acquainted, and a difficulty in comparing particular items with those of preceding years, must appear disadvantageous. The advantages of a standard system, should such a one be devised and generally adopted, appear so great, however, as to outweigh the inconveniences of changing an existing system to put it into operation. In the first place, it may be assumed that the standard system, being the result of the combined experience of a large number of roads, will be the simplest and best. In the second place, any changes or improvements which may be necessary from time to time, either on account of a change in operating methods or from some other cause, will concern a large number of roads, and consequently the best method of making them can be considered and determined by a body of experts instead of by individuals. Again, standard methods of accounting permit the comparison of results secured upon different roads with a fair degree of accuracy. This is not only of importance to the investor, but of equal if not greater value to the operating officials. It enables them to compare their work with that of other companies in different particulars and thus learn whether they are securing as good results as other lines operating under similar conditions. Considerable work has already been done by the American Street Railway Association in the direction of a standard system of accounting, and should the meeting at Cleveland aid in the selection and adoption of such a system by any considerable number of roads, it would be a result which would be very welcome to the street railway industry.

THE Brooklyn Bridge, from an engineering standpoint, has been considered one of the most wonderful and interesting structures of modern times. In it many engineering problems were attacked in an entirely original manner, and in many respects the practice was years ahead of the date of the construction. The transportation problem presented by the bridge after its completion was quite as interesting and quite as much of a marvel as the superstructure itself. In our article on the bridge, published on another page, we present not only a short account of the peculiar engineering features, but also a most careful statement of the traffic conditions and the methods

which have been employed in transportation. This, we think, will be found one of the most complete and popular presentations that have yet been made. It is interesting to note the fact that the foot traffic over the bridge was even at first when it reached its largest development an insignificant fraction of the bridge income. When the total receipts from the traffic on the bridge were nearly $580,000, the foot passenger receipts amounted to less than $20,000. In 1891, when the footways were made free, it was nearly nothing. Even the receipts from the vehicular traffic formed a very small fraction of the total income, as will be seen from the diagrams presented. For some three years past the growth of traffic on the bridge has been almost at a standstill, and it is supposed by many that, owing to what may be called the saturation of the area which feeds the bridge, a further growth of any considerable amount is not to be expected. The recent change in the terminal facilities and the consequent freedom from crowding and greater convenience of access, may perhaps alter this estimate and a new growth of traffic begin. The safety of operation should not escape comment. 435,000,000 passengers carried during the period of a little more than thirteen years with only three accidents which have resulted in severe or fatal injury, is a record which deserves the careful study of every railway man. As an example of successful cable work the bridge is a most interesting example. All the conditions seem to favor this method of operation. Especial interest attaches to the engineering features of the bridge at present on account of the recent opening of the new terminals and the installation of electric railway apparatus for switching and for the operation of trains across the structure at certain hours of the day. That electrical apparatus can be successfully used for these purposes seems to be proven beyond a doubt, and that a great gain can be made in time by electric handling of the cars at the termini, is evident as far as anything can be which has not had the test of experience.

IN another column will be found a discussion by Mr. Uebelacker, of the proper form for car wheel flanges. The problem is taken up from a geometrical standpoint and the proper form for the flange deduced from theoretical considerations. Mr. Uebelacker finds as one of the fundamental points that the inside face of a flange for a seven foot wheel base on a curve when the outside rail has a radius of thirty feet must have an angle of six degrees and forty-two minutes in order merely to touch the rail without clearance. This is the horizontal angle. To obtain clearance he makes the angle seven degrees. The horizontal angle being established, the vertical angle of the face is found to be sixty-four degrees thirty minutes. With proper fillets to complete the action of the flange it then becomes nearly that of the working side of the Master Car Builders' Standard. Mr. Uebelacker's statement of the geometry of the problem is very clear and easily followed and his conclusions appear to be sound. It seems fair to conclude that if the back of the flange could have the same angle or flare as the face the wear of the guard rails would be greatly reduced. This in most cases, however, is unfortunately impossible. An understanding of the theory will make modifications of the form possible in many cases.

* * * * *

A corollary to Mr. Uebelacker's article on the proper shape for car wheel flanges would be that the side of the rail head should have the same shape or section as that of the wheel and flange. When the flange of the wheel is made of the theoretical form and the rail head conforms thereto theory would indicate that wear could produce no change of outline in either the wheel or rail. Even when the flange becomes so thin that it could no longer be allowed to run, the outline of the face of the flange should not change, remaining the same as that of a new wheel. The flange suggested by Mr. Uebelacker in his paper is precisely this form and is not only that of equally distributed, but of minimum, wear also. Hence, the form of wheel flange and rail head perpetuate themselves. Actual practice has shown that this is the case. Under such conditions "sharp" or vertical flanges are never found. They are mechanically impossible. This is an especially valuable feature because wheels with sharp flanges are in the highest degree dangerous. They leave the rails easily and the smallest obstructions throw them off. The sharp flange has the additional disadvantage of constantly cutting or grinding the rail head. The grinding upon the head of the rail takes place constantly on the tangents as well as upon curves. It not only destroys the rail, but in doing so taxes the motive power by increasing the traction. They may be said to approach the form of maximum friction and consequently maximum side wear of the rail head. The conditions found on one railway, however, differ so completely from those found on others as to make the practical adoption of a standard wheel section very difficult.

MR. TANDY'S paper in our last month's issue on the economic results found in some electric railway power stations of America, is one of the first attempts yet made in this special field of investigation, certainly as regards published results, to determine the relative economy of different types of power stations. Ten stations, large and small, were selected by the author from a much larger number, information concerning which was in his possession, and while it is true that future decisions cannot safely be based on the results of but ten examples of past experience, it is nevertheless possible to learn much from the tables which Mr. Tandy so carefully prepared, particularly as they represent actual tests made by himself at each station with the object in mind of obtaining results which should make "true" comparisons possible. It is obvious that such compilations are vastly more reliable and worthy of study than those which are obtained from a number of different observers whose methods may vary in every detail. It appears that the cheapest power produced in any of the ten stations under discussion cost $.0061 per kilowatt hour with direct connected generator units and anthracite coal at $2.40 per net ton. In this station the water consumption was less than 19.9 lbs. per kilowatt hour at the switchboard—a very remarkable result. This was a large city power station containing every coal and labor saving appliance, and the interest on investment is, of course, a considerable additional element in the cost of power. The most expensive power in the ten stations cost $.0112 per kilowatt hour, and was produced in a city station by cross compound, condensing engines belted to generators, and with water tube boilers running at 150 lbs. pressure, the coal used being a mixture of Cumberland and bituminous coal, costing $3.05 per net ton. Mr.

Tandy's experience leads him to believe that in a large number of cases it is a mistake to use compound or triple expansion, condensing engines, on account of the additional complication, more rapid depreciation and larger interest charges, and he states that the cheapest electric railway power produced in the United States, so far as he is aware, is produced in a station having simple non-condensing engines of large units, directly connected with their generators, and supplied by steam at 110 lbs. pressure from fire tube boilers fed with bituminous coal, costing about $1.50 per ton. This power costs but $.0058 per kilowatt hour, while the cost for the construction of the station was less per kilowatt than for any station of its kind in the United States. From other sources of information we may add that the roads whose power was furnished from this station operate both long and short cars, and that their power costs about one cent per car mile, including insurance, interest and taxes, while of the total operating expenses and fixed charges of the station, about forty-seven per cent are for fuel, twenty per cent for wages, and sixteen per cent for interest on investment. Such an example as this shows us, not that condensation is a failure in street railway power stations and simplicity in equipment always economical, but only that conditions may be such, particularly when low priced coal is combined with high priced water, that fuel saving devices cannot earn interest upon their cost, plus depreciation. Mr. Tandy states that power for railway purposes can be, and is now being produced, with coal at $1.60 per ton, for $31.61 per horse power year of 365 twenty hour days, and from this figure as a minimum the cost ranges as high as $70 per horse power, these figures excluding, we presume, interest on investment. It is probable that many street railway managers will find that by replacing their present station equipment with the simplest and best in the market to-day, they will be able to make an annual saving equivalent to a large percentage return upon the required investment.

Reflections Concerning Pingreeism.

Now and then a man appears whose deeds exhibit so rare and distinctive a quality that the mother tongue fails adequately to characterize them, and they become permanently attached to the patronymic of their great originator. Thus our vocabulary has been enriched by such expressive words as *gerrymander*, to redistrict with fraudulent intent; *chauvinism*, insensate and maudlin patriotism, and *burke*, to strangle one's chance acquaintances with the amiable design of selling the remains for dissection. Akin to these in derivation and general import is the highly distinctive term which forms the subject of these remarks. It may briefly be defined as the looting of corporate property for political gain. It differs from blackmail by being perpetrated ostensibly for the public weal, and is distinguished from ordinary confiscation in that the victim has committed no crime save prosperity. In effect it forcibly seizes for general distribution the profits earned by a street railway company and rightfully belonging to the stockholders. Thereby applause and votes are won from well-meaning persons of communistic proclivities who would shrink from pocket-picking, but see no harm in quietly robbing the investors in corporations acting under public franchise. In stilling any disturbing qualms of conscience, it is usual to assume that such franchises are granted without proper equivalent and that therefore the public may from time to time extort such tribute as may seem good to its myopic vision. Now, in fact, the street railways of this country have already richly repaid the public for their franchises. It is far within the bounds of truth to say that, on the average, for every dollar invested in a street railway another dollar has clinked into the coffers of the people through the resulting increase in property values. Pingreeism not only ignores, but would paralyze that splendid suburban growth which is the munificent payment daily being made by the street railways for the benefits they have received. The whole point and purpose of the American system of uniform fares is to stimulate this growth and to put the whole municipal area and its environs on an equality. This great work, which above everything else secures the common people freedom from the tenement dens of the city, depends on the economic possibility of a single fare and free transfers. It involves the same principles upon which are built the postal systems of the world. The single fare must then be established at such a figure as will make it possible to carry the meagre traffic of regions just opened for habitation, by recouping the loss there necessary from the profits on the local business. How considerable these losses may be it is easy to comprehend. In its suburban work the West End system of Boston carries immense numbers of passengers for six or seven mills per mile, and it contains nine free transfer routes that give the passenger transportation at three to four mills per mile, besides others little less generous. This must be balanced by the gains on shorter routes or the road would have to go out of business. So liberal is the free transfer system that the actual passenger receipts of the West End road amount to only 4.50 cents per passenger carried. At this rate the margin for profit is so small that a reduction of the legal fare to four cents—one of the less rabid forms of Pingreeism—would compel either a complete abandonment of the far sighted policy that has built up greater Boston or cessation of dividends. Neither the abolition of all transfers nor any possible increase of traffic from lessened fare would substantially help the matter. And what is true of this great road with its conservative capitalization and small funded debt is in part true of nearly every other. The least evil inflicted would be to render nearly worthless entire capital stock, with complete crippling of growth and cessation of improvements as the other horn of the dilemma. A three cent fare—the true and original Pingreeism—means turning over the street railway properties of this country to duly appointed receivers. The only way in which such fares can be even locally secured without confiscation of whatever value there may be in street railway stock is by a retrogression to the old zone system which has long since been abandoned as against public interest, or by municipal ownership with taxes high enough to cover the inevitable deficit. Such is Pingreeism—a choice between robbing one part of the public and injuring another. It is to be feared by the public as a block to municipal progress, by the street railways as imminent bankruptcy. It is more to be dreaded by the investor than any form of public ownership, for it wrecks his property while disclaiming all responsibility for its management

CONSTRUCTION

A New Power Station at New London, Conn.

During the spring of 1896 the managers of the New London Street Railway Company decided to build a power station and produce their own power, instead of hiring power longer from other sources, a course which at that time they were pursuing. Upon arriving at this conclusion E. H. Kitfield was engaged as consulting engineer and instructed to proceed at once with the work of preparing plans and specifications for a complete plant, and the work, after being started upon, was carried on rapidly to its completion.

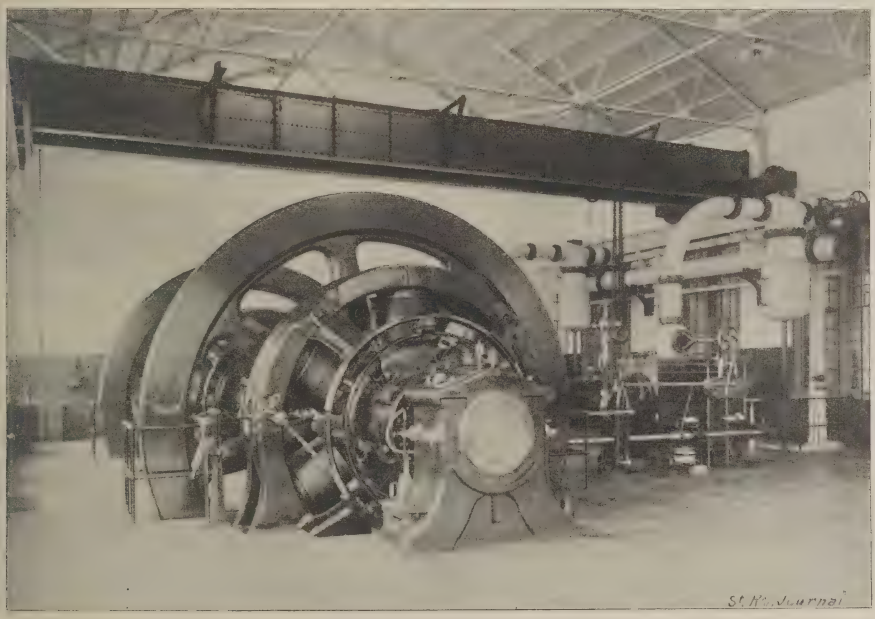


FIG. 1.—ENGINE ROOM—NEW LONDON STREET RAILWAY.

The station, which is shown in Fig. 3 and is 132 ft. 3 ins. × 46 ft., is built in a substantial manner of red brick and local granite underpinning above its foundations. The underpinning is laid in irregular ashler and topped with a cut granite water table extending around all sides of the building.

The stack is of brick, 125 ft. high, and is of octagon shape for the first twenty-four feet of its height, and circular in shape for the remainder.

The foundation walls of the building are extra heavy and of local granite laid in cement mortar. Upon excavating for the foundations of the stack and engines, the nature of the excavated material made it advisable to use piles for this part of the work. Oak piles were driven until a firm bottom was reached, and cut off at the grade of mean low water and capped with two feet of Portland cement concrete. Upon this concrete were laid the stack foundations, which were of granite blocks split to nearly even thickness and arranged in regular courses in Portland cement mortar. The foundations for the engines were laid up with hard burnt red brick and Portland cement mortar.

The boiler room floor and the engine room basement are on the same level, the engine room floor being ten feet above the basement. This arrangement is recommended as it gives the necessary head room for the easy inspection of the foundations of the engines, heaters, condensers, piping and wiring which are here located. Open areas are left in the engine room floor over the condensers. This enables them to be distinctly seen at all times from the engine room, while all principal regulating valves in the basement can be operated from the engine room floor by wheels supported by suitable floor stands.

The engine room is 69 ft. × 44 ft. and is equipped with a ten ton girder traveling crane and carriage. This crane moves on a track supported by steel columns built into the side walls of the building and at a convenient height for handling any of the heavy machinery in the room. Both the roof and the crane were furnished by the Berlin Iron Bridge Company.

The roof has self supporting steel trusses covered

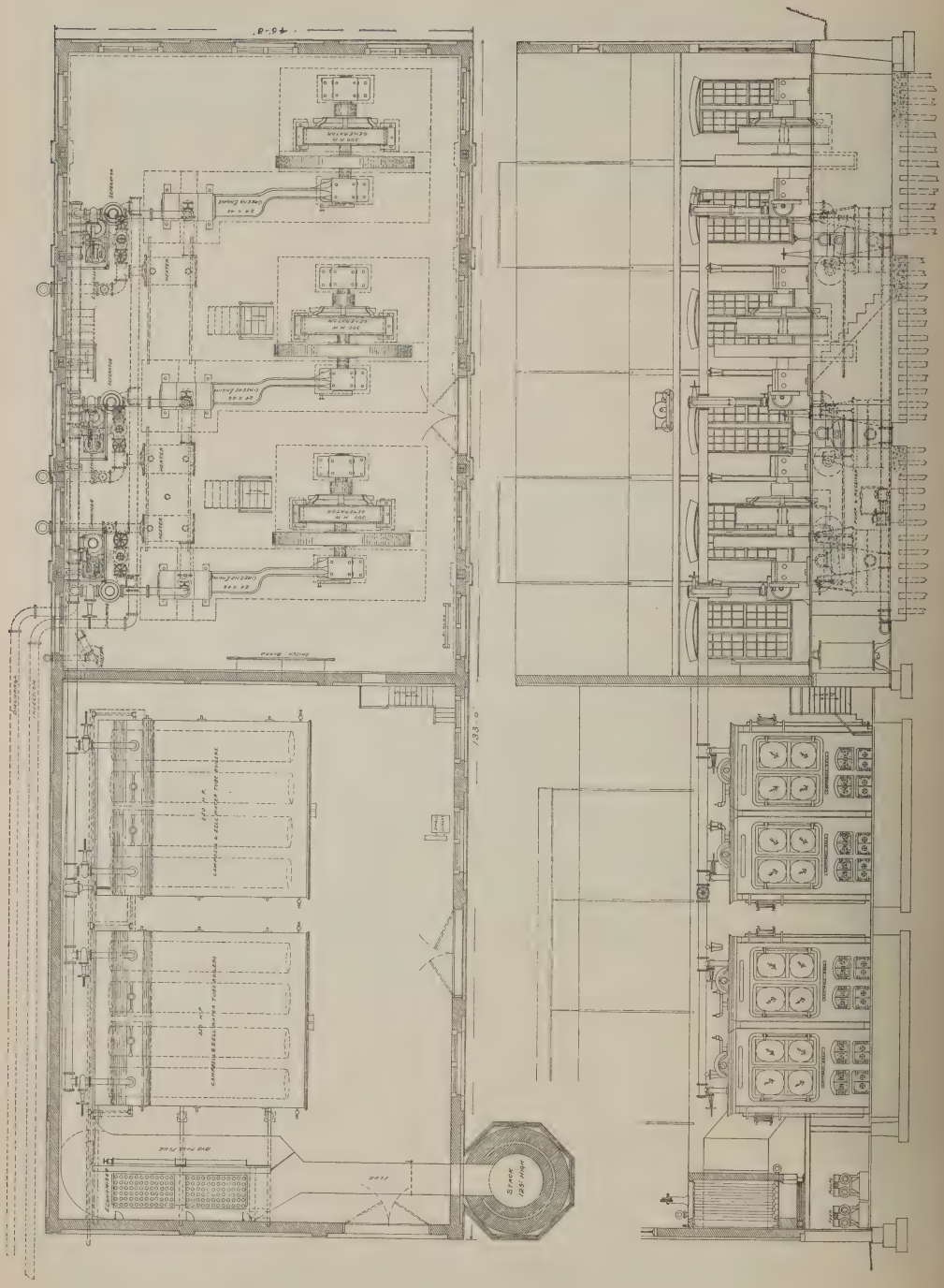


FIG. 2.—PLAN AND SECTION OF POWER STATION.

with corrugated iron and provided with Louvre windows over the engine room, and latticed shutters over the boiler room for ventilation. That part of the roof over the engine room is lined on the inside with the Berlin patent anti-condensation lining which absorbs all sweating of the metal roofing or moisture of whatever nature which might occur at this point.

There are three 24 in. × 48 in. improved Greene engines, having balance wheels weighing twenty-three tons and making 100 r. p. m., their normal capacity on a condensing basis being 600 h. p. Directly connected to each engine is a 300 k. w. railway generator of the latest type made by the General Electric Company. The switchboard is of the slate panel type, supported by a suitable frame of iron, and consists of two generator panels and two feeder panels, each equipped with circuit breakers, cut-out switches, ammeters, lightning arresters and voltmeters. There is also a main panel upon which is mounted a wattmeter for recording the total output of the station. In this room, in a convenient position, is also a set of Howe railroad scales which weigh the fuel delivered on a platform situated on the outside of the building.

The engine room floor is of spruce plank on which are laid narrow strips of maple highly polished. The walls are neatly painted in colors. The boiler room is entered by a single fire door and stairs from the engine room and is equipped with two batteries of Campbell & Zell water tube boilers of 1500 h. p. capacity. The floor is of hard burnt selected brick laid on edge and grouted with cement, and presents a smooth and durable surface. The Greene economizer, which can be used or cut out by a by-pass flue, is supported on steel girders so as to give a head room

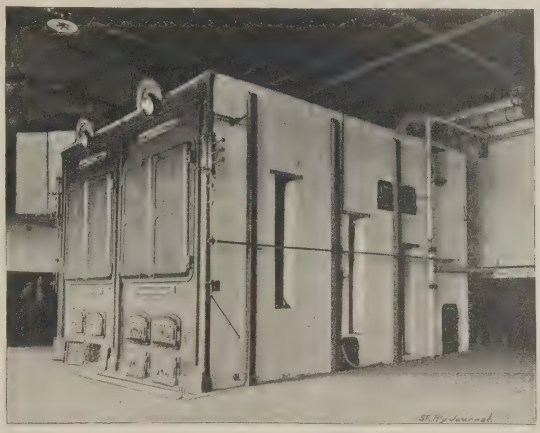


FIG. 4.—BOILER ROOM.

FIG. 3.—EXTERIOR OF STATION.

of seven feet underneath it. This space is utilized as a pump room, and here are located two Knowles duplex boiler feed pumps, injectors, watermeters and the motor for operating the cleaning mechanism of the economizer.

The piping of the station is shown in Fig. 2. The main steam pipe is of wrought iron of extra heavy thickness, and all fittings connected with it are of extra heavy flanged cast iron. It is supported on cast iron brackets having movable rollers to allow for the expansion and contraction of the piping, and the brackets are securely bolted to the side walls of the building. All valves in this main are of the Chapman heavy duty flanged type with by-pass and outside screw and yoke. The connections with the boilers and engines are made with brazed copper bends and independent gate valves, each engine having in addition a Stratton separator.

Connected to the exhaust of each engine is a National feedwater heater and Knowles vertical independent condenser. The engines can also exhaust directly to the atmosphere, if desired, through the medium of automatic relief valves. The water used to condense the steam is taken from Shaw's Cove directly in front of the station. The height to which this water is lifted is slight and the average temperature is under 60 degs. F., two conditions favorable for economic operation.

The feedwater for the boilers is obtained from three independent sources, and by an arrangement of auxiliary pumps and injectors it would be impossible for any accident to cut off the supply. After passing through the heaters and economizers the feedwater enters the boilers at about 300 degs. F. All pipes conveying the feedwater are brass from the main heaters to their connections with the boilers. All water of condensation in the main steam pipes is delivered back to the boilers by gravity, and the other water of condensation too low to enter the boilers by this method is collected and delivered into the boiler by an automatic pump and receiver. All pipes are covered with magnesoasbestos. The blow-off piping from the boilers is laid in open trenches in the boiler room floor and covered with cast iron floor plates.

The company operates from fifteen to twenty cars in summer, although a smaller number answers the requirements of the winter traffic. The road is 7.18 miles long, of single track with necessary turnouts, and is laid with fifty pound T rail. The outgoing feeders are No. 000 and a return feeder of 400,000 is also used.

The station was also built under the supervision of E. J. Richards, representing Mr. Kitfield, architect and engineer. The officers of the road are Walter Learned, president; W. A. Tucker, treasurer, and L. Bently, superintendent, and under their able management the road in four years has greatly increased in value.

Framing in Car Construction.

The engraving (Fig. 1) shows a large twenty-five foot car body recently built by a well known manufacturing company and intended to be used on double trucks. There are some points in regard to these bodies that deserve attention. The first of these is the fact that the plates and the upper and lower rails of the raised roof are continuous.

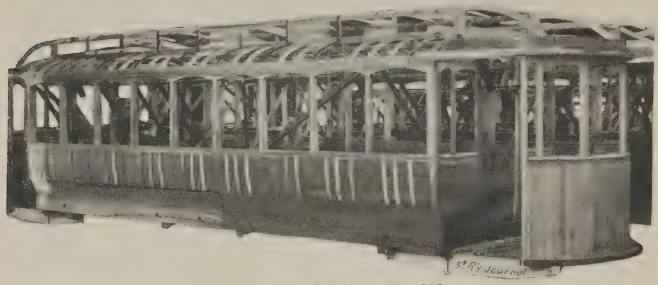


FIG. 1.—FRAME OF 25 FT. CAR.

The framing of the raised roof side was so stiff and light, that when lifted upon the frame and supported by the ends only there was no perceptible sag at the center, even where none of the iron or other carlines had a bearing upon anything.

The hood vestibule and raised roof are all carried forward as one construction. The plate is spliced back of the corner in such a way as to make the joint with the bow a very strong one. Across the front of the vestibule large pieces of stuff are fitted in between the heads of the vestibule posts. These are something more than blocking pieces and are allowed to project upward in order that they may be worked down to the curve of the roof and take and firmly hold the ends of the roof boards.

This construction is very clearly shown by Fig. 2 which illustrates the form of hood and the method of building the vestibule into the hood. The solid block thus formed reinforces the weakest portion of the hood construction and protects the ends of the thin roof boards where they are in greatest need of it.

The theory of this vestibule and the platform timbers is that it has been made strong enough to resist any blow which would not destroy the end of the car itself. With a blow of sufficient force to wreck the vestibule the end of the car would be destroyed. The destruction of the vestibule would therefore prevent the end of the car from utter wreck by cushioning the blow.

For ability to carry the loads which are imposed upon the platforms of electric cars this vestibule is amply strong and will be durable under the hardest service. The platform timbers are shouldered at their ends against an intermediate sill, and are carried by very heavy stirrups from the end sill. While using the very deep timbers in the floor frame the company does not depend entirely upon them for strength, since they are subjected to very severe twisting strains. It therefore reinforces both of these sills as well as the side sill by iron plates ⅜ in. thick by 5 ins. in depth. These plates are used to line the side sills, while those on the end sill and intermediate sill are turned back at the ends so as to take a firm bearing against the side plating. This method of lining or reinforcing timbers with plates of iron gives an enormously increased strength in a vertical direction and enables much shallower sills to be used than would otherwise be practicable. This is an important point in reducing the height of the car floor from the track.

In looking at the window rail or panel above the window it will be noticed that all the screw heads are plugged. It is a rule with the company which should be more widely followed, to cover all screw heads with wooden plugs so that the paint shall always have a sound basis. When screw heads, etc., are merely covered by putty and then painted it is very common to have the putty shrink with time and then work out, destroying the paint. In the case of this car the narrowness of the streets prevented the use of the straight steam car side with a deep truss.

The buffer is formed by plating the ends of the timbers with iron. In the center this plating is increased in width to the full depth of the timbers which project in front of the sheeting so as to prevent the dash from being injured by the hub of wheels, etc.

On the panels in Fig. 1 will be noticed a number of strips of wood. These are only the straps which hold the panels in place while the ribs are being wedged against it. These straps are left on the body until the glue is thoroughly set in order to secure perfect adhesion of the parts.

The platform timbers have a deep bearing upon the first cross sill. (See Fig. 1.) This cross sill is made considerably deeper than the side sill for the purpose of getting vertical strength to resist the upward thrust of the platform timber. This construction gives strength for the regular work, but also provides for resisting safely heavy blows upon the buffer iron. The extra depth puts the timber in the best shape for taking the strain of the load.

A new electric line has recently been completed at Pittsburgh, which will connect the suburbs of Knoxville.

FIG. 2.—METHOD OF CONSTRUCTING HOOD.

This new line will be called the Hilltop line, and is a branch of the Pittsburgh & Birmingham Traction Company, which connects the old city of Pittsburgh with those districts situated on the southern shore of the Monongahela River. The Hilltop line runs across the Monongahela over the Smithfield Street bridge, and goes up Brownsville Avenue, which has a grade of fifteen per cent. The line has been in great demand, because it will afford rapid transit facilities to about 50,000 people who have hitherto been entirely dependent upon inclines and such walking accommodations as unpaved streets afforded.

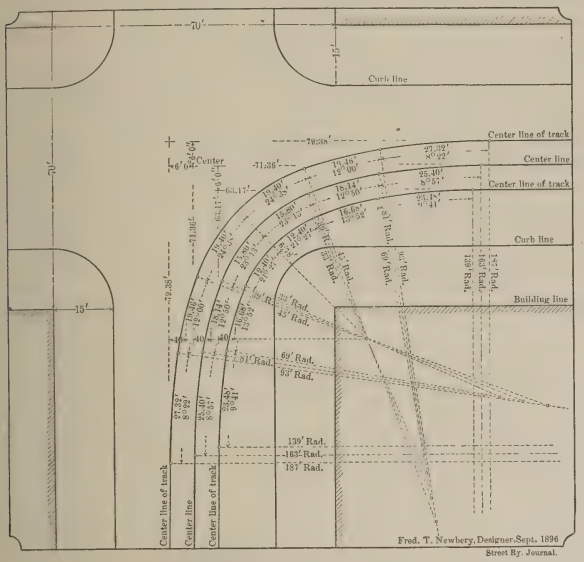
The Birmingham Traction Company operates twenty-two cars on the Hilltop line, the cars being equipped with two fifty horse power Westinghouse motors and controllers. To take care of the increased traffic occasioned by the opening of this line, the Birmingham Traction Company has recently remodeled and re-equipped its power house at Thirty-first and Carson Streets.

Method of Laying out Transition Curves.

The accompanying diagram and table subjoined show a method of laying out spiral curves employed by F. T. Newbery and are taken from a book soon to be issued by him on this subject.

The controlling point in adjusting transition curves is the distance permissible, according to the judgment of the engineer, from the curve at the inside street corner to the center of the inner track. In the diagram this is shown to be 6.78 ft., bringing the nearest rail within 4.3 ft. from the curb. In laying out the curve the center line should be first run in so as to prepare the roadbed, and after that is done the center lines of each track should be run in. Offsetting from the center line is not sufficiently accurate for spiral work. The length and curvature of the rails required can easily be found from the table below for different radii so that the work may be quickly and properly set in place.

The total amount of throw for building up the spiral is 4 ft. as shown at what would be the origin of a simple curve of 90 degs. connecting the center lines.



TRANSITION CURVE DIAGRAM.

TABLE SHOWING DATA FOR SETS OF CURVES ARRANGED IN PROPER ORDER.

Example : 40 ft. curve, compounds to 83 ft. and then to 167 ft.; total angles 45°. B. C. to apex is 72.70 ft.

CENTER CURVE.			SECOND CURVE.			THIRD CURVE.			B. C. to Apex.
Rad	Angle	Length	Rad.	Angle	Length	Rad.	Angle	Length	
30′	20°23	10.6	63′	14°29	15.94	127′	10°08	22.60	59.03
31	20°45	11.2	65	14°16	16.18	131	9°59	22.88	60.41
32	21°06	11.3	67	14°04	16.44	135	9°50	23.16	61.79
33	21°27	12.4	69	13°52	16.68	139	9°41	23.48	63.17
34	21°46	12.9	71	13°41	16.94	143	9°33	23.80	64.55
35	22°05	13.5	73	13°29	17.18	147	9°26	24.12	65.93
36	22°23	14.0	75	13°19	17.42	151	9°18	24.44	67.30
37	22°40	14.6	77	13°09	17.66	155	9°11	24.76	68.66
38	22°57	15.2	79	12°59	17.90	159	9°04	25.08	70.01
39	23°13	15.8	81	12°50	18.14	163	8°57	25.40	71.36
40	23°28	16.4	83	12°41	18.38	167	8°51	25.72	72.70
41	23°43	17.0	85	12°32	18.60	171	8°45	26.04	74.04
42	23°58	17.6	87	12°25	18.82	175	8°39	26.36	75.38
43	24°12	18.2	89	12°15	19.04	179	8°33	26.68	76.72
44	24°25	18.8	91	12°08	19.26	183	8°27	27.00	78.05
45	24°38	19.4	93	12°00	19.46	187	8°22	27.32	79.38
46	24°51	20.0	95	11°52	19.66	191	8°17	27.62	80.71
47	25°03	20.6	97	11°45	19.88	195	8°12	27.92	82.03
48	25°15	21.2	99	11°38	20.10	199	8°07	28.20	83.35
49	25°27	21.8	101	11°31	20.30	203	8°02	28.44	84.66
50	25°38	22.4	103	11°25	20.50	207	7°57	28.76	85.97
51	25°49	23.0	105	11°18	20.70	211	7°53	29.04	87.28
52	25°59	23.6	107	11°13	20.90	215	7°48	29.32	88.58
53	26°10	24.2	109	11°06	21.10	219	7°44	29.53	89.88
54	26°20	24.8	111	11°00	21.30	223	7°40	29.94	91.18
55	26°29	25.4	113	10°55	21.50	227	7°36	30.10	92.48
56	26°39	26.0	115	10°49	21.70	231	7°32	30.36	93.78
57	26°48	26.6	117	10°44	21.90	235	7°28	30.60	95.07
58	26°57	27.2	119	10°39	22.10	239	7°24	30.84	96.36
59	27°06	27.8	121	10°34	22.30	243	7°20	31.08	97.65
60	27°15	28.4	123	10°28	22.50	247	7°17	31.32	98.93

The Problem of the Continuous Rail.

BY WARD RAYMOND.

In reading over the article on "The Electrically Welded Continuous Rail" in the December issue of the STREET RAILWAY JOURNAL, the question arises in the mind of the writer, Is the problem to be solved in the manner therein outlined?

Continuous track is not a thing of to-day or of yesterday. In the year 1858, a man named Geo. E. Dering obtained a patent in England for "Improvements in the Permanent Way of Railways." To quote him, he says: "The object of my invention is to obtain continuous, even and durable rails, to effect which I connect together the successive separate rails, firstly, by soldering with any suitable metal or alloy, employing by preference the processes known as 'hard soldering' or 'brazing'; or secondly, by the processes known as 'autogenous soldering' or 'burning together,' a sufficient degree of heat being applied to cause union by the partial or complete fusion of the metal of the rails; or thirdly by a welding process." Here then we have every element of continuous track, the welding extending, from his description, sometimes to the chairs and other fastenings.

We do not know now to what extent Dering's patent was practically applied, though he states, "I find, however, such joints standing perfectly under the very heavy traffic of the up line of the Great Northern Railway." It is probable that it never came into any extensive use.

The question lay dormant until brought forward by A. J. Moxham, of The Johnson Company, in a paper read by him before the American Street Railway Association, at Cleveland, in October, 1892. Since then, due to his perseverence and faith, it has been a very live question. To the careful student, with the data now available before him, there can be little doubt that the continuous track formed of electrically welded sections of rail is the ideal one, and the same study is convincing that it can be done commercially and practically. The question then arises, What is the best manner of accomplishing the desired result? To arrive at this, a discussion of the several methods is necessary.

In the first place, the arch enemy of continuous track is the longitudinal stress caused by temperatures lower than that at which the rails were welded, and consequent tendency to shrinking of the rail in a longitudinal direction. This shrinking must be counteracted by a pull on the ends of the rail sufficient to stretch the rail a corresponding amount.

Under a drop of 86 degs. F.—and 80 degs. is a high range—a sixty foot rail will contract about ⅜ in., and therefore in cold weather it must be stretched by this amount in order to occupy as much space in the track as it did when warm. This, as can easily be calculated, corresponds to a stress of 126,000 lbs. in a ninety pound rail.

Temperatures above that at which the rails were welded cause compression and this has never been found to make trouble where the track was at all secured by the roadbed. Clearly then, one aim should be to have the rails in a normal state at as low a temperature as possible, or at such temperature as will afford the maximum protection against the dangers of breaks from tension and buckling from compression. And by normal state is meant that at which a higher temperature produces compression and a lower one tension.

Two ways are open to do this, first, by welding the rails when they are at this temperature, and second, by mechanically and forcibly putting them in a state of compression or tension as their temperature may be above or below that at which it is desired they shall be normal. As it is practically impossible to obtain the exact temperature desired, the first or natural method cannot be used unless by artificially cooling the rail, a method worthy of study if no simpler way were at hand. The second or mechanical method is however more readily available. And here let it be said that nearly all track welding has heretofore been done during the summer season when the ground and rails were warm. Such track as has been welded in the fall, notably in Canarsie, a suburb of Brooklyn, has shown a remarkable decrease in the number of breaks over that track welded in the summer, and this in spite of many unfavorable conditions and the fact that some of the apparently lower percentages in other places were caused by only considering the breaks occurring after the primary breaks have been mended and the road relieved of considerable stress.

Experience would seem to point to the winter season as the time for welding continuous track as then the rails are materially contracted, and though exceptionally cold snaps may be productive of a slight state of tension in the rails, yet the maximum stress would be nothing like that in rails welded in the summer and probably far below the strength of the welds.

The idea that unsettled and inclement weather should be looked for in winter to interfere with the work is more an imaginative than a real evil. To be sure, there will be bad days, but taking them through a month they are not so many as on first thought appear. There are always, too, repairs or other work that can be done then, for no plant in which the machinery is so concentrated and worked under such forced and unfavorable conditions can be operated continuously, be the management ever so good.

In some places objection may be made to opening the streets at this time of year, but this question will not often arise and the advantages to be gained by welding at this season are so great that they should weigh heavily against this objection where it can be overcome.

The first experiments made with mechanical compression while confirming the belief that it would decrease the tensile stress, developed certain minor difficulties due to the form of the compressor and manner of welding. These difficulties can however be easily overcome, and in some cases, as will be pointed out, entirely disappear.

We have now seen that it is possible to so construct a railway track that it shall never be subjected to more than a predetermined tensile stress and therefore the necessity for welds having a minimum strength of 200,000 lbs. or more is avoided.

What are the other qualifications? While the old adage "the cheapest is not always the best," is as true of joints or welds as elsewhere, nevertheless it is a fact that cost is a prime consideration and upon it largely depends the available field. The chief element of the cost being that of the labor required for operating the welding outfit and the fixed charges upon its high cost, both practically constant amounts per day irrespective of the number of welds made, it is evident that the greater the number of welds made per day, the less the cost per weld.

The three types of weld experimented with have been what are known as the "yoke weld," which was the first one tried in Boston in 1893 and made by welding two yokes or U bars to the webs of the rails; the "chock weld" made by welding side chocks over the joint, and the butt weld suggested by Mr. Eyre as the next to be tried.

The yoke weld was the first idea and was believed to be a satisfactory union for some time after the first had been applied, in fact until the cold weather came and they began to fail. Track which was thus welded in Boston in 1893, though old and worn out at the time became greatly improved, the hollows in the head at the joints rolling out and disappearing until it was impossible to tell from the head of the rail where the joint had been.

This weld had one fault and at that time it was a vital one—it was not strong enough to stand the tensile stress. At that time no way was seen for relieving this stress and all experiments were directed towards securing a stronger weld. The weld, however, being localized upon the web of the rail, the head and base flanges remain practically cold. So that with this weld it is possible to compress any amount of track previous to welding, performing this operation later, the hard head and base flanges preventing the compression in the rail from expending itself in upsetting the rail at the point of welding. This difficulty was experienced in applying the compression method to the chock welds.

With the yoke weld and the proper amount of compression in the rail, breakages should be practically unknown. It was moreover quickly applied, as high as 100 joints per day of twenty-two working hours being welded. Nor was the current consumed excessive.

This matter of current is more than a question of capacity in the welding plant as the limit is set not by the capacity of the machine, but by that of the lines supplying the current. This, while not of so much importance near the center of a large system, becomes a serious question as the outskirts are approached or the distance from the power house increased. At Brooklyn this was so serious that a special power station was erected at Canarsie solely for the purpose of supplying the welding machines. Since then by the addition of a "booster" to the outfit, the amount of current available from a given line has been increased, but there is still a limit and as a matter of fact, in practice the constant reaching of this limit has been the source of more delay than any other cause.

The chock weld was found to be greatly superior to the yoke weld in strength and without doubt is the more perfect union of the two rails as the ends are, with the enveloping chocks, brought to a welding heat and the whole fused together, the two becoming absolutely one rail. This cannot be made in one weld, however, except in the case of very low rails, owing to the difficulty of properly distributing the welding current and amount of power required. In point of time it requires more than the yoke weld, seventy joints per day of twenty-two working hours being as much as has been possible with the present machines. The whole section of the rail being brought to a softening heat at one time or another of the weld, the compression method cannot be applied unless the compressor is kept on the joint while welding so as to prevent the rails from coming together and upsetting the softened portion. This idea of maintaining the compressor on the joint while welding, though suggested in the patent above referred to, was abandoned at the time of designing the compressors as it would require too much time to adjust and operate it in this manner, thus cutting down the capacity of the outfit. The chock weld also requires more current than the yoke weld, usually needing additional feeder lines above those required for the operation of the cars upon the road.

We have now seen that the requisites for track welding are, a weld in a state of compression, or lacking that, with as small a tensile stress on it in cold weather as possible, small consumption of electrical energy in operating the welder and the maximum welding capacity per outfit. With these points before us we will investigate the suggested butt weld. Here it is proposed that the welding current shall be passed from one rail to the other simul-

taneously throughout its entire cross section, and when the ends are brought to a welding heat they shall be forced together.

Let us assume that one joint having been welded, the machine is brought to the next joint which has already succumbed to the preceding force of men and has been properly cleaned and clad in its armor of clamps, contacts and chocks. When we come with the welder to the joint we will find an opening of about half an inch caused by dragging one of the rails toward the last weld to provide the upset as will be later shown. The first thing to do will be to fill this gap with a shim or short section of rail as large as we can force in. The compressor, a massive tool weighing in the neighborhood of 5000 lbs. is next moved into place and the gripping wedges applied to secure it to the rails. Next the welder is lowered into position, and after the contacts are adjusted the current is turned on. When the rail ends are at a welding heat the compressor is brought into play and the loose rail dragged towards that already welded at the other end to form the upset and provide for the flow of metal. This upset cannot be less than half an inch and, considering the fact that there is a double weld owing to the shim being between the rail ends, probably more. This means that instead of compression in the rail we are starting with a state of tension. The stress required to drag a 60 ft. rail through its fastenings on the ties and the roadbed is an unknown quantity and varies greatly with the length of time the rail has been laid, style of roadbed, etc., but it is usually a very considerable amount. We may relieve the rail of some of this stress by sledging wedges in the next gap but this is an uncertain factor and unless the men are closely watched apt to be not thoroughly done.

Nor is this all the tension we will have in the rail, for as it was welded its end was highly heated and this heat extending backward into the rail caused a perceptible elongation varying with the time required to make the weld, sufficient in some cases to raise the temperature of the rail above 212 degs. for several feet each side of the weld.

This expansion due to heating is relieved in the chock weld to a certain extent by leaving every second or third joint unwelded, and after the first has cooled off, or better still, at night when the whole track is cooler, returning and welding those not welded before. With the butt weld this cannot be done, as we would be confronted by a gap of an inch or so, too much of a shim to weld through. Even with the half inch shim it is probable that difficulty will be found in bringing the rail ends to a welding heat without burning the shim, as the heat will concentrate in this while being conducted away from the rails by the clamps, which must be kept cool, and which, owing to the style of weld, must approach very close to the ends, leaving what is known in welding as a short "projection."

As this style of weld has not been submitted to a successful practical trial in the street, the time required and amount of current necessary are at present unknown quantities, but enough is known of it to show that it will require much more time than either of the other types. A large amount of current will probably be required, owing to the fact that the whole section of the rail must be welded at once, and owing to the mechanical construction of the apparatus.

We have thus seen that the yoke weld combined with compression gives us a track at a cheaper cost per joint than the other styles, and with a smaller draft on the feed lines of the system. Without compression the chock weld should come first, as the capacity of the machine is greater with this than with the butt weld, and the fact that the rail is not left in an initial state of tension to the extent it is with the butt weld more than offsets the estimated greater strength of the latter.

Once welded, it can hardly be said that there is any difference between these welds, as in any case there is an absolute integral union of the several parts. In the yoke weld the head of the rail is unaffected by heat, and its structure and wearing qualities remain unaltered. The conductivity is in any case for all practical purposes that of the rail.

As there is generally more than one way of reaching any end, so electric welding is not the only manner of constructing continuous track. Another method practiced at present is that of "cast welding," a process now too well known to need description.

While it is fair to suppose that the cost of electric welded joints may be largely reduced as the art now in its infancy progresses and the capacity of the outfits increases, we find on the other hand that with the cast welded joint requiring 100 to 125 lbs. of iron, possibly more, material forms a large proportion of the cost and an item which it is not possible to reduce.

That the cast welded joint is a good one and a worthy foe for the electric weld there is no question. Both will find supporters and the field is large enough to stand division. Healthy competition is a thing to be desired by the public if not by the competitors. That the mileage of cast welded track has forged ahead of its rival is due, to quote Mr. Eyre, to the fact that while "The casting process is a comparatively simple one, similar in its operation to well known foundry practice, the electric welding has been almost in the nature of pioneering."

With further experiment and increased knowledge, the defects heretofore met with will be eliminated and electric welded track should become the wish of every wide-awake manager.

In its darkest days—and it must be said that electric track welding has had its dark days—the writer has firmly believed in its future and felt that its advantages were sooner or later to be appreciated. If this paper shall be of any assistance in bringing that day one step nearer its mission will have been accomplished.

Inclined Plane Railways and Ropes.

A paper was read on the above subject at a recent meeting of the Engineers' Society of Western Pennsylvania, by Samuel Diescher, of Pittsburgh, the well known authority on this subject. An abstract of Mr. Diescher's paper follows:

Inclined planes are constructed for the transportation of passengers and commodities on grades too steep to be surmounted by ordinary means of travel. The characteristic features between inclined planes for passenger transportation and cable railways, lie in this, that on an inclined plane there are only two cars employed, and they are permanently hitched, whereas, a cable railway is not limited to a certain number of cars, and the cars are only temporarily connected with the rope. A further difference between the two types is that on an incline the cars travel alternately in one direction and then in the other, but on the cable road they travel in the same direction as long as they remain on the same track. The feature of endless cables being connected with the driving drum by mere friction, and not by a fixed attachment is not peculiar to this type of railways, since it has been employed during the first half of this century, on the famous Portage Road in hoisting canal boats across the Alleghany Mountains, and its principle is frequently met with on gravity inclines.

The range of employment of cable railways with gripping devices is confined to grades on which the resistances from car and load do not exceed the friction in the grip, and it should by right be further confined to grades on which in a case of emergency the car may depend upon its brakes. The steepest grade on which a grip road is operated is twenty-two per cent. This is on one of the cable lines in operation at San Francisco, Cal. It extends over one square only.

The power employed in the operation of inclined plane roads is, with a few exceptions, steam. Most of the exceptions are where electric motors have been geared to the drums. This arrangement is in use only on inclines doing a moderate business, where the consumption of fuel and the employment of a fireman would exceed the cost of the electric current furnished by some electric railway plant. The other exceptional instance is where water is found at the level of the upper landing in such quantity that it may be used to supply the additional weight required by the car at the top of the incline to overbalance the weight of the car and contents at the foot of the incline.

Recently another type has been introduced which is a compromise between a gravity incline and an electric railway. It is built with single track as well as with double track, and is known as the "balance system." So far, it has been used exclusively for the transportation of electric street cars on grades too steep to be surmounted in the ordinary way. This type has no power plant of its own, but the operation is performed by the motor of the ascending car. To accomplish this, the car is counterbalanced to the extent of its dead weight; in a single track plant this state is

attained by a properly balanced iron dummy car, traveling simultaneously with the motor car, but in opposite direction. By this means, the dead weight of car and motor are held in equilibrium. In the case of a double track line, the necessary balance is established by another car traveling in opposite direction. The accord in travel between the one car and the dummy, respectively, or the two cars, is accomplished by the employment of a rope extending from one car to the other by way of a sheave located at the head of the incline. In the case of a double track both cars are temporarily connected to different ends of the rope, which they drop upon their arrival at the respective termini of the plane. As a matter of course, in the double track plant schedules must be closely observed, else the travel will be very irregular and unsatisfactory to its prtrons. It is obvious from the consideration of these points, that the operating expense of such an inclined plane is very small, and were it not for its limitation by length and grade, its applicability would be very extensive.

Inclined planes as just referred to, are in successful operation at Seattle, Wash.; Portland, Ore.; San Francisco, Cal.; Providence, R. I.; Easton, Pa., and Beaver Falls, Pa.

The complications attending the equipment of passenger inclines with power plants of their own, are due to the precautions necessary to surround the operation with as many safeguards as may be made available for the prevention of accidents and for the protection of the passengers.

As a rule, an inclined plane of this type is always provided with a safety rope, that is, a rope of which each end is attached to another car, passing also around a certain device located at the head of the incline. It consists usually of one or more sheaves and a braking device, and is known in practice as the safety apparatus. This rope is not intended to be active in the hoisting operation, but it is to render service in case one of the hoisting ropes break, in which instance it takes the place of that hoisting rope. According to the design of the safety apparatus, one or more band brakes are employed with necessary tightening gear, all of which render its application very effective and prompt. By the means of this device the engineer at the levers is able, in case of emergency, to either hold the cars at any point on the tracks, or to let them slowly approach their respective landings. Many devices were suggested in place of the safety rope, but up to this, none has been produced whose efficiency and reliability compare with this simple but always ready means for the prevention of accidents. Since the installation of inclined planes, several incidents have occurred in which serious trouble was obviated by means of this rope; in some cases the passengers did not even learn that anything had happened.

More recently automatic mechanisms have been employed to guard against accidents caused by sudden disability of the engineer; he may faint or may be struck by lightning, etc. These provisions consist of self-acting, braking and throttling devices so constructed and arranged that if a car happens to touch a certain lever or rod, projecting from the sill of the upper landing floor, then an auxiliary throttle and a powerful air brake are simultaneously brought to action whereby not only the steam is shut off, but the whole machinery is quickly brought to a standstill.

The hoisting ropes, of which there is generally one—but in some cases two—to each car, have one end hitched to a car and the other to the drum or drums.

The connection between drum and engines is in most cases effected by gearing. The direct connection in which the crank is mounted on the drum shaft is not commendable on inclines with fixed landings, because it is almost impossible to effect smooth landing of the cars with such an arrangement. For instance, if the engines are stopped when the cars are still a couple of feet from the edge of the landing floor, and if in such a case the car at the head is much more heavily loaded than the one at the foot of the plane, steam must be admitted to complete the run, but no matter how quickly the throttle is closed thereafter, in many cases the expansion of the steam will be sufficient to bring the car up with a blow against the landing that will shake machinery, cars, teams and passengers, and may even cause more serious trouble.

Assuming that the majority of the inclines are not over 1000 ft. long, and that the average speed at which they run is 600 ft. per minute the time of motion will not be over two minutes. The pause between two succeeding runs is in most cases five minutes, in some rare ones, however, as much as twenty minutes. It is plain, therefore, that the engines have ample time to cool off entirely between runs, and for this reason they require reheating before they can work with full efficiency. It is obvious then that the larger the engines the more heat will be wasted in reheating them after every trip. Since the direct connection of engines with the drum shaft requires larger engines, because of their necessarily slower piston speed, it is evident that for this reason also, this method of applying the power is not the best for inclined planes. Another bad feature of direct connection is that at the beginning of a trip, the oscillations of the engine pistons are too distinctly felt by the passengers to be pleasant.

Concerning the drums, it may be said that the larger their diameter the better. The same holds good in regard to the distance at which they are to be located with respect to the head sheaves at the landing. Bending around a curve of large diameter is easier on the rope than if the diameter were small. A drum of large diameter may be located nearer to the head sheaves than one of small diameter, because, on account of its smaller width of face the angle of deflection of the rope, as this travels from one edge of the drum to the other during the process of winding, is smaller too.

Concerning the relative costs of drums, it may be said, that whether the diameter of a drum is large or small, the capacity to accommodate the rope must be the same for any particular incline. But the compression of the shell, produced by the tension in the rope, is in the aggregate greater with drums of small diameter than with those of large diameter and equal winding capacity. This is due to the fact that if a rope, belt, or chain be wound around a cylinder, the total radial compression exercised by such rope, etc., for one coil around the whole circumference, is always equal to the tension in the rope times twice 3.1416, and the compression the shell sustains in the direction following the coil, is equal to the tension in the rope itself. With a drum whose shell is built up of staves, these latter are under transverse strain and must, therefore, be made stronger the wider the drum face is, and it is very essential that their beveled sides be fitted to perfect contact, else the drum will collapse. In a drum, the shell and spiders of which are cast as one piece, the radial compression does not come into action, and in such a case the compression in the direction of the rope need only be provided against. This, as already stated, is the same in magnitude as the tension in that rope. The difference in weights between drums of different diameters is for drums of like rope bearing surfaces too small to be considered, especially if we take into account that in the case of a larger diameter we get a smaller shaft, can locate the machinery nearer to the head sheaves, have narrower foundations and need less ground for the accommodation of the power plant. As to the largest diameter commendable in any particular case, we must consult the shop facilities as well as those for shipment, but up to twenty feet there should be no trouble on that score.

The endless rope driving system is employed on inclined planes in cases where the track is so long that the whole rope cannot be coiled upon a drum unless this drum is excessively large in diameter and face, or that double or multiple winding would have to be resorted to. The multiple coiling is not commendable, owing to the injurious effect it has on the rope, but if adopted the safety apparatus, in case such is to be installed, will be more complicated and the more so as more layers are coiled upon the drums.

A subject of very great importance in connection with the operation of inclined planes is the wire ropes. The deterioration of a wire rope is directly in proportion to the wear it produces in a sheave it travels over. Sheaves will wear, no matter how carefully they may be set and how good the material and workmanship may be. But such wear is considerably increased if a rope deflects from the course it would travel if it followed the direction indicated by the sheave. This condition prevails in all cases where the rope is coiled upon a drum, during which process it constantly alters its course, and in doing so it assumes different radial positions resembling the ribs of a fan, having its center of radiation in the point of contact with the sheave. Since these deflections occur under more or less pressure between the surfaces in contact, they necessarily cause a displacement of particles of metal, resulting in a gradual deepening of the groove. It is to be noted that whenever a rope deflects from the course of a guiding groove, the point of contact acts as a fulcrum for the swinging motions of that rope, and if these deflections take place under any pressure at all, abrasion must follow. Any difference in the hardnesses of the rope and the sheaves will have its effect upon the relative wear, but it will not protect the harder of them from eventual desintegration.

With a sheave or drum of very large radius, and a short arc to cover, at a low strain and slow speed, there is little difficulty in the wires accommodating themselves to their altered relative positions, but under high strain, at high speed, a comparatively small radius of curve, and a long arc to cover, this adjustment does not take place as it should with regard to the preservation of the rope, but is forced. In consequence of this, not only does abrasion occur among the wires, but they have also a tendency to squeeze each other out of shape. It is owing to this that ropes which have worn out under heavy strains show the wires, particularly those of the inner strands, pressed into hexagonal form.

The abrasion and deformation can be obviated to some extent by a liberal application of a lubricant. This has the twofold effect that it facilitates the readjustment of the wires and protects the rope from corrosion.

Up to the present all steel used in the manufacture of high grade wire ropes is imported from England. A few of the American rope manufacturers import the finished wire, others say that a better quality of wire is made here than in England. One of the foremost American rope making concerns stated upon written inquiry, that it had spent over $100,000 in experiments with domestic steel, but its efforts did not meet with success.

According to my experience the best results as to long wear and strength have been obtained with ropes made of crucible steel wire of an ultimate tensile strength between 160,000 lbs. to 170,000 lbs. to the square inch of wire section, and four per cent elongation in twelve inches between the jaws of a testing machine.

In the following is presented the history of a set of ropes for an inclined plane. First is given the tests of the wires of which these ropes were composed, then the test of the rope as soon as the wires were assembled; then follows the record of their gradual deterioration, and finally the tests of the worn ropes after they were thrown out of service. The table referring to the wires is arranged according to maxima, minima and average. The wires were tested during March 19–20, 1891. The report says: tested sixty pieces in all, with the following results: in elongation five pieces only gave less than 3.5 per cent, six between 3.5 per cent and 4 per cent. It is highly

probable that these pieces were cut from too near the ends of the coils, as the second pieces of the same coils gave better results. A few of the twist tests were low, and these few low ones were caused by clip marks made on end of wire in process of drawing. Better results were always found in taking pieces from same coil further from the end of the wire.

W. G. No.	Dia. inch.	Ult. tens. per sq. in.	Elong. in 12 ins.	Twists in 8 ins.	
12	.LL3	184,000	5.6 per cent	28½	Maxima.
10	.139	194,000	5.6 "	21	
9	.155	183,000	5.2 "	17	
12	.105	158,000	2.3 "	9	Minima.
10	.131	168,000	2.8 "	3	
9	.150	170,000	3.9 "	8	
12	.109	171,700	4.2 "	22.4	Average.
10	.134	176,300	4.6 "	16	
9	.148	177,700	4.7 "	15	

The average ultimate strength of individual wires was: No. 12 1600 lbs., No. 10, 2491 lbs. and No. 9, 3069 lbs. Each of these ropes was two inches in diameter, had six strands and each strand contained nineteen wires, all laid around a hemp center.

The composition of this two inch diameter rope, based upon the average strengths of wires according to above test report is as follows:

Each strand consists of 6 wires	No. 9,	@ 3060 lbs.,	equal	18,360 lbs.
7 "	" 10,	@ 2490 "	"	17,430 "
6 "	" 12,	@ 1600 "	"	9,600 "
Hence aggregate strength in one strand				45,390 lbs.

The strength of the rope composed of six strands equaled 272,340 lbs.

According to the experiences of rope manufacturers, the strength of a finished rope is ten per cent lower than the aggregate strength of the wires of which it was made. Therefore this particular rope should stand an ultimate strain of 245,000 lbs., in round figures, but when put to test it parted under a strain of 222,000 lbs. which is considerably below what was expected. The piece tested was twenty feet long between the sockets. The test was made at the works of the Phœnix Iron Company. Upon consultation with the manufacturers of this rope, they explained the excessive difference between the strength of the wire combined in that rope and that of the rope itself, in that there is always more or less of a disturbance in the uniformity of tension on the strands when the fastenings are put on; some of the strands are slacked off a little and this, of course, throws an undue strain upon the remaining ones.

There were three of these ropes made, and they were used on an inclined plane. One served as a safety rope, and the other two as hoisting ropes. This incline is engaged in the transportation of passengers, and teams of ordinary weight. The cars are 12 ft. wide × 24 ft. long. Owing to the great steepness of the grade, nearly seventy-two per cent, a passenger cabin could be accommodated under the floor for teams.

The operation commenced on June 1, 1891. A general inspection of the incline is made every two months. At these occasions particular attention is paid to the state of the ropes. Those points are looked for that show the most wear and contain the greatest number of broken wires in a length of twelve inches. From one examination to the other the progress of deterioration is recorded; in this manner the following results were gathered:

Record of gradual deterioration of wire ropes used on an inclined plane transporting passengers and teams. Grade of incline seventy-two per cent. Least constant tension in each of the two hoisting ropes is nine tons; highest occasional tension fifteen tons. Service began on June 1, 1891. Up to March, 1894, the counts of broken wires were made while the ropes were coiled in the drum and at rest. After that date all counts were made with the ropes stretched out on the tracks. The figures mean number of broken wires found within twelve inches length of rope.

Date of insptn.	N. hoist. rope.	Safety rope.	S. hoist. rope.
Oct. 9, 1893.	2	3	7
Dec. 30,	2	3	9
Mar. 20, 1894.	4	4	14
May 9,	17	8	30
July 31,	17	21	46 Discarded.
		Traveled 20,000 miles.	
Oct. 9	19	25	
Dec. 15,	24	31	
Feb. 27, 1895.	25	32	
Apr. 27,	28	34	
June 25,	30	46 Discarded.	
		Traveled 38,000 miles.	
Aug. 29,	30		
Oct. 29,	30		
Dec. 27,	30		
Feb. 28, 1896.	32		
Apr. 30,	32		
June 26,	32		
Aug. 27,	32		
Oct. 24.	33 Had traveled 51,000 miles, still in service.		

The south hoisting rope during its life performed work equal to 180,000 ton-miles. After it was taken out, two pieces of it were prepared for testing. They were 20 ft. long between the sockets, and were selected from the worst sections found in the whole rope. Tests were made at the Phœnix Iron Works, Oct. 29, 1894, and the test pieces were marked respectively, "A" and "B." Piece "A" contained a section which showed forty-two broken wires within 12 ins. at the examination of preceding June, and piece "B" contained a section that showed forty-six broken wires in 12 ins. at same examination. The report says:

"In piece 'A' four strands broke at 168,000 lbs. strain; these strands were numbered respectively, 1, 3, 4 and 6. Three wires of strand No. 6 pulled out of socket.

"In piece 'B' three strands broke at an ultimate strain of 195,000 lbs."

During June, 1895, the safety rope too showed considerable signs of deterioration and was also thrown out of service and subjected to a final test. The length of test piece, and place of test were the same as in the preceding case. The number of broken wires found at its last inspection was forty-six in 12 ins. as in the previous case.

The strands were numbered, and strands Nos. 1 and 2 broke at a strain of 108,000 lbs., No. 5 next, at 72,000 lbs., then No. 6 at 54,000 lbs., No. 3 at 42,000 lbs., and No. 4 at 27,000 lbs.

The report says further: "No wires pulled out. Elongations were measured by travel of piston, were taken after application of load and represent the stretch between the breaking of one strand and that of the next. The sum therefore, gives the total elongation at the breaking of the last strand. These elongations were with respect to the order in which the strands broke, 0.22 ft., for first two strands, then, 0.16 ft., 0.09 ft., 0.101 ft., and 0.106 ft., and from this the total elongation was 0.677 ft.

The ultimate strengths exhibited by these old ropes when tested are surprisingly high, and especially so if, in addition to the deterioration from broken wires, we take into account that resulting from the abrasion and deformation of the wires. Assuming that these tests are correct, the high results must be sought in the fact that the breaks of the wires are not arranged in a ring around the rope, but are generally well scattered, and only in a few instances are there as many as three breaks found close together. Hence they overlap each other and, as it were, "break joints;" thus the rope approaches in its make-up that of a rope made of fibres, as cotton, jute and hemp. In such ropes the strength lies secondarily in the friction by which the slipping tendency of the fibres is counteracted. With long fibres, like those of hemp, the friction exceeds the absolute strength of the fibres.

I have here a sample of an old rope of originally two inches diameter. It served on a freight incline, traveled about 45,000 miles under a minimum strain of 9 tons and a maximum of 15 tons. It must therefore have performed at least 450,000 ton-miles work.

One of the three ropes above considered had to be replaced after three years' service, the second after four years' service, and the third one is still in action, having already served five years and five months, and traveled about 51,000 miles, whereas 50,000 miles is considered extraordinarily good service on an inclined plane.

According to the report on test of the discarded safety rope, the different strands parted under following strains:

Strands Nos. 1 and 6,			at	108,000	lbs.
" "		5,	"	72,000	"
" "		2,	"	54,000	"
" "		3,	"	42,000	"
" "	and	4,	"	27,000	"

The above results show that these strands were not of like strengths, for, by subtraction it is seen that the combined strength of strands Nos. 1 and 6 were 108,000 lbs. less 72,000 lbs., equal to 36,000 lbs., and in the absence of specific data in relation to their individual strengths, the best thing we can do in this instance is to divide the combined strain evenly between these two strands, and then we get for each of them 18,000 lbs. Accordingly, we obtain the following strengths for each of the six strands of that rope:

Strand No.	1,			18,000 lbs.
" "	6,			18,000 "
" "	5,	72,000 less	54,000,	18,000 "
" "	2,	54,000 "	42,000,	12,000 "
" "	3,	42,000 "	27,000,	15,000 "
and "	4,	which broke last,		27,000 "
		Total		108,000 lbs.

From the test report on the strengths of the individual wires, made at the time the ropes were ordered, March, 1891, we learn that the combined strength of seven wires forming the core of the strand, is 17,430 lbs. Deducting from this the usual ten per cent loss of strength on account of twisting, we get 15,700 lbs. in round figures as the net strength of a core strand.

This leads to the following deductions:

First. That strands Nos. 1, 6 and 5, were each 300 lbs. stronger than the mere core strand.

Second. That strands Nos. 2 and 3 were each weaker than their core strands would have been if in sound condition.

Third. That strand No. 4 which broke last, was 11,300 lbs. stronger than its core strand alone would have been if perfectly sound. As we may further conclude, that, with the exception of strand No. 4, all strands had their outside wires considerably weakened, and that strands Nos. 2 and 3 must have had their core wires weakened also. For each of these two strands stood less of a strain than their cores would have sustained if uninjured. And finally, the strength of strand No. 4 indicates that its outside wires must have been in a much better state of preservation than those of the other strands, for, it stood 11,300 lbs. more of a strain than its core would have sustained when in its most perfect condition.

With respect to strands Nos. 2 and 3, it remains undetermined to what extent the core wires were affected, because it is impossible to ascertain what portion of the test strain bore upon the skin and

the core wires respectively. From all of this we glean the information that, although in many cases relating to badly worn ropes, the the core may be in comparatively sound condition, it is not advisable to accept such a state as the rule, because there are no means by which we can obtain positive knowledge of the true condition of such core wires in any given case. The injury to which core wires are most exposed is deformation of their sectional form. The constant tension in the outer wires produces a tendency to contract the area of the section of the strand, and thereby pressure is exerted upon the wires forming the core. This pressure is considerably increased when the rope bends over a sheave, in which case the strand, and certain wires on the convex side of the arc, come under special high tension and at such occasions the core wires must sustain excessively high compression. In consequence of this they become deformed, assume a hexagonal shape and stretch in proportion as their sectional area is reduced. From my own observations in examining worn out wire ropes, I found that in general the core wires remained whole as to length, but they were invariably changed in respect to their sectional area.

Therefore, on inclined planes and on all railways in operation on steep grades by the aid of wire ropes, great care should be exercised in regard to the condition of the rope; and whenever it is found that within the length of the pitch of a strand about forty per cent of the wires are broken, it is time to have the rope thrown out and a new one put in its place. The reason for selecting the pitch as a unit of length is, that within such length all outside wires are once exposed to abrasion and extreme bending, and further, that when a wire is so broken that its length does not exceed that of one twist of the rope, the friction by which that wire is held from slipping is not sufficient to make it bear any considerable portion of the strain it ought to bear.

DISCUSSION.

Mr. Negeley: I would like to ask Mr. Diescher what he considers the most reliable test for wire rope?

Mr. Diescher: The most reliable test is that made of the wires, because it tells all about the qualities of the material of which the rope is to be made. A test of the finished rope gives the ultimate strength of the rope, but nothing else. A rope may stand a very high tensional strain and yet be too brittle for its intended purpose.

A member: I would like to ask Mr. Diescher if he ever examined a worn rope to see how many inside wires were broken, or if the broken wires are all on the outside.

Mr. Diescher: The breakage in wires occurs as a rule on the outside. I have untwisted rope that was much worn and badly broken, yet the seven inner wires were unbroken, although, in some cases, very much worn and altered in section. The breaking of the wires is caused chiefly by brittleness. Were it otherwise, the fractured ends would show some reduction of section and would stand apart. Such is not the case. On the contrary, no taper is seen there, and the ends remain in close contact for several weeks. The fact is, that a new break is almost invisible until oil gets into it, and it is not easily noticed by touch either. The surfaces of the break are as even as when sheared. The brittleness arises from two sources: first, from the alternate bending and straightening of the rope at the sheaves, and second, from the vibrations to which it is subjected while traveling over the track pulleys. These latter are always more or less eccentric on account of which the rope is alternately raised and dropped with every revolution of every pulley it goes over. The effect of these vibrations grows with the tension and the speed at which the rope travels.

Mr. Negeley: Mr. Diescher, as I understand, recommends the testing of the single wires. I have in my experience of testing wire rope failed to find satisfactory results. Several months ago I made about sixteen full size wire rope tests, including ¾ in., ⅞ in., 1 in. and 1¼ in. diameters, of English and American make, all of them falling short of manufacturer's own claim of from five to ten tons. The material was claimed to be cast steel.

Mr. Diescher: The manufacturers say that the strength of a rope is ten per cent less than the combined strength of all the wires of which it was made. I am unable to state whether this is based upon experience or whether it is merely an assumption. To obtain reliable data about the strength of a wire rope it is necessary that the contrivance by which that rope is to be fastened to the testing machine shall be very carefully prepared and attached. The usual method of fastening the ends of the test piece into sockets with tapered holes does not insure uniformity of tension in all of the strands of that rope. Concerning the steel used in the manufacture of wire, we know that there are many grades of crucible steel, and that, therefore, the mere fact that a rope is made of crucible steel, does not signify that it must necessarily be a strong rope.

Mr. Negeley: Why are three different sizes of wire used in one and the same rope?

Mr. Diescher: The reason for this is that a strand made of wires of same size will not be round but hexagonal in its cross section. If we arrange six wires around a central one, all of the same diameter, they will form a hexagon. It matters not how many more layers of the same sized wires we may pile on, the cross section of the whole will always be that of a hexagon. By using three sizes of wire, so that the medium one is used for the seven core wires, and the two other ones in such a manner that the smaller lie on the corners and the large wires between the corners of the hexagon, the whole will be round. A round strand is less subject to abrasion than one exposing corners.

A member: What is the best lubricant for a rope of this kind and would it increase the durability of rope if the sheaves were lined with hard wood?

Mr. Diescher: Rope manufacturers recommend a mixture of linseed oil and pine tar, but almost every one using ropes has an opinion of his own on this subject. At some inclined planes they skim the oil off the drainage from the exhaust of the engines. Some use Mica axle grease. A few years since the Standard Oil Company was in the market with a special compound for the preservation of wire ropes, which is much praised by the people who use it.

Concerning the effect of wood lined sheaves on the durability of wire rope, it may be said that in cases where the rope does not bear very heavily on the lining, and the tension is moderate, the life of the rope is thereby extended, but not to a degree whereby the expense and annoyance of relining would under all circumstances be outweighed by the increased life of the rope. It is not so much the external abrasion of the rope from contact with cast iron as the bending, followed by brittleness and internal wear, that brings on its early destruction. In former times grooves used to be lined with various kinds of materials, as wood, leather, rubber, hemp rope, etc., but now lining is not used to any considerable extent, except in the transmission of power by means of fast running light wire rope. With heavy ropes at high tension, lining wears out too fast to afford an economical advantage over ordinary cast iron sheaves with turned grooves.

A member: Are ropes not thrown out on account of having performed a certain amount of service?

Mr. Diescher: The amount of work performed by a rope does not determine its condition or reliability in respect to further service. One rope may have done much work and still be in serviceable condition, whereas another one may wear out after comparatively short service under precisely the same conditions as before. I know of a case that came within my own observations, in which one set of ropes served eight years and the succeeding one was badly worn and broken up after only eight months' use; the conditions were the same in both cases.

Mr. Swensson: Has the stretch anything to do with it?

Mr. Diescher: The stretch is due mostly to a reduction of the diameter of the rope, brought about by the internal wear in the hemp center as well as among the wires themselves, caused chiefly by the bending around sheaves under high tension.

Mr. Swensson: Does not the breaking of the wires increase the stretch?

Mr. Diescher: The breaking of the wires does not materially add to the stretching of the rope unless it has very far advanced. For the wires do not very soon part after breaking occurred; the ends butt against each other and remain so for a considerable time. This would be different if the breaks had been caused by pulling strains, which in such a case would have had to exceed the elastic limit of the wires near the break.

Mr. Swensson: Speaking about sheaves for carrying rope, we have found that leather lining is best for wearing qualities.

Mr. Diescher: Leather is a very good material to line sheaves with, where power is to be transmitted from one shaft to another, and a high coefficient of friction is desired to prevent slipping. For finished cast iron and steel this coefficient is .15, for wood .17, for leather and rubber from .19 to .20.

Mr. Shellenberg: Is there nothing to be said in favor of iron ropes?

Mr. Diescher: Iron ropes are now very little used for hoisting purposes; they are too cumbersome and expensive when compared with steel rope of equal capacity. For instance, a one inch diameter steel rope stands thirty-three tons, costs nineteen cents per foot and requires a four foot diameter sheave. An iron rope of the same hoisting capacity is 1⅜ ins. in diameter, costs thirty-one cents per foot, and requires a sheave of six feet diameter. Aside of this, an iron rope is much more subject to wear, on account of its softness, than a steel rope.

Mr. Swensson: Have you any information in regard to the smallest diameter a sheave should be for a ⅝ in. rope?

Mr. Diescher: Until a few years ago the rule was to allow one foot sheave diameter for every quarter inch rope diameter. Since then the rope manufacturers concurred in demanding larger minimum diameters. What this is to be can be found on every price list of wire ropes. On derricks much smaller sheaves are employed than under ordinary conditions, because on the one hand it is very inconvenient to have large sheaves attached to a mast head or boom, and on the other, small size wire ropes are too cheap when compared with hemp ropes of same capacity as to impress the necessity of employing special means for the preservation of the rope.

Mr. Ruhe: Has not the increase been brought about by the use of steel instead of iron rope?

Mr. Diescher: According to the manufacturer's list, for ropes of same diameter, whether of iron or steel, the sheaves are of same diameter.

The Norwell & Scituate Street Railway Company, of Norwell, Mass., has been granted a franchise to build and operate its lines in Scituate, and the work of construction will be begun early in the spring. The proposed road will extend from the end of the Hanover Street Railway at Assinippi to Scituate Harbor, a distance of about nine miles. Among those interested are Jonathan Hatch, Horace T. Fogg and Wm. D. Turner, of Norwell, and Henry Webb, of Scituate.

SCIENCE · ENGINEERING · INVENTION ·

Loop of North Chicago Street Railroad Company.

In order to get the best result from the surburban lines connecting with city railways it has been found quite important to provide waiting rooms at the connecting points and to otherwise make the lines accessible. It has also been found important to have the passengers discharged at one point and taken on at another.

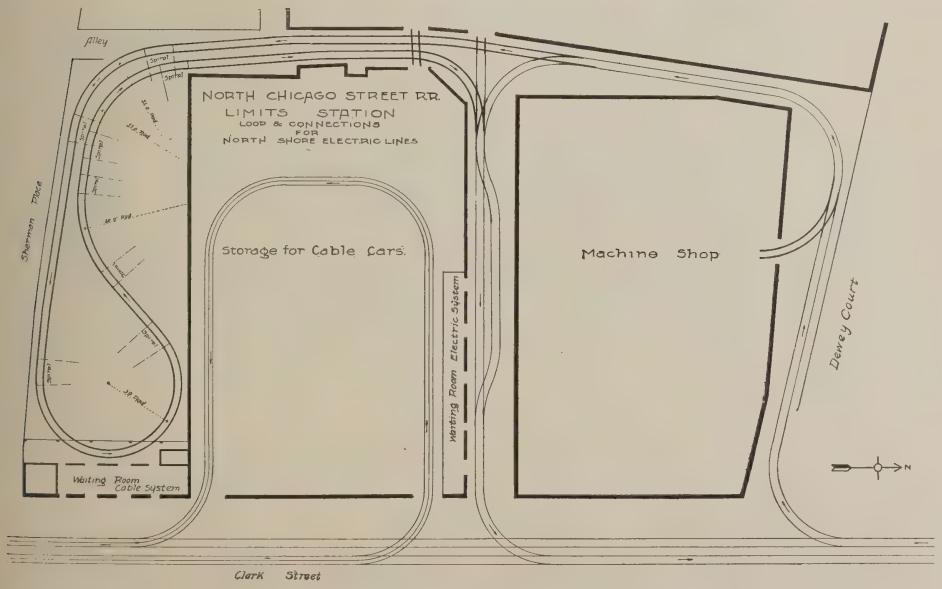
Fig. 1 illustrates the method of this connection between the terminal of the Clark Street and Wells Street cable lines of the North Chicago Street Railroad Company with the Evanston, Belmont Avenue, Halsted Street and Clark Street electric line at the Simits Station. The direction of the cars is shown by the arrows. The passengers from the north get off at the waiting room of the cable system and take the cars from the street at that point. The passengers from the south go right through the waiting room for the electric system and take the cars for the north at that point under cover. These waiting rooms are kept warm during the winter and are of great convenience.

The portion of the loop shown in heavy lines was furnished by the Paige Iron Works of Chicago, and is of 72 lb. T rail 4¾ ins. high, and the guard being made of 60 lb. Shanghai rail 5¾ ins. high. The guard is bolted to the main rail by spacing blocks, placed three or four feet apart, both inside and outside rails being guarded. All the curves have spiral connections between the curves and the tangents, so designed that there is no shock to the car in entering or leaving the curves. The entire yard is paved and the passageways for the cars kept in first class condition.

With this arrangement the number of cars on the trains can either be increased or decreased as desired, after the passengers leave the cars and before they are filled again.

The loop has been found to greatly increase the ease in operation, and to reduce materially the headway on which the cars can be run.

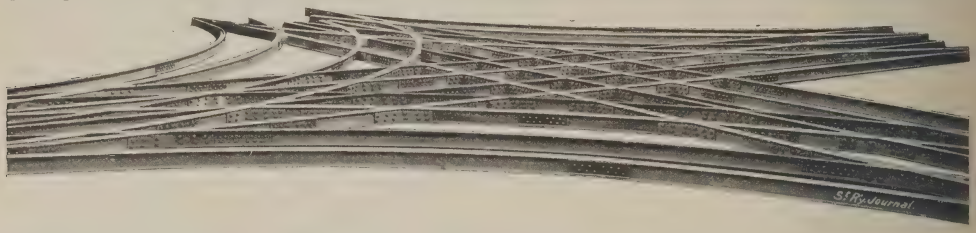
LOOP OF NORTH CHICAGO STREET RAILWAY COMPANY.



Large Piece of Special Work.

The accompanying illustration shows a large piece of special work made by the Weir Frog Company for the West Chicago Street Railway, and intended for use at the crossing at Clinton and Randolph Streets, Chicago. A duplicate of this was also made by the same manufacturers for the company for use at Clinton and Madison Streets.

The illustration does not give a good idea of the size of the work, but this can be gained from a knowledge that the intersection measures between switches 130 ft., and between the middles of opposite curves, 57 ft. Composing this work were sixteen frogs, four special open hearth cast steel double switches and mates; four special open hearth cast steel single switches and mates; four crossings, angles 90 degs. each; six crossings, angles 38 degs. each; all made of nine inch Cambria guard rail, 104 and 107 lbs. per yard.



LARGE PIECE OF SPECIAL WORK FOR WEST CHICAGO RAILWAY.

Each intersection was erected complete in the erecting yard of the Weir Frog Company, and connections all marked for the placing in position at point intended for. After being put in place the contractors notified the Weir Frog Company that this large piece of work was so accurately built that there was less difficulty in connecting to position than any similar piece of special work.

Long Car on Single Truck.

The accompanying engraving shows one of the cars of the Kingston (N. Y.) City Railway Company mounted on a single Peckham Extra Strong 9-A-X truck. The car measures 22 ft 8 ins. body, and 32 ft. over all while the wheel base is only 7 ft. This is the first example, it is said, of a car of this length upon a wheel base of only 7 ft. This seeming impossibility is accomplished through the use of the Peckham bridge truss described in former issues, by which the ends of the car are supported by a true truss frame. The diameter of the wheels is 30 ins. and the gauge 4 ft. 8½ ins.

In spite of the extreme length of the car the riding is very easy, and the cars take the narrow radius curves upon the line without difficulty.

LONG CAR AT KINGSTON, N. Y., ON SINGLE TRUCK.

Anniversary Number.

The eighteenth annual number of the *Tradesman*, published at Chattanooga, Tenn., has recently been issued. This number contains over 260 pages and presents a very complete review of the industrial side of the South. One of the many features is a directory of 5000 mills and factories in the Southern States.

Tramways in New South Wales.

The lines of the Sidney & Suburban Tramway Company are under the direction and control of a Board of Railway Commissioners. These lines are to a large extent worked by steam motors, and it is remarkable that with so many grades, such sharp curves and crowded streets, there are so few accidents. Two lines, however, employ the cable system and one by electricity. In all there are sixty-one miles in operation, upon which last year 66,352,069 penny fares were collected, the train mileage being 2,503,161 miles and the gross earnings per train mile twenty-eight cents. A few years ago these tramways were not a profitable investment to the Government, but are now yielding some dividends upon the capital stock. On the lines which are worked by steam motors, the motors draw two or three and occasionally four cars, each capable of seating seventy passengers. The fares are collected on the section or "zone" system and the great bulk of the fares paid are paid by penny tickets, two being charged for the first section out of Sidney, and generally one for each section afterwards, the average being about a penny a mile for each full section. The tramway conductor is required to ring a bell register for each penny ticket received and to tear the ticket in half before the passenger, and though cash is taken it is discouraged by making the payment in cash heavier than that by ticket. Tramway tickets can be purchased all over Sidney, and many people will accept them as small change, though not adapted for this purpose, as they show wear rapidly.

The great problem in the tramway service has been to keep down operating expenses. The lines are always well patronized by the public, but until a few years ago, the cost of running absorbed nearly all the gross receipts. The Railway Commissioners have, however, succeeded in introducing many economies, and this has in the main conduced to the increase in the earning power. Consideration has recently been given to the question whether the tramways could not be worked more cheaply by electricity. The evidence in favor of electricity is so strong that the prospect of the change is steadily growing, although the cost of re-equipping the lines will be quite large.

Trucks for New York.

The Metropolitan Street Railway Company, of New York, awarded an order last month for 150 trucks to the Peckham Motor Truck & Wheel Company. The trucks will be used under the new open cable cars which are being built by the John Stephenson Company, and which will be put in service during the coming summer.

Roller Bearings.

In the January issue of the STREET RAILWAY JOURNAL was given a description of roller bearings for street cars, made by the Mossberg & Granville Manufacturing Company. A number of interesting tests have been made with these bearings, the results of which are given herewith.

One of these was made by the Westinghouse Electric Company in February, 1896, on a street car truck. The result of this test was as follows:

I. ROLLER BEARINGS.

Lbs. on Lever.	Watts per Min.	Revs per Min.	Watts per Rev.	Total Revs.	Total Secs. Run.	Notch.
630	600	270	2.2	587	172	2

II. PLAIN BEARINGS.

630	1000	179	5.7	195	70	2

Curves of this test are shown in Fig. 1.

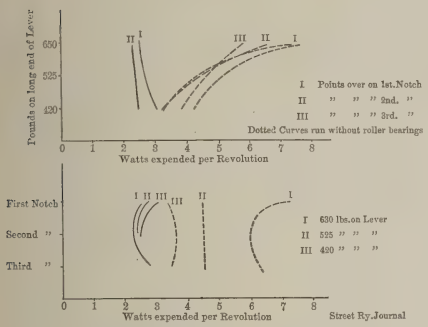


FIG. 1.--DIAGRAMS SHOWING RELATION BETWEEN WATTS EXPENDED AND LOAD ON TRUCK.

A number of tests with these roller bearings have also been made by the Interstate Consolidated Street Railway Company, of Attleboro, Mass. The two cars used in these tests were numbered 15 and 17 respectively, No. 15 being fitted with plain bearings and run over the north line of the Interstate Consolidated Street Railway Company from Attleboro to Plainville, a distance of six miles. Car No. 17 was fitted with Mossberg roller bearings and run over the east line, a distance of eight miles, the same wattmeter being used in both cars.

The results of these tests showed a saving of forty per cent in favor of the car fitted with roller bearings. Car No. 17 carried more passengers per mile, which taken into account materially increases this percentage of the saving of the power. The results of the tests were as follows:

CAR NO. 15. OLD STYLE BEARINGS.

No. of trips	12
Miles run	144
Meter readings	24,050
Meter constant	5
Total watt hours	120,250
Electrical horse power hours	161.1
Electrical horse power hours per mile	1.13
Total passengers	671
Passengers per mile	4.65

Another test was also made by this same company upon cars with and without roller bearings on a four and one-half day's run. The results of this test were as follows:

CAR NO. 17. ROLLER BEARINGS.

No. of trips	12
Miles run	192
Meter readings	19,330
Meter constant	5
Total watt hours	96,650
Electrical horse power hours	129.5
Electrical horse power hours per mile	.67
Total passengers	1,124
Passengers per mile	5.8

making a difference of 76.05 per cent in the saving of power in favor of the car with the roller bearings, and during the tests car No. 70 lost two trips of twenty-six miles on account of hot boxes. This added to the power used by car No. 70 would show a slight increase in the saving of power with the roller bearings.

The efficiency of these roller bearings is also well illustrated by

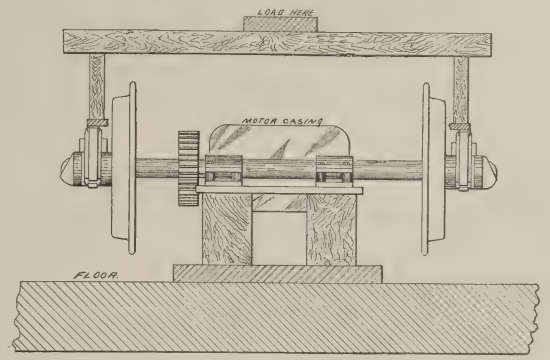


FIG. 3.—METHOD OF MAKING TEST.

another test (Fig. 3). A steel wheel weighing 130 lbs., and 14 ins. in diameter was speeded up to 10,000 r. p. m., and continued revolving for one hour and thirty-three minutes after suddenly discontinuing the source of power. This was accomplished with absolutely no detriment to the bearings. A plain bearing would probably have been ruined under such conditions. This test was repeated over forty times.

Automatic Track Switch.

The accompanying illustration shows the operating magnets of the automatic electric track switch manufactured by the New York Switch & Crossing Company. This switch is operated as follows:

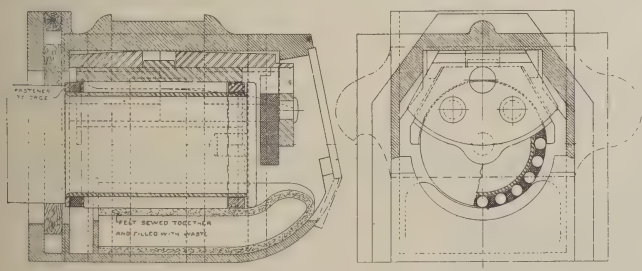
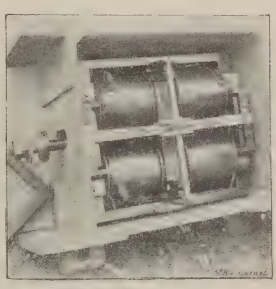


FIG. 2.—CROSS AND LONGITUDINAL SECTIONS OF BOX WITH ROLLER BEARINGS.



INTERIOR OF SWITCH BOX

a section of track about 30 ft. in length, and about 20 ft. distant from the switch tongue is insulated from the remainder of the track and is electrically connected with the magnets in the switch box. These magnets are four in number, two on each side of a reciprocating soft iron armature which is connected through a lever with the switch tongue. The negative terminals of the magnets are grounded and the electrical connections in the box are so arranged that only one of these two pairs is excited at the same time, the bar being alternately attracted from one side to the other. Each time that it is so thrown the connections are reset so that the next impulse of current will attract it in the other direction.

If the motorman on approaching a switch desires to pass over

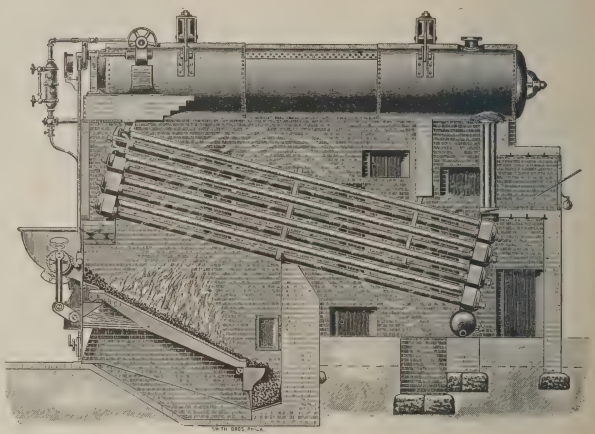
it as it is then set, he simply shuts off the current and runs by momentum over the insulated section. If, however, he desires to change the position of the switch tongue he passes over the insulated section with the current on. The current from the wheels then passes through the rails instead of into the ground, and actuates the switch. One of these switches has been in use on the lines of the North Hudson County Railway Company, of Hoboken, N. J., for over a year and has given such good satisfaction that the company has installed recently a considerable number of them.

A Mechanical Stoker.

The accompanying illustration represents a mechanical stoker under a National water tube boiler. It will be seen from the illustration that the grate is open underneath, and made with horizontal openings or air spaces, so that the finest coal cannot drop through while natural draft is depended on. These grates are also mounted on rollers to make the reciprocating motion as light as possible. This is a great help as a grate weighs 3500 lbs., and this entire weight has to be kept in motion. It will also be seen that the hopper or coal receptacle is much larger than is usually employed, to allow longer intervals between filling.

On the side of the hopper is mounted the feed and shaking mechanism with graduated scale and pointer for close regulation of either feed or shaking. The feed mechanism is operated direct from a crank lever above the boiler setting and driven by a line shaft running over the boiler direct coupled to a small engine or motor. The use of belts is avoided, as belts are found to give considerable trouble, owing to the close proximity to heat and dust. No slipping or variation of speed can occur with this crank arrangement. The levers, connecting rods, ratchet wheel and pawls are made of hardened steel, and a great deal of attention has been paid to making this device substantial and durable.

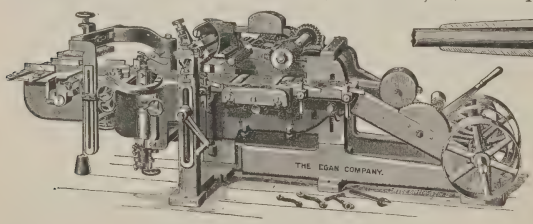
Among the advantages claimed for it is the fact that abundant natural draft is secured by making the grates with ample openings and good self cleaning motions. It can be regulated independent of the feed to suit coal of all kinds, enabling dirty coal or anthracite coal to be burned as readily as pea coal. The feed of coal can be very finely adjusted even to a fraction of a few pounds per hour by the simple feed mechanism shown on the side of the hopper; thus the fire is fed uniformly and any desired thickness of fire can be retained all day long over a perfectly clean grate, which is an impossibility in hand firing. It is not necessary to open the fire doors, and only one-fifth the labor or attention is required. It is also claimed that where this stoker is in use absolutely no unburnt coal can reach the ashes or be wasted; that this grate outwears the old fashioned grate and that it requires no experience to operate it. These stokers have been in use over two years and are giving good satisfaction wherever used. They are manufactured by Alfred Box & Company.



MECHANICAL STOKER.

Extra Heavy Twelve-Inch Standard Moulder.

The accompanying illustration shows the special heavy standard twelve inch moulder, manufactured by The Egan Company. This is a very heavy four sided moulder designed for large work and will be found equal in capacity to an inside moulder, yet possessing all the advantages of an outside moulder in setting up for all kinds of heavy or light work. It is especially adapted to work all kinds of heavy building material, car work, mantel work, etc.



EXTRA HEAVY MOULDER.

The frame is very heavy, well braced, with ample floor space. It is made extra long so that the belts may have a greater pulling capacity and every advantage and convenience for easy running. The spindles are made of the very best cast steel, large in diameter and run in extra long self oiling boxes lined with genuine Babbitt metal. The patent outside bearing goes to the floor and is bolted solidly to the frame at the base. No bolts or outside boxes have to be taken off to raise and lower the bed. The feed is extra powerful and consists of four rolls, two in the bed and two above, all driven by powerful gearing. There are two feeds in the machine. This machine is very carefully built, and the metals of all kinds used in its construction are of the very best quality.

Bent Glass for Street Cars.

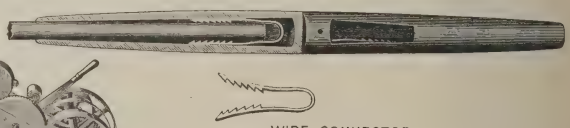
The largest works in America for bending glass are situated at St. Louis, Mo., and are owned by the Oriel Glass Company. These works are devoted exclusively to the bending of glass, and an entirely new process is used. The great capacity of the works enables this company to execute any size of order promptly, and the company guarantees to perfectly fit any pattern or radius for which bent glass is required. The company also pays special attention to packing its goods so that all orders will arrive at their destination in sound condition. The glass furnished by this company will be found especially satisfactory in street railway work where bent glass is required.

Electric Heaters.

The H. W. Johns Manufacturing Company has recently published an attractive pamphlet, descriptive not only of its electric heaters, but also of the general principles of electric heating, which makes it particularly interesting to all street railway managers. The theory of electric heating is carefully described, and some very valuable hints are given upon the proper construction and arrangement of heaters, whereby for the same amount of current better results can be secured. The subject is an important one, and these manufacturers seem to have made a careful study of it, and the results secured by them they are giving to the trade in their catalogues.

Wire Connectors.

The accompanying illustration shows the "Monarch" automatic wire connector which has a number of novel features. With this device, a wire connection can be instantly made without the use of a tool, and without injury to the wire or coupler. As will be seen from the illustration the connector consists of a shell, inside of which is slipped a toothed spring, by which the connector is prevented from coming off after it is shoved over the wire. If the connector is to be taken off a small pin is inserted in the hole back of the spring, which releases the spring and the wire is withdrawn. The connector is manufactured by the Bradford Belting Company, and will specially commend itself for emergency work,



WIRE CONNECTOR.

The Allegheny City (Pa.) Council has granted the Mt. Troy & Reserve Township Traction Street Railway Company a franchise to build its lines on many of the streets of Allegheny.

STREET RAILWAY NEWS

Meeting of the Executive Committee A. S. R. A.

A meeting of the Executive Committee of the American Street Railway Association will be held at Niagara Falls on Feb. 15–16. At this meeting the Committee will select the subjects for discussion at the next annual meeting in October. It is the wish of the Committee that if any member of the Association has any subject which he would like to have discussed he should bring the subject to the attention of the Committee before that date.

New York Railroad Commissioners Report.

Advance sheets of the New York Railroad Commissioners' report have been recently issued, giving the recommendations of the Board. The Commissioners devote quite a little space in their report to recent motive power experiments in New York City, including the trial of the underground trolley system on the Lenox Avenue line of the Metropolitan Street Railway Company; the Hardy compressed air cars on the 125th Street line of the Third Avenue Railroad Company, and the Hoadley compressed air system on the Lenox Avenue line of the Metropolitan Street Railway Company. The report also mentions the fact that the Manhattan Elevated Railroad Company intends to make experiments with the Hoadley motor and describes the experiments with electricity on the Thirty-fourth Street branch of the Manhattan Elevated. The following is a summary of the recommendations pertaining to the street railways of the state made to the Legislature by the Commissioners:

An amendment empowering the Board to summarily compel steam and street railroads intersecting at grade to erect interlocking switch and signal devices.

An amendment relative to applications of street surface railways for a certificate of public convenience and necessity, empowering the Board to certify to the whole or a part of the route proposed by the new corporation, or to compel an existing corporation to build such additional lines as are deemed to be required by public convenience.

An amendment to the stock corporation law, further restricting the issue of stock and bonds by railroad companies.

An amendment prohibiting grade crossings and providing for the abolition of those already established.

An amendment compelling all passenger cars on elevated railroads to be lighted by gas or electricity.

An amendment compelling the use of fenders on street surface cable or electric cars and generally regulating the operation of such roads as to speed, use of air or power brakes and other safety appliances.

An amendment limiting the number of passengers that may be carried on open cars of street surface railways.

Connecticut Railroad Commissioners' Report.

The report of the Railroad Commissioner's of Connecticut has recently been issued. The report states that the increase in mileage of street railways for the past year has been only 29.70 miles, due probably to the statutory prohibition against the crossing of any steam railroad at grade by any electric, horse or cable road in the state.

Twenty-seven street railway companies sent reports to the Commissioners, but of these, four were not yet in operation, or were operated by other companies. These four companies are omitted in the compilation given below. The total capital stock issued of all the street railways in Connecticut is reported as $9,221,740; the funded debt as $8,690,100, and the floating debt as $849,256, making the total liabilities $18,861,096. The cost of roads is given as $16,538,224 and the cost of equipment as $2,047,038, making a total of $18,585,261. The length of roads is given as 329.34 miles, with 22.58 miles of sidings, making a total of 351.92 miles of single track, including sidings. The cost of the equipped roads averages $56,139 per mile of road or $52,537 per mile of single track, including sidings. The capital stock issued averages $27,894 per mile of road, or $26,105 per mile of track. The funded debt averages $26,386 per mile of road, or $24,694 per mile of track, including sidings.

The gross earnings amounted to $2,589,619, an average of $7,863 per mile of road operated, being $.2056 per mile run. The operating expenses amounted to $1,704,725 or $5,176 per mile of track, being $.1353 per mile run, and amounted to 65.83 per cent of the gross earnings, leaving as the net income $884,895.

Of this sum $417,060 was paid for interest and $128,131 for taxes. Out of the remainder, eleven companies paid $221,100 in dividends on their $5,992,500 of capital stock, an average of 3.7 per cent. One company failed by a few dollars to earn its operating expenses. The total number of miles run was 12,597,085 and 52,789,791 passengers were carried. There were 270 persons injured in the operation of the roads, of whom twenty were fatally injured.

The number of passengers injured was sixty-three, of which four were fatally injured. Four employes were injured, none of them fatally, and there was 223 others, neither passengers nor employes, who were hurt, of whom sixteen died.

Pennsylvania Railroad Commissioners' Report.

The report of the Board of Railroad Commissioners of Pennsylvania gives the following figures, in reference to the street railways in Pennsylvania:

Total capital stock, outstanding, of all street railway companies $154,973,293; funded debt outstanding $41,036,790. The current liabilities are $25,638,969, making total liabilities of $221,649,052. The total cost of all the roads is given as $98,341,984, and the total cost of equipment is given as $17,948,551, making the total cost of all the roads and equipment $116,290,535. The gross earnings of all the roads is stated as $18,791,554, and income from other sources as $22,573,330, making a total income of $41,364,884. The expenses are given as follows: operating expenses, $10,621,691; taxes, $1,183,343; interest, $1,822,303; rentals, $5,889,965; other expenses, $17,450,190; total, $36,967,492. The companies paid $3,548,035 in dividends. There are 1562 miles, 3319 motor cars and 534 trail cars operated in the state. In the operation of these roads 118 persons were killed and 993 persons were injured. These figures are for the year ending June 30, 1896.

Annual Convention of the Northwestern Electrical Association.

The fifth annual convention of the Northwestern Electrical Association was held at Milwaukee, Wis., Jan. 20 and 21. The headquarters of the Association were at the Club House of the Pfister Hotel. The papers presented to the Association were as follows: "Incandescent Lamps," by F. S. Terry; "Protective Devices for Transformers," by H. C. Wirt; "Insurance as Affected by Electrical Construction," by George S. McLaren; "Röntgen Ray Phenomena," by C. D. Haskins; "Defects and Dangers of Municipal Ownership," by Mr. Schuette; "Safety Devices for Electrical Circuits," by W. M. Stine; "Gaseous Fuel as a Means of Cheapening Electricity," by N. W. Perry; "Electrical Supplies," by W. W. Low; "Electric Heating," by George Cutter.

The new officers elected are: president, H. C. Higgins, Marinette, Wis.; first vice-president, G. L. Cole, Beloit, Wis.; second vice-president, J. H. Harding, Laporte, Ind.; secretary and treasurer, T. R. Mercein, Milwaukee, Wis.; directors, Messrs. Debell, Rand and Bean.

La Crosse, Wis., was selected as the next meeting place.

Convention of Manufacturers' Association.

The convention of the National Association of Manufacturers was held at Horticultural Hall, Philadelphia, beginning Jan. 26. There was a large attendance. The Association includes in its membership a large number of the most important and influential manufacturers in the country. The annual banquet was held Jan. 28.

Foreign Notes.

Algeria.—Some of the details of the electric line here have been settled upon. Three generators of 300 k. w. each will be used. The cars will be equipped with two motors each and will be able to carry forty-two passengers each. The operation will be by a French company.

Berlin, Germany.—The negotiations between the Berliner Pferdebahn-Gesellschaft and the municipality on the substitution of electric for animal power have been settled as follows: The franchise of the company is extended to the end of the year 1919; the company agrees to build all lines judged by the municipality to be necessary within a limit of 100 k. m., the city to pay one-third of cost for lines built between 1902 and 1907 and one-half between 1908 and 1911, a new arrangement to take effect in the last eight years of the franchise. The operation will be by overhead wire. The mixed system of accumulators will only be employed where the municipality judges it necessary. If, however, a new system more desirable should be developed the company must adopt it. The change of equipment must be made within two months after the contract receives the approbation of the Government and must be concluded within five years. The company in exchange for the franchise is to pay the city four per cent of its gross receipts, up to 7,500,000 fr. The tax will increase in proportion to the receipts, but is never to exceed ten per cent. At the expiration of the concession the entire plant becomes the property of the city without further payment.

Blackpool, England.—The Town Council has decided to proceed with the application for Parliamentary powers to extend the tramways through the Borough.

Bolton, England.—At a recent town meeting it was decided to apply to the next session of Parliament for permission to extend the tramways into outlying districts, and to introduce electric traction.

Bordeaux, France.—The electric line which has been in operation here for some time has received the right to make important extensions. The overhead system will be used mainly, but a short section will be equipped with accumulators or conduit.

Bray (near Dublin), Ireland.—The Bray Electric Tramway Company, Limited, will soon apply for permission to construct a number of tramways in Bray and vicinity. It is proposed to use electric traction.

Brussels, Belgium.—For the first eleven months of 1896 the Societe des Trams-Car reports an increase in receipts of 21,000 fr.

Cairo, Egypt.—The length of line here is 32 k. m. double track, and 6.4 k. m. single track. The gauge is one meter. Overhead wires are used. The rolling stock includes sixty cars of which forty are motor cars. Each of the latter is equipped with two G. E. 800 motors. All cars are open and separated into two compartments, one for Europeans and the other for natives. The power station is situated not far from the Nile and employs the water of that river for feed water. Three boilers are used and three direct connected units of 225 k. w. each.

Crewe, England.—It is proposed to build an electric railway in Crewe and the surrounding district.

Cronstadt, Russia.—It has been decided by the municipal authorities of Cronstadt to construct an electric railway in that city.

Dover, England.—Bids for the construction of an electric railway, to be built by the Corporation of Dover, will shortly be opened. The contracts will be made in three divisions; the first being for the permanent way, for the construction of which the Borough Surveyor has been authorized to invite bids; the second contract will be for the rails and metal work; and the third for the electrical equipment, rolling stock, etc. The Council has already purchased a suitable site for the car sheds. Stephen Sellon has recently been appointed consulting engineer for the proposed electric railway.

Great Yarmouth, England.—The Great Yarmouth & District Tramway Company, Ltd., was incorporated Dec. 8 to construct, purchase, or lease tramways in Great Yarmouth or elsewhere in Norfolk or Suffolk, to equip, maintain and work the same by electricity or any other power and to supply electric light, heat and power. The capital stock of the company is $1000 in shares of $10 per share. This company is registered by Ashurst & Company, 17 Throgmorton Avenue, London, E. C. Among the incorporators are E. Lazarus, chairman of the company; T. R. Thompson, director; W. F. Parshall, engineer; J. Devonshire, secretary, and A. Boyter, manager; all of 83 Cannon Street, London, E. C.

Grenoble, France.—A special State Commission appointed last October to investigate the propositions made by the Grenoble Tramway Company for the equipment of an electric line here has acted favorably on the petition of the company.

Laval, France.—By a recent decree the establishment in the Mayenne Department of a narrow gauge railway is declared necessary between the towns of Laval, Landivy and Mayenne.

Le Mans, France.—By a decree dated Dec. 15, M. Faye has been awarded the concession for an electric line in this city, and construction will be commenced at once.

London, England.—A bill has been introduced to incorporate the City & West End Railway Company for the purpose of constructing an underground railway to be operated by electricity from Bridge Road, Hammersmith to Cannon Street at a point near Budge Row. The capital stock is to be $3,150,000 with power to increase this by a further sum of $1,050,000. Among those interested in this company are T. Davidson, R. E. Tarrant, J. H. Lukach, F. E. Warburg, and others.

THE Metropolitan District Railway Company has asked permission to increase its capital stock for the purpose of equipping its existing lines with electricity.

A BILL has been presented to Parliament granting permission to incorporate the West Suburban Railway Company, for the purpose of building an electric railway, over four miles in length, from Paddington to Willesden. The capital stock of the company will be $350,000, divided into $10 shares. The directors of the company will be T. Clayton, J. Fellows and F. Watkins.

Middlesborough, England.—The Imperial Tramways Company has made application for permission to extend its lines and use the overhead electric system.

Mons, Belgium.—The construction of the Mons-Boussu electric railway will be commenced soon. The line will reach from Mons through Jemappes to Boussu, and it will be double track from Mons to Jemappes. The gauge will be one metre.

Montmorency, France.—The *Journal Officiel* has published a decree declaring the public need of a tramway with mechanical traction in the Seine-et-Oise Department, between Montmorency, Enghien, and Saint-Gratien.

Moscow, Russia.—The gross receipts of the Moscow tramways for November, 1896, were $15,962, as against $18,905 for November, 1895.

Nice, France.—At the annual meeting of the Nice Tramway Company last month, the receipts were given as 555,000 fr.; expenses, 389,000 fr.; profit, 166,000 fr. This permitted the distribution of a dividend of 6½ per cent against 6 per cent for last year.

Paris, France.—The General Council of the Seine Department has voted to permit the Compagnie Générale des Tramways to install the trolley system on its line from the Bastile to Charenton upon certain conditions. The line is to be one simply to test the system and if the Department should decide not to permit the continuation of operation the company must at any time and at its own cost replace the street in its original condition within six months.

AT a recent meeting of the Société Internationale des Electriciens, M. Hillairet presented some interesting statistics on the street traffic of Paris. Since 1890, statistics show a traffic in the city of about 290,000,000 passengers per year, with accommodations for only 300,000,000. The number of carriages in service in the city averages 25,000 per day, of which 10,000 are for hire.

Persia.—The Société des Chemins de Fer of Persia at a meeting held Dec. 10, in Brussels, voted to increase its capital to 4,000,000 francs.

Rouen, France.—The following figures are given by *Le Génie Civil* of the operation of the Rouen Tramway Company (trolley) for four months, ending Oct. 31, 1896:

Number of car kilometres (average per month)	241,666
" " kilowatt hours " " "	170,657
" " " " per car kilometre	.710
Consumption of coal per kilowatt hour	1.90 kg.
" " " per car kilometre	1.36 kg.

St. Petersburg, Russia.—The official railway report gives the total length of railway lines in the Empire, 39,331 k. m., of which 8031 k. m. are double track. Of these lines, 22,576 k. m. are operated by the State. The amount of railway under construction is given as 12,517 k. m.

Stapleton, England.—The Bristol Tramways Company has received permission to extend its lines through Stapleton to Staple Hill.

Toulon, France.—Work has been commenced upon the electric line in this city.

Trieste, Austria.—It is said that the tramway company at Trieste intends to substitute electricity for horses on its lines.

Turin, Italy.—The Chamber of Commerce of Turin is advocating the construction of an electric railway across the St. Gothard Pass. An English syndicate is said to be ready to advance the necessary capital which will be 40,000,000 fr. The line is to be constructed between Aosta and Martigny and will have a length of 60 k. m.

Versailles, France.—The Societe du Tramway de Versailles à Maule has been organized under the direction of Adolphe Perrichont and Galloti, engineers, to build a tramway line between Versailles and Maule. The capital stock is fixed at 1,800,000 fr., all subscribed.

West Bromwich, England.—A bill has been proposed granting the owners of the steam railway, now in operation at this place, permission to introduce the overhead system of electric traction.

Whitechapel, England.—A company is about to be incorporated for the purpose of constructing an underground electric railway about two miles in length commencing at the line of the Metropolitan District Railway, near the eastern corner of Whitechapel, and running to Bromley. The capital stock will be $600,000, with power to borrow a further sum of $200,000. The directors of the company will be Sir Myles Fenton, L. H. Isaac, Cornwallis Ponsonby, and four other persons to be chosen by them.

Electric Tramways and Railways in Ireland.

The advance sheets from the U. S. Consular Reports for January, give the following interesting information concerning the electric railways of Ireland. "The U. S. Consul at Dublin writes that the Dublin United Tramways have published notices of their intention to proceed in Parliament, session of 1897, with bills to permit extensive construction of new lines and to substitute electric traction for horse power upon the existing lines. The company has also given notice of its intention to proceed before the Privy Council, Easter sittings, 1897, for authority to extend, vary and enlarge existing tramway lines with such changes at passing places or crossings as may be necessary. All of these notices are the legal preliminaries toward the adoption of electricity as the means of traction upon existing lines and such extensions as they may make. The new extensions contemplate a large number of lines connecting the various suburban districts with each other and with the city proper. The Dublin, Wicklow & Wexford Railway Company has also given notice of its intention to proceed in the parliamentary session of 1897, with bills to allow extensions of its system of railways and with power to substitute electricity as the motive power upon its system to such extent as it may choose. This company now operates about 140 miles of railway. It is said that it is the intention of the company to substitute at an early date electric traction for both passenger and goods trains on its line from Westland Row (Dublin) to Bray, a distance of about 14 miles, most of the way lying through populous surburban towns. It is alleged that the competition of the Southern District Electrical Tramway, which parallels this line for 8 miles, has made this change necessary, as this line, which was opened in May, has already seriously interfered with the earnings of the railway and is constantly growing in favor with the suburban population. The Municipal Council of Bray is also favorably considering the construction of an electric tramway. Bray is a fashionable seaside resort, with a constant population of about 10,000, and has at present no tramway system. I also understand that the Tramways Company of Belfast intends to apply to Parliament for power to substitute electric traction on the tramways of that city. Should the action of Parliament be favorable to these various projects, there should be a good Irish demand for electrical goods."

The Effect of Hardening Plastic Rail Bonds.

From recent tests made on the Edison plastic rail bond it appears that where the rail joints are well maintained no injury to the contact is found to result from the hardening of the plastic alloy. F. H. Tidman, receiver for the Lake Ontario & Riverside Railway Company, writes as follows:

"As I had a very long experience with the earlier forms of the amalgam used in the Edison plastic rail bond and which was designed by Mr. Edison, I wish to say that on a road in Orange the bonds were mixed so as to harden and had four or five years' successful use.

"If a connection jarred loose from any cause the heat produced by increased resistance quickly softened the amalgam and re-established the contact. In designing the more modern forms of this bond, it was decided to put in a slight excess of mercury and to allow sufficient room in the receptacle holding the alloy, to prevent its being put under pressure. This alloy when properly used, will remain plastic for years, as I can testify from long experience. If this alloy is put under pressure the excess of mercury is forced out, leaving a brilliant white metal of great density and of better conductivity than the plastic form. It readily softens under heat and will not be blackened by an arc."

Calendars for 1897.

A number of very attractive calendars have been sent to this office within the last month, among which may be mentioned,in addition to those referred to last month, those from the Cutter Electrical &Manufacturing Company, of Philadelphia; American Electrical Works, of Providence, R. I.; S. G. Barker & Son, of Scranton Pa.; The National Carbon Company, of Cleveland; Joel H. Woodman, of Hoboken, N. J.; The Ashton Valve Company, of Boston, Mass.; J. W. Hoffman & Company, of Philadelphia, and R. D. Nuttall Company, of Allegheny, Pa.

The Peckham Motor Truck & Wheel Company, has recently issued an unusually large and tastefully decorated calendar. The page for each month is printed on a large sheet 17 ins. × 23½ ins. On the different sheets of the calendar are published half tones and descriptions of the Ruggles rotary snow plow and of the different trucks manufactured by the Peckham Truck Company. A number of half tones of cars equipped with Peckham trucks are also given.

Projected Road at Catania, Sicily, Italy.

Catania. a seaport city at the foot of Mt. Etna, does not as yet possess a street railway system, but there are now on foot two projects, by two different engineers, for building electric railways. Both promoters have applied to the municipal government for concessions, one of which will doubtless be granted. Giulio Baurittel and Fratelli Prinzi, of Catania, are the two parties that have applied for franchises.

Cost of Early Track Construction.

In an old pamphlet which was discovered recently in the Astor Library in New York, are some interesting figures with reference to the cost of a piece of track laid by the Baltimore & Ohio in 1830 and 1831. I. L. Sullivan, evidently a civil engineer, in a report to R. L. Colt, estimates that the track laid with wooden sleepers, wood bearers and plate rail, exclusive of ground and graduation, would cost $4362 per mile; with stone blocks, wood bearers and plate rail, of which the cost of iron was $1324, the cost would be $5115 per mile; with granite sills in line with plate rail, of which the iron was $2037 the cost would be $6500 per mile, divided as follows:

Sills at $11.50 per 100,	$3680
Bar iron,	1300
Broken stone,	640
Various items,	880

This engineer speculated on two ton loads and one ton cars and said in his report that the Baltimore & Ohio Company would be doing a very rash thing if it went beyond this point.

He also says, "The locomotive engine now operating successfully on the Baltimore road, made by Mr. Winans to run on a friction carriage, though of moderate power, has a great useful effect."

Mr. Winans was apparently the first to patent outside journals and to reduce the resistance from friction from 11¾ lbs. to 4 lbs. per ton.

Purchase of the Second Avenue Railroad.

It is announced that certain stockholders of the Metropolitan Street Railway Company, of New York, have purchased the Second Avenue Railroad, of New York. Wm. C. Whitney is reported as saying that the Second Avenue Railroad will undoubtedly be leased to the Metropolitan Street Railway, and will also be changed from horse traction to the underground electric system at an early date. The Second Avenue Railroad has been in operation since 1854, and now carries approximately 20,000,000 passengers per annum.

Consolidation in Pittsburgh.

Newspaper reports state that the Federal Street & Pleasant Valley Passenger Railway has been leased to the Second Avenue Traction Company. The lease will be for a long term of years; but the details have not yet been fully decided upon.

Center Vestibule Cars.

Double deck cars possessing a number of novel features are being manufactured by C. L. Pullman's Center Vestibule Car Company. These cars, instead of having end platforms, have a central vestibule, or passage, with divided central entrances so that there is both entrance and exit at either side of the cars. Seating compartments occupy the ends of the cars and open into the vestibule. These cars are provided with roof seats, and have four stairways in the vestibule leading to the roof seats. They also have an elevated cab for the motorman, which is accessible by the stairways. These cars have the advantage of seating double the number of passengers and the cost of electrical equipment is therefore proportionately less. They can be used for summer and winter traffic without change. It is also claimed by the manufacturer of these cars that old equipment can be remodeled and altered into center vestibule cars at a comparatively low cost.

A Novel Jack.

A jack which possesses a number of novel features is being manufactured by the Pearson Jack Company. In addition to working very satisfactorily when in a perpendicular position this jack will hoist heavy weights when it is working at an angle. Its chief advantage, however, lies in the rapidity with which it will lift a car back to the rails after the car has been derailed. The usual method of restoring a derailed car is by hoisting, blocking and then pnshing the car over or by the use of engines, derricks, frogs or various other machinery more or less cumbersome. The Pearson jack, however, as it possesses the power of working at an angle and of swinging through a large arc while supporting the load, will restore a car to the rails in a very short time and it requires but two men to operate it. This tool is so light and compact that it can be carried on a car without adding materially to the weight.

THE contract for the new passenger station of the Baltimore & Ohio, at Baltimore, at the southern entrance to the Belt Line tunnel, has been let and work will commence immediately. The electric locomotives used in the Belt Line tunnel will stop at this station when completed. The improvements will cost somewhere in the neighborhood of $100,000, and result in a great saving of time running between Washington and New York.

News Notes.

Addison, N. Y.—The business men of Addison are organizing a stock company to build an electric railway to Woodhull. Among those interested are G. H. Brewster, John Hinman, W. O. Feenaughty, D. M. Darrin, H. D. Baldwin, R. P. Brown, E. M. Welles, F. H. Wheaton, B. G. Winton, O. B. Stratton and C. O. Shockey.

Allentown, Pa.—The East Penn Traction Company has filed in the Recorder's office at Allentown, a paper expressing its intention to build an electric railway through Lehigh County, beginning at the Bucks County line on the road leading to South Bethlehem, thence to Coopersburg, Centre Valley, Friedensville and Colesville to the Northampton County line.

Asheville, N. C.—A bill has been introduced in the Legislature incorporating the Asheville & Biltmore Street Railway Company.

Baltimore, Md.—The Baltimore Traction Company contemplates building several additions in the southwestern part of the city.

The City & Suburban Railway Company is considering an extension of its lines in the western part of the city, from Mount Street to North Avenue.

Atlanta, Ga.—The Atlanta Consolidated Street Railway Company will extend its Fourteenth Street line several miles to the park which will soon be built near Atlanta by the Exposition Park Company.

Augusta, Ga.—Among the incorporators of the Aiken & Augusta Railroad Company are H. Cloud, Charles Kirkpatrick and Mr. Leander, of Philadelphia. The capital stock of the company is $150,000. Work on the proposed lines will be begun at an early date.

Baltimore, Md.—It is reported that the Pikesville, Reistertown & Emory Grove Railroad Company will extend its lines from Pikesville to Baltimore. At Baltimore the line will connect with the Baltimore City Passenger Railway and the company will run its cars over the latter road into the center of the city.

Barre, Vt.—The incorporators of the Barre Street Railway Company are A. O. Humphrey, J. J. Flynn and F. C. Kennedy, of Burlington. The company expects to build an electric railway from Barre to Montpelier, and will begin work as soon as the frost is out of the ground.

Benton Harbor, Mich.—The Benton Harbor Electric Railway & Transit Company, which was incorporated last week, has organized with the following officers: president, J. W. Hamilton; vice-president and general manager, H. D. Deam; secretary, W. H. Hollis. This company proposes to build a tunnel under this city and extend the road eastward to Paw Paw, Allegan and Decatur with a branch through the Michigan fruit belt. Work will be begun next month.

Bound Brook, N. J.—At the annual meeting of the stockholders of the New York & Philadelphia Traction Company, held in Trenton on Jan. 13, the following officers for the ensuing year were elected: president, N. B. Cox; vice-president, John Blair MacAfee; secretary and treasurer, J. H. Darrah.

Brockton, Mass.—The Brockton Street Railway Company has applied to the Legislature for franchises to extend its lines to Taunton.

Camden, N. J.—The Electric Train Bulletin Company has been incorporated by J. W. Harner, of Beverly, N. J., and others to manufacture, buy, sell and lease train bulletins or indicators and general electric devices. Capital stock, $500,000; paid in, $1000.

Canon City, Col.—A meeting was held in Canon City recently by the citizens of Canon City and vicinity to take aggressive steps towards the building and operation of the Canon City & Cripple Creek Gold Belt Railway, and it was decided to circulate petitions asking for rights of way and terminal facilities in Canon City. Among those interested are Samuel P. Dale, A. H. Atwater, Judge Bailey, Dr. Peare, Clyde Dawson, Joseph W. Milsom, C. Deweese and Ernest Sell. It is stated that $50,000 has been raised towards the enterprise.

Catskill, N. Y.—The Catskill Electric Railway Company has been incorporated to build and operate an electric railway, two miles long, from Catskill to Jefferson, Greene County. The directors are Charles S. Williamson, William S. Robert, Louis E. Robert, Michael W. Conway, W. C. Courtney, W. C. Wood, Howard A. Mock, Daniel W. Sharpe and Schuyler W. Mattison. Capital stock, $30,000.

Chillicothe, Mo.—Elmer Moorman, is interested in an electric railway from Chillicothe to Trenton, Avalon and Hale City.

Cincinnati, O.—At the last meeting of the Wyoming Village Council an ordinance was passed granting the right of way over Springfield Pike to the Cincinnati, Hamilton, Middletown & Dayton Street Railroad Company, and the prospects for the immediate construction of the road are favorable.

Cleveland, O.—The Cleveland & Chagrin Falls Electric Railway Company has elected the following officers: president, V. A. Taylor; vice-president, M. A. Sprague; secretary, E. J. Kennedy; treasurer, William Prescott. Directors: V. A. Taylor, E. J. Kennedy, William Prescott, C. F. Lane, L. M. Coe, M. A. Sprague, F. D. Carpenter, R. L. Palmer, F. N. Wilcox, George Simon, J. E. Ensign. Work on the company's lines is progressing rapidly with several large forces of men at work at different points. The company has abandoned its first plan of locating the power house in Orange Township, and negotiations are now under way to erect the building, together with car barns and machine shop, in or near Cleveland.

Detroit, Mich.—G. F. Smith, George M. Hendrie, W. C. Sterling, Cameron Currie, J. L. Carleton, Strathearn Hendrie, Frank T. Lodge and Truman Newberry are the promoters of an electric railway from Detroit to Toledo, by way of Monroe and Dundee. Franchises have been applied for in many townships along the route. Work will be begun in the spring.

Doylestown, Pa.—It is proposed to extend the Quakertown & Springtown Electric Railway, now in course of construction, to Argus, Trumbauersville, Tylersport, Schlictersville, Sellersville and Perkasie. The promoters of the enterprise consider that section a good field to operate.

East Windsor, Conn.—A bill has been introduced in the State Legislature by Mr. Rockwell of East Windsor, incorporating Jehiel H. Simonds, Charles G. Harrison, Sylvester R. Rockwell, L. B. Griffin, Charles E. Woodward, George A. Ellis, Edwin F. Thompson, John Mason and George S. Phelps as the East Windsor Electric Railway Company.

Elizabeth, N. J.—The Westfield & Elizabeth Street Railway Company has been incorporated to build an electric railway from Westfield to Elizabeth. The officers are: president, Chandler W. Riker, of Newark; secretary, E. W. Hine, of Orange; treasurer, Adrian Riker. Capital stock, $250,000.

Farmington, Me.—An act has been presented to the Legislature incorporating Leonard Atwood, William DeWitt and W. H. Ambler, of Philadelphia, H. H. Rice, of Farmington, and others, as the Franklin, Somerset & Kennebec Railway Company to build a railway from Farmington via New Sharon, Mercer, Starks and Norridgewock, or through Mercer, Rome, Smithfield, Belgrade and Oakland to Waterville, or an alternate line to Augusta or Gardiner, steam or electricity to be used as the motive power. The capital stock is fixed at $100,000.

Fort Wayne, Ind.—Reports state that contracts aggregating $275,000 have been awarded for the construction and equipment of an electric railway from Fort Wayne to Wawasee Lake, Ind. The distance is twenty-eight miles.

Frederick, Md.—The Myerville & Catoctin Railway Company has been organized for the purpose of building an electric railway from Middletown to Myersville, a distance of five miles. The incorporators are D. C. Winebrenner, Cyrus F. Flook and Reno S. Harp, of Frederick; Maurice E. Brightbill, of Anniville, Pa.; George W. Wachtel, George D. Toms and John C. Leatherman, of Myersville. A preliminary survey of the route has been made, and the right of way to some extent procured.

Gainesville, Ga.—Samuel C. Dunlap, C. C. Sanders and others are promoting an electric railway to be built in Gainesville.

C. E. King, J. M. Hunt and others intend forming a company to construct an electric railway in and near Gainesville.

Grafton, W. Va.—Franchises have been granted to Theodore L. Swan, C. L. Brown and T. H. Wilson, of New York, to build an electric railway from Grafton to Pruntytown.

Hamilton, O.—The Commissioners of Montgomery County, have granted the Cincinnati & Miami Valley Traction Company a fifty year franchise for the construction of its lines along the Cincinnati pike, in that county. Work is to begin before June 1 and be completed before Dec. 1, 1897.

Hanover, Mass.—Reports state that the Bridgewater, Whitman & Rockland Street Railway Company is being organized by a Philadelphia syndicate to build an extension of the lines of the Hanover Street Railway Company to the towns named in the title, also to Abington and East Bridgewater. Capital stock, $25,000.

Holbrook, Mass.—The Selectmen of Holbrook have granted a franchise to the Randolph, Holbrook & Nantasket Electric Railway Company to build its lines in Holbrook. The company will begin work on its lines in the spring. Douglass Brooks, of South Weymouth is interested.

Kittery, Me.—Frank E. Rowell, Horace Mitchell and others have applied for the incorporation of the Kittery & Eliot Street Railway Company. Capital stock, $200,000.

Laconia, N. H.—Charles A. Busiel, of Laconia, ex-governor of New Hampshire, is the promoter of several electric railways in the vicinity of Laconia. The three principal ones are as follows: from Laconia to Gilford and from Gilford up Mt. Belknap; from Laconia to Belmont and Gilmanton Corner, and from Meredith or Ashland to Center Sandwich, Albany and Conway, covering a forty mile stretch of country.

Laramie, Col.—J. R. De Remer is making surveys for an electric railway from Laramie to Horse Creek.

Little Falls, Minn.—Eastern capitalists are inspecting the country in and about Little Falls and St. Cloud with a view to building an electric railway between the two towns.

Montpelier, Vt.—The Consolidated Lighting Company, to which an electric railway franchise has been granted, will begin work on its lines in the spring. C. H. Pitkins is president and E. D. Blackwell treasurer and general manager of the company.

Newark, N. Y.—George F. Chism, civil engineer of 92 State Street, Albany, is endeavoring to interest capitalists in the proposed electric railway between Lyons and Newark. His plan is to survey

the route, estimate the cost of the road and take charge of the work.

New Baltimore, Mich.—At a recent meeting of the voters of Chesterfield a franchise was granted from New Baltimore to Chesterfield, to James G. Tucker, receiver of the Detroit & St. Clair River Railroad Company. Another was granted to him from Chesterfield to within 2½ miles of Mt. Clemens. Mr. Tucker agreed to furnish a $2,000 bond, that the road be constructed within the prescribed time. Among those interested in the company are Wm. H. Ashwell, Home Bank Building, Detroit, and Lester B. French, 12 Whitney Building, Detroit.

New Bedford, Conn.—Reports state that William W. Crapo and Henry Crapo have secured a controlling interest in the Union Street Railway Company and will improve the company's property in many ways.

New Castle, Del.—A bill has been introduced in the State Legislature to incorporate the New Castle, Newport & Wilmington Railway Company, to build and operate an electric railway from New Castle through Newport to the Wilmington city limits at Maryland Avenue and there to connect with the Wilmington City Railway. The incorporators are S. P. M. Tasker, Edward Mendinhall, Joseph H. Gould, David W. Elkinton, John A. Cranston, Samuel A. McDaniel, Hiram R. Borie, W. Atwood Weldin, W. S. Quigley, Thomas Holcomb and Albert E. Kruse. Capital stock, $100,000, with privilege to increase to $200,000, and to issue $200,000 bonds.

New Haven, Conn.—The transfer of the ownership of the New Haven & Centerville Horse Railroad to the Fair Haven & Westville Railroad Company was formally completed on Jan. 2.

New Paltz, N. Y.—The New Paltz & Walkill Valley Railroad Company has been incorporated by Hugh H. Douglass, G. H. Harman, Paul Shiffer, Charles G. M. Thomas, James F. Reid, Joseph H. Devoe, George E. Woods, Henry M. Brundage and William G. Hoyt to build and operate an electric railway from Highland, N. Y., along the turnpike to New Paltz, a distance of nine miles. Capital stock, $150,000.

Norway, Me.—The electric railway projected by A. F. Gerald, of Fairfield, Me.; E. W. Eastman, of Auburn, Me.; John D. Clifford, of Lewiston, and L. H. Burnham, of Albany, between Norway and Waterford will be known as the Oxford Central Electric Railway. Meetings are being held in the cities along the route to secure funds for building the line and rights of way.

Philadelphia, Pa.—The Fairmount Park Transportation Company has purchased a tract of eighteen acres bordering on Fairmount Park, which it will convert into an excursion resort for the patrons of the road. Toboggan slides, scenic railways, shoot-the-schutes, carrousels, a bicycle track, music, the usual electrical novelties, a café and other attractions will be introduced. A lake about 2000 ft. long for boating and a wooded island in the center of it will be among of the attractions.

Phœnix, Ariz.—James Goodwin, of Tempe, Ariz., proposes to build an electric railway from Phœnix to Mesa, by way of Tempe.

Pittsburgh, Pa.—The West Side Belt Railroad Company has completed surveys for twelve miles of its proposed lines from the terminus of the Little Saw Mill Run Street Railway in the West End to Finleyville and Monongahela, and will begin construction work as soon as possible. The road will be both for freight and passengers, and will open a large territory in which there are no transportation facilities. J. D. Callery is president, and John S. Scully, E. H. Stowe, William J. Burns, John C. Reilly, and James S. Scully are directors of the company.

Pottsville, Pa.—The Pottsville & Reading Railway Company, controlled by the Schuylkill Electric Railway Company, will complete the extension of its lines between Pottsville and Schuylkill Haven in the spring.

Redding, Cal.—John Spelman, F. B. Flood and H. W. Weldon are the promoters of an electric railway in Shasta County, from Redding to Keswick, a distance of eight miles. Franchises have been applied for.

St Joseph, Mo—The St. Joseph Railway, Light, Heat & Power Company, will extend its lines from the foot of Sixth Street to the stockyards.

Sandusky, O.—Surveyors are at work on the lines of the Sandusky, Ashland & Coshocton Railroad Company, projected several years ago, and it is reported that the road will be built this spring and equipped with electricity.

Spokane, Wash.—The Washington Water Power Company will extend the Ross Park Street Railway to the Mission Street Bridge.

Syracuse, N. Y.—The Syracuse & Oneida Lake Electric Railway Company will start work on its proposed line between Syracuse and Oneida Lake as soon as the frost is out of the ground. An engineer will examine the plans for the construction in a few days. The franchises for this road were granted about two years ago. At the annual meeting of the stockholders the following officers were elected: president, W. B. Kirk; vice-president, T. W. Meachem; secretary, W. S. Wales; treasurer, J. B. Morgan.

Tacoma, Wash.—The University Land Company will build a wide boulevard from the center of the city of Tacoma to University Place, and the Puget Sound University, which is situated at University Place, has secured $250,000 from its patrons for the building of a conduit electric railway over this boulevard as soon as it is completed.

Titusville, Pa.—The Titusville Electric Traction Company has been incorporated with a capital stock of $100,000.

Torrington, Conn.—Erastus Gay, of Farmington; A. R. Wadsworth, E. C. Ayer, John A. Reeve, Lester L. Lowrey, Adrian Moses and Edwin H. Gillett, are the projectors of an electric railway from Torrington to Farmington, via Whigville, Burlington and Harwinton.

Celebration of Successful Electrical Transmission at Buffalo.

The successful transmission of electric power from Niagara Falls to Buffalo was celebrated Jan. 12, by a banquet at the Ellicott Club, which was attended by about 400 invited guests. The menu cards were elaborately gotten up, the covers being made of aluminum, manufactured at Niagara Falls with the electricity developed there, and with the name of each guest engraved thereon.

Among those present were Nikola Tesla, E. J. Houston, Charles F. Brush, Elisha Gray, Charles A. Coffin, George Westinghouse, S. Dana Greene, E. W. Rice, J. P. Ord, F. J. Sprague, L. Bannister, D. O. Mills, Francis Lynde Stetson and Dr. Louis Duncan.

Personals.

Mr. S. H. Bennett, secretary and treasurer of the Atlanta Railway Company, Atlanta, Ga., received from the employes of the company on Dec. 25, a handsome umbrella.

Mr. J. B. McCleary, who has acted as superintendent of the Birmingham (Ala.) Railway & Electric Company for some time, was appointed general manager of the system at the recent election.

Mr. Victor Wandruszka, chief engineer of the Electricitäts-Gesellschaft Felix Singer & Company, of Berlin, recently read an interesting paper on the Walker system of electric railways before the Verein für Förderung des Lokal und Strassenbahnwesens in Vienna.

Mr. C. P. Wilson, of Philadelphia, has been appointed superintendent of the Sioux City Traction Company to succeed Mr. I. B. Walker, whose resignation from that position went into effect Jan. 1, as mentioned in our last issue. Mr. Wilson is a graduate of the Cornell University, and has recently had charge of the street railway system in Indianapolis.

Mr. Edward Caldwell, for the past two years business manager of the STREET RAILWAY JOURNAL, has accepted the position of general manager of the Railway Advertising Company, controlling the advertising privileges of the Metropolitan Street Railway Company of New York, the Consolidated Traction Company of New Jersey, and the Union Traction Company of Providence. Mr. Caldwell has made many warm friends in the street railway field who will wish him abundant success in his new position.

Mr. Clarence E. Stump, who is very well known among the electrical fraternity, has recently connected himself with the monthly magazine, *City Government* as its president and treasurer. This magazine is devoted to the discussion of practical affairs of municipalities and aims to give the latest and best information concerning city governments. Mr. Stump's long and extensive experience in technical journalism has well fitted him for the presidency of such a paper.

Mr. John M. Roach, the well known street railway manager, of Chicago, has been appointed general manager of the West Chicago Street Railroad, as well as of the North Chicago Railroad Company. This places him in charge of the extensive Yerkes railway interests on that city. Mr. Roach well deserves this appointment, in the opinion of his friends, as he has had wide experience in street railway affairs. He commenced his street railway career in 1872, when he began as a conductor on the North Chicago City Railroad. He soon rose from this position to one of more responsibility, and was finally appointed purchasing agent, the duties of which office he discharged in a most acceptable manner. As manager of the north side system, he has given an excellent service.

Mr. H. H. Vreeland, president of the Metropolitan Street Railway Company, of New York, who is an expert steam railroad engineer, as well as street railway engineer, was engaged last month by the Pratt Syndicate which recently secured control of the Long Island Railroad, to give an opinion upon the traffic improvements possible on that road. The plans of the new syndicate contemplate very radical changes in the operation of that line, and include, it is said, the equipment of a number of the suburban lines near Brooklyn with electric power. Mr. Vreeland's early railroad training was acquired largely on the system of the Long Island Railroad Company, where he served in a number of capacities and where he acquired a very full acquaintance with the traffic conditions of the road so that he was particularly competent to make suggestion upon possible improvements.

Mr. Frederic L. Wanklyn, of Montreal, has been appointed general manager of the Toronto Street Railway. Mr. Wanklyn was born in Buenos Ayres, not quite thirty-eight years ago, and educated at Marlborough College, England, He served a regular pupilage under the chief engineer of the Manchester, Sheffield &

Lincolnshire Railway, at the Gorton Works, Manchester. His first appointment was that of resident engineer of the Tramways & General Works Company on its lines in Lombardy, Italy. Subsequently he became general manager and engineer of the Lombardy Road Railways Company, with headquarters at Milan. He was appointed by the late Sir Joseph Hickson assistant mechanical superintendent of the Grand Trunk Railway, and later works manager at the Point St. Charles Locomotive Works. He has been master mechanic in charge since the change in administration of the Locomotive Works. Besides discharging the duties of these important positions, he acted as consulting mechanical engineer to the Montreal Street Railway during the construction of its power house. He is a member of the Canadian Society of Civil Engineers and an associate member of the Institute of Civil Engineers, England.

Mr. M. K. Bowen, who has been superintendent of the Chicago City Railway for several years was elected last month general manager of the company. Mr. Bowen has shown remarkable executive ability in the management of this line and is regarded as one of the most expert managers in the country. He was born in Jefferson Barracks, Mo., ten miles below St. Louis, in 1856. He was a son of the Confederate General, John S. Bowen, who was killed while fighting for the Confederacy, and a grandson of Pierre Menard, the first Lieutenant-Governor of Illinois. He received his early education at the St. Louis University, and later at the Washington University in St. Louis, taking a course in engineering at the latter institution, which laid the foundation of his future career. In 1877 Mr. Bowen went into the service of the United States Government as assistant engineer on a triangulation survey of the Mississippi River. Later he was made assistant engineer of the jetty work in the harbor of New Orleans and the pass. In 1880 he became identified with the St. Louis & San Francisco Railway in charge of the topographical survey from Fort Smith, Ark., through to California. He was engaged in this line for several years, when he began his career as a street railway man. In time he became chief engineer and superintendent of construction of the Kansas City Railway, which was building its cable lines at that time. After the completion of the road, Mr. Bowen became general superintendent. A short time after the road was in working order, Mr. Bowen went to New York City as representative of the Short Electric Railway Company, remaining there a year. He went from New York to Chicago to take the position of superintendent of the Chicago City Railway. Mr. Bowen married Miss Allie De Berry, of Jackson, Miss., in 1880.

M. K. BOWEN.

Obituary.

ALBERT M. KING, who has filled the position of general superintendent of the Jackson & Sharp Company's works for eighteen years, died suddenly on New Year's night, of heart disease, at the age of forty-eight years.

JOHN F. OSTROM, for several years manager of the street railway department of the Pennsylvania Steel Company, died in Philadelphia, Jan. 3, after an illness of five months. Mr. Ostrom was very widely and favorably known in street railway circles, and was regarded as a man of high ability and character, and with an exceptionally good knowledge of street railway engineering.

LOUIS H. HART, the secretary of the American Society of Heating and Ventilating Engineers and the business manager of *Heating & Ventilation*, died very suddenly at his home in Brooklyn on Monday, Jan. 25. Mr. Hart was for some time connected with the *Electrical World*, but in 1891 he resigned his position and commenced the publication of *Heating & Ventilation*, with which paper he has been actively connected since that time. Mr. Hart was always very popular and well liked by his wide circle of friends, and his death will be greatly felt in trade journalism.

COL. WM. H. SINCLAIR, of Galveston, Tex., died suddenly of apoplexy on Jan. 11 while writing letters in his room at the Powers House, Rochester, N. Y. Mr. Sinclair was born at Akron, O., on Oct. 31, 1839. He was educated in Michigan and served in the Federal army from 1861 to 1867. Upon leaving the army he decided to remain in Texas, and entered into active political life, serving in the Legislature and as Speaker of the House, and also as Collector of Internal Revenues, and Postmaster at Galveston. In 1876 he purchased a controlling interest in the Galveston City Railroad and under his management this road became one of the best systems in the South. Mr. Sinclair always enjoyed the confidence and respect of his many friends who will regret exceedingly to hear of his death.

AMONG THE MANUFACTURERS.

The Paige Iron Works, of Chicago, are mailing to the trade some handsome circulars, showing work recently completed by them, illustrating their methods of construction, etc.

The Mossberg & Granville Manufacturing Company, announces that it has moved its office to 101 Sabin St., Providence, R. I., where all letters to the company should be addressed.

The Falk Manufacturing Company, of Milwaukee, Wis , reports that it is doing considerable business. Among the recent orders secured by this company is a contract for welding the rails of the street railway at Los Angeles, Cal.

The Ranken & Fritsch Foundry & Machine Company, of St. Louis, Mo., is offering for sale its large shops together with all their equipments. The stockholders want to sell the plant as they desire to retire from the machinery bnsiness.

The Sterling Varnish Company, of Pittsburgh, Pa., reports that it is making heavy European shipments this month and is also shipping heavily to the General Electric Company, which company is using the Sterling varnish much more extensively than ever.

The Firm of Ford & Bacon, engineers, consisting of Frank R. Ford, George W. Bacon and George H. Davis, has changed its name to Ford, Bacon & Davis, and has moved its main office to the St. Paul Building, New York, these changes taking place Feb. 1.

R. W. Hildreth & Company, of New York, and George F. D. Trask were the contractors for the roadbed and track of the Washington, Alexandria & Mount Vernon Railway system, described in our last issue, the work not all being done by one firm, as stated last month.

The Clonbrock Steam Boiler Company, of Brooklyn, N. Y., has secured the entire boiler contract for the Tennessee Centennial Exposition to be held the first of May next. This is quite a triumph for the Climax boiler as a number of other makes of boilers were offered in competition.

The Jos. Dixon Crucible Company, of Jersey City, N. J., has issued a neat catalogue showing the price and good qualities, and the uses to which Dixon's silica graphite paint may be put. This paint is manufactured with the special points in view, of durability, economy and beauty of finish.

The Railway Advertising Company, of New York, has recently issued a neat little pamphlet giving the location of all points where transfers are given on the system of the Metropolitan Street Railway Company, of New York. The Railway Advertising Company controls the advertising in the cars of this system.

The Clonbrock Steam Boiler Company, of Brooklyn, N. Y., has issued a very fine catalogue of the Morrin "Climax" water tube boiler of which it is the manufacturer. This catalogue contains the results of a number of interesting tests upon this boiler, together with a number of testimonials and illustrations of the boiler and its different parts.

Sargent & Lundy, of Chicago, were the designers of the plant of the Toledo Traction Company described in the last issue of the STREET RAILWAY JOURNAL. All the work of this firm is characterized by excellent mechanical and economic features, and the company has a very high reputation as consulting engineers for electric lighting and railway work.

Eugene Munsell & Company, of Chicago, Ill., miners and importers of mica, announce that they have moved into their new quarters at 117-119 Lake Street. The increased facilities for handling their Western business will enable them to carry a larger stock of mica and drop forge copper segments, and thus place them in a position to fill all orders promptly.

Ahearn & Soper, of Ottawa, Ont., have secured the contract for the complete rolling stock of the Quebec Electric Railway, including cars, motors, etc. The system at Quebec will be as nearly as possible a duplicate of that at Ottawa, which is giving entire satisfaction. The motors used will be of Westinghouse make and will be specially adapted for the grades which exist at Quebec.

The Mica Insulator Company, of New York, Chicago, and London, announces that it has removed its Western headquarters to 117-119 Lake Street, Chicago, and is in a position to fill all orders for its "Micanite" specialties promptly. During the past year the company has enjoyed an increased trade in the West among the electrical manufacturers, electric railways, and lighting companies.

The Standard Air-Brake Company, of New York, has recently issued a neat little pamphlet giving a number of strong reasons why Standard air brakes should be used by general managers. The pamphlet contains a number of illustrations of the different types of air compressors manufactured by the Standard Air-Brake Company, and of a number of cars equipped with Standard air brakes.

T. C. Rafferty, who is well known among electrical supply and street railway men in this country, is now associated with the Metropolitan Electric Company, of Chicago, having disposed of all his other electrical interests. All of Mr. Rafferty's friends and customers will be pleased to learn of his new connection, which will afford him ample scope for his energetic work, enabling him to take care of his customers' wants in a befitting manner, and renew old and pleasant trade relations.

The Jewell Belting Company, of Hartford, has recently secured an order from the United Electric Company, of Springfield, Mass., for four 40 in. Jewell dynamo belts each 70 ft. long, to be used in the new station of the United Electric Company, at Indian Orchard. The belts manufactured by the Jewell Belting Company have made excellent records, and have been in use a number of years.

The Composite Brake Shoe Company, of Boston, Mass., writes in regard to its new cork plug shoes, that its standard wooden plug shoes continue to give excellent satisfaction in street railway work, but that for heavy steam railroad service the shoes with cork plugs give better results. It is found that cork expands with heat and also that it gives a higher coefficient of friction than the shoes with wooden plugs.

The Consolidated Car Fender Company, of Providence, R. I., has issued a neat little folder giving the strong points of the Providence fender which is manufactured by this company. It is stated that in 219 accidents on two roads thoroughly equipped with Providence fenders, the fenders have saved the lives of ninety-seven per cent of the persons struck, and ninety-nine per cent of the lives saved were saved without injury.

The Fuel Economizer Company, of Matteawan, N. Y., has recently issued a very neat catalogue of Green's fuel economizer. The catalogue contains a number of illustrations and interesting tests showing the saving in fuel when this device is in use. These tests have proven that the economy effected by the adoption of a Green's economizer varies from ten to twenty per cent of the total fuel consumed, according to the temperature of the gases escaping from the boiler.

The Walker Company, of Cleveland, O., has commenced an assumpsit suit for $15,000 against the Glen Oaks & Prospect Heights Railway Company, Jas. H. Seiberling, Monroe Seiberling, A. G. Seiberling and Fred Patee, all of Peoria, Ill., for breach of contract. The Walker Company contracted with the company and parties named for generators and motors; and without cause, the Glen Oaks Company canceled the contract. The Walker Company is making a test case of this.

Drummond's Detective Agency, of New York, has been very successful in recently securing the conviction of three railway conductors, in Bridgeport, for embezzling fares. The conductors were convicted in the City Court, where a light fine of $5 and costs in each case was imposed. The men took an appeal to the Court of Common Pleas, but the testimony given by the Agency's detectives was so strong that the conductors have decided to withdraw their appeals and pay the fines.

The Cambria Iron Company, of Pittsburgh, Pa., has recently appointed W. McLain agent for the sale of its various Bessemer and O. H. steel products in the vicinity of Pittsburgh, including ingots, blooms, billets and slabs; angles, beams, channels, Z bars, etc.; T rails and fastenings, girder rails and appendages; rounds, squares and flats; cold rolled steel and special shapes. Mr. McLain has an office in Room 818, Park Building, Pittsburgh, and will be glad to answer all inquiries about these articles.

The Berlin Iron Bridge Company, of East Berlin, Conn., has been awarded the contract for a bridge, between Point Pleasant and Manasquan, by the counties of Ocean and Monmouth, N. J. This bridge will be one of the longest highway bridges in the United States and is to be 1910 ft. in length. The Secretary of War has ordered a draw span constructed in this bridge, which will give two clear openings, one of forty-five feet and the other of fifty feet. The Berlin Iron Bridge Company's contract includes the substructure as well as the superstructure for the bridge.

The Philadelphia Engineering Works, Limited, of Philadelphia, Pa., has recently issued a neat catalogue giving details of construction and several testimonials relating to the steel chimneys manufactured by that company. The catalogue contains a number of very fine half tone engravings of several steel stacks recently built by the Philadelphia Engineering Works. The company recently built a steel stack 217 ft. high, for the Ridgewood pumping station at East New York, in the remarkable time of ten weeks. This is said to be the tallest stack in America.

The Goheen Manufacturing Company, of Canton, O., has recently issued a pamphlet giving the report of William Broom, of London, England, on hints and facts relative to the preservation of iron and steel structures. The pamphlet contains a number of valuable suggestions as to the best way of preserving iron and steel from atmospheric influences, rust decomposition, gases, acids, alkalies, etc. The pamphlet also contains a table showing the relative cost of keeping an eighty foot railroad bridge in first class condition for a period of thirty-two years with paint compositions of different kinds.

The Electric Insulating Company, of St. Louis, Mo., manufacturer of the Peerless armature compound is meeting with good success in the sale of its well known specialties. H. H. St. John, the representative of the company in Boston, and F. M. Bernardin, of Kansas City, have been doing an especially good business. As a single instance of the high regard in which Peerless armature compound is held it might be stated that the electrical engineer of Kansas City, Mo., has recently specified that the Peerless armature compound shall be used on the rewinding of all of the armatures belonging to that municipality.

Armature

The Wheeler Rail Joint Company, of Marion, Ind., at a meeting of the directors and stockholders on Jan. 13, elected Geo. W. McNulty president and Jay Willard Clark secretary and treasurer, the old officers retiring from the company. This is actually a reorganization of this company. Major G. W. McNulty is well known among street railway engineers as the builder of the Broadway Cable Railway, New York, and is one of the most prominent street railway engineers in this country. Offices will be opened in New York very soon, and the company contemplates pushing the Wheeler rail joint with all the vigor possible.

D. G. Morton & Julian C. Smith, both of Baltimore, have formed a partnership to carry on a general engineering and contracting business with offices in the Law Building, Baltimore. Mr. Morton was formerly with the Southern Railway, as assistant engineer on construction and later with the Baltimore & Ohio as supervisor of Philadelphia division. Mr. Smith has been for a number of years engaged on street railway construction work in Baltimore and Washington as assistant to A. N. Connett, and was superintendent of the Ninth Street line of the Metropolitan Railroad Company in Washington.

T. E. Lonergan, the founder of what is now known as Thiel's Detective Service (and for the past three years manager of its New York office) has reopened business on his own account under the title of Lonergan's Detective Service, with offices in the Bennett Building, New York. Thirty years' experience in the successful direction of important detective work justifies the promise of efficient service. His staff includes men trained to specialties of life and accident insurance investigations: railway and street railway construction, organization and administration; patent infringements and kindred matters.

The Pennsylvania Steel Company, of Steelton, Pa., has received from the Boston Terminal Company the contract for the steel work of the new Southern Union Station train house. It is a singular coincidence that the Pennsylvania Steel Company built the Northern Union Station for the Boston & Maine Railroad and should now secure the southern station, besides having furnished the steel for three sections of the subway. The southern station is one of the largest contracts of its kind ever placed, involving 14,000,000 lbs. of steel. This would require nearly 600 cars to transport it and would make a continuous train over three miles long. A contract of this kind will give employment to many thousand men for the next six months.

The Ball & Wood Company, steam engine builder, is moving its New York offices from Cortlandt Street, into the new Beard Building, 120 Liberty Street, where the conveniences for transacting business will be very much improved. The company's new rooms are five or six in number and occupy the entire south end of the building, commanding not only plenty of light and air, but also a beautiful view of New York Harbor. This company had occupied its old quarters for some nine years and in moving to new ones will be in good company. Henry R. Worthington, pump manufacturer, and other firms and corporations in similar lines of business, are also tenants of the Beard Building. A cordial invitation is extended to all friends of the company to visit its new quarters.

Charles A. Schieren & Company, of New York, have recently executed a very large order for belting in a remarkably short time. The order was for the People's Electric Light & Power Company, of Newark, which was burned out Tuesday night, Dec. 29. The order was received on Wednesday, Dec. 30, at noon, for 118 ft. of seventy-two inch, three ply leather belting to be put in at the station of the Light Company in complete order at four o'clock Dec. 31. By working several gangs of men all night Schieren & Company were able to complete the job in twenty-eight hours after the receipt of the order. C. A. Schieren & Company have recently received an order for 116 ft. of seventy-two inch, three ply leather belting for the Brooklyn Heights Railroad Company, of Brooklyn, and are also working on an order for 126 ft. of seventy-two inch, three ply leather belting for the North River Electric Light Company, of New York City.

The American Engine Company, of Bound Brook, N. J., shipped during the month of December, 1896, one 60 h. p. American-Ball engine to the Scranton *Truth;* one 50 h. p. motor to the Western Newspaper Union; one 12 h. p. motor to the Western Newspaper Union; one 100 light dynamo to the Chattanooga *Daily News;* one 60 h. p. American-Ball engine to the Albany *Journal;* one 5 h. p. motor to the Gazette Publishing Company; one 12-h. p. motor to the *Toledo Blade;* one 12-h. p. motor to the W. D. Boyce Company; one 9 k. w. dynamo to the Age-Herald Publishing Company; one 9 k. w. to the Dayton *Journal;* one 3 h. p. motor to the Indianapolis *Sun;* one 75 k. w. to the Inquirer Company; one 3 h. p. motor to the Harrisburg *Telegram;* one 9 k. w. dynamo to the Jarecki Manufacturing Company, and one 100 h. p. motor to the Boston *Herald*.

The Gates Iron Works, of Chicago, Ill., announce that they have commenced the manufacture of high speed engines. This company will hereafter manufacture the Fischer-Gates single and four valve self-oiling, automatic engines, built according to the design and under the patents of Fred. F. Fischer. These engines will be handled on the market by Fischer & Whiteside, of Chicago. Plans for additions to the already large plant of the Gates Iron Works are completed and it is intended to push this branch of their business with a great deal of energy. A catalogue illustrating and describing the

novel features of the Fischer-Gates engine, many of which are already familiar to the engineering fraternity, will be ready for distribution in a very short time. Orders for these engines have already been booked, and the company anticipates a very large trade in the near future. The reputation of this concern and of the gentlemen who are associated with it will assure a first class machine and the most cordial and courteous treatment of their patrons.

The Walker Company, of Cleveland, O., received a large order last month for the installation of an electric lighting plant in the Waldorf Hotel. The installation will be, it is said, the largest isolated lighting plant in the world. The expressed wish of the owners of this property in this as in all departments of construction was to secure the best possible material regardless of cost, and the award of the contract to the Walker Company is therefore particularly gratifying. The installation will include as well the largest storage battery plant in the conntry. This will be furnished by the Electric Storage Battery Company, of Philadelphia, and will be made up of chloride plates, fifteen inches square, with a total capacity of 4000 ampere hours at 120 volts and will weigh approximately 90,000 lbs. Three booster dynamos will be used in connection with this battery plant. The Western Electric Company has the contract for these machines as well as for the entire signaling system.

The Hazelton Boiler Company, of New York, reports having recently installed boilers in the plants of the North Adams Electric & Railway Company, North Adams, Mass.; The Bristol & Plainville Tramway Company, Bristol Conn.; The Goodyear Rubber Company, Middletown, Conn.; The Central Railway & Electric Company, New Britain, Conn.; The Equitable Gas Light Company, New York City, and the Lambertville Spoke Manufacturing Company, Lambertville, N. J., aggregating 1600 h. p. The majority of these orders were received from old customers for enlarging their steam plants. The Hazelton Company is now building 400 h. p. for Memphis Light & Power Company, Memphis, Tenn., in whose plant nearly 1000 h. p. of these boilers have been in successful operation for nearly six years. The Hazelton Company is also building a stock of 200 h.p., 250 h.p. and 300 h. p. boilers (these sizes being most popular with their customers) in anticipation of a lively spring trade, and to enable them to give prompt deliveries. Numerous inquiries for prices and recent sales indicate that an active revival of business may be expected in the near future.

The Cutter Electrical & Manufacturing Company, of Philadelphia, has recently issued an extremely handsome and original calendar. The conventional calendar pad is mounted upon a heavy card, 11 ins. × 14 ins. in size, upon which is printed a full detail section drawing of the I. T. E. circuit breaker. All the various metals used in the circuit breaker are printed in their equivalent colors, necessitating on each calendar eight separate impressions. The whole is handsomely embossed and the effect produced is extremely novel and satisfactory. The success which the Cutter Company has met with in the past year in the development of this circuit breaker is extraordinary. Although the company has devoted the best part of five years to the study of circuit breakers, it is only within the past two years that the device has been placed upon the market as an absolute success, electrically, mechanically and also artistically. I. T. E. circuit breakers have been specified in most of the important buildings which have been erected in the course of the past year, and important shipments to various foreign countries have been made. The range of manufacture is large, more than ninety sizes and types of circuit breakers being manufactured.

The Cahall Sales Department, of Pittsburgh, Pa., claims that it is the sole owner of the process of making headers or manifolds and crossboxes for water tube boilers of "flowed" steel. This company claims that "flowed" steel is a special mixture of open hearth steel which is manufactured under a secret formula that belongs to this company alone, and the knowledge of the preparation of which is in the possession of no one except the Penn Steel Castings & Machine Company, of Chester, Pa. The Cahall Sales Department learning that headers and crossboxes claimed to be made of "flowed" steel were being sold by other parties, wrote the Penn Steel Castings & Machine Company, asking if that company had ever furnished "flowed" steel headers to other parties than the Cahall Sales Department. In reply to this inquiry the following letter was received from the Penn Steel Castings & Machine Company: "We beg to state that we consider the special mixture for "flowed" steel we are making for you, your property, of which you have the sole right, and we never have nor never will furnish "flowed" steel to anyone but yourselves unless authorized by you. Neither will we give to anyone any information as to the formula under which this special mixture is made."

William Tod & Company, of Youngstown, O., has recently published a very handsome catalogue descriptive of its improved vertical engines, a number of which are giving very excellent results in electric stations, both railway and lighting. The catalogue is made especially valuable for steam engineers from the fact that over fifty pages are devoted to tables descriptive of the different coals in use in this country, evaporation tables and other tables and formulæ extremely useful in steam engineering. It is a book which would form a valuable addition to the library of any engineer. The company reports an excellent demand for its engines. Among recent orders filled is one for an electric station in New Orleans, where one 600 h. p. and one 1200 h. p., triple expansion, Williams' improved, vertical engines are to be installed. These engines are directly connected respectively to two 200 k. w. and two 400 k. w. General Electric generators. The engines are designed to operate under 160 lbs. initial steam pressure and a twenty-six inch vacuum. Very high economy is expected. The cylinder dimensions of the two engines are respectively 14½ ins., 29 ins. and 37½ ins. × 28 ins. stroke; and 21½ ins., 35 ins. and 55½ ins. × 36 ins. stroke. This is the second order for these engines in this particular station, and shows conclusively that the former equipment is giving good satisfaction.

The Ball Engine Company, of Erie, Pa., states that its vertical engines for electrical service have been received with the greatest amount of favor by those who appreciate merit and good workmanship in an engine. Since Oct. 1 last, its works have been running till ten o'clock every night, and part of the time all night, on account of several large contracts received for vertical engines. Some of these orders are just being completed, among these being a 400 h.p. vertical cross compound engine, arranged for direct connection to 125 k. w. Siemens-Halske generator, which was shipped a few days ago to the Nicopal-Mariopol Mining & Metallurgical Company, Mariopol, Russia, and will furnish electric power to various machinery in the steel works mentioned. The company has shipped to the Chicago Public Library four 200 h. p. vertical cross compound and one 100 h. p. vertical tandem compound engines, each engine being direct connected to two General Electric machines. The form of arrangement and the details of these engines are entirely new, and the plant when erected will be a very complete one. Besides the above the Ball Engine Company has under construction at present one 400 h. p. vertical cross compound engine, and one 150 h. p. vertical cross compound engine, for the Shoenberger Steel Company, of Pittsburgh, Pa., each of which is direct connected to Siemens-Halske generators; also for the Apollo Iron & Steel Company, of Apollo, Pa., one 150 h. p. vertical cross compound engine direct connected to a General Electric alternating lighting machine, both the dynamo and exciter being driven from the shaft of the engine, and arranged on the same base with the engine.

The New Process Raw Hide Company, of Syracuse, N. Y., is receiving a number of very flattering testimonials from its customers. One well known street railway man who is now the manager of one of the leading street railways of the country writes the New Process Raw Hide Company, as follows: "I have used the pinions made by your company on three different roads. The mileage obtained from them has been very satisfactory. The greatest point to be observed however, in the use of your raw hide pinions, is the fact that the raw hide pinion does not perceptibly wear the gear. The gears of electric motors represent the greatest cost of repairs on motors of any mechanical part. It is true that the raw hide pinion usually costs about three times as much as the steel pinion, but steel pinions will wear out a gear within eighteen or twenty-four months. When raw hide pinions are used, it will be found that the gear will last for many years. There are other advantages to be taken into consideration by the applicatien of raw hide pinions. These are, first, that they reduce the noise made by the motor very materially; second, that they are a factor of safety at times when the motorman or driver puts his power on too quickly; third, by their use the gear case is not necessary and, fourth, a saving will be made on the lubricants which are now used in gear cases. Another advantage is that the absence of grease from the gear cases stops the possibility of any grease dropping on the pavements, which in some towns is a source of great annoyance to the people. Raw hide pinions will be found to work better with new gears. It is not fair to the pinion to place it in service with a partly worn out gear."

The Electric Mutual Casualty Association, of Philadelphia, through its attorneys, Taylor, Upton & Smiley, of Niles, O., has just secured a verdict for one of its members in the Common Pleas Court of Trumbull County, O., in the case of Cora Barb *v.* Mineral Ridge & Niles Railway Company and in the case of Aaron Barb *v.* the same road, dismissed by the plaintiff. The facts in the case are the following: On June 30, 1896, the plaintiff, Aaron Barb and wife were in a covered wagon driving along the tracks of the Mineral Ridge & Niles Street Railway, and when at a point midway between street crossings, they suddenly attempted to cross said tracks without taking proper precaution, consequently their wagon was struck by one of the defendant's cars and demolished, and they themselves claimed receiving personal injuries to the amount of $1500 and $2500 respectively, for which amounts they brought suit. The evidence of negligence on the part of the driver Barb was strong, but under the Ohio statutes such negligence could not be imputed to his wife. However, by the skillful introduction of evidence and cross examination on the part of the defendant, it was shown that Mrs. Barb "would not have allowed her husband to drive across there if she thought there was any danger and he had spoken of crossing the tracks at that point and she had consented to it." The Court charged the jury especially as to the significance of the woman's admission and it took but a few minutes for that body to render a verdict for the defendant. Another feature of the trial was the introduction of evidence given by a female detective employed by the Association. She had obtained employment in Mrs. Barb's millinery shop and testified that Mrs. Barb, subsequent to the accident, did all kinds of hard work, such as lifting counters, boxes, etc., and boasted that she was never sick. The trial of the wife's case revealed to the husband that a detective, engaged by the Association, had also been in his employment, to whom he had boasted, since the accident occurred, of his physical powers and his athletic abilities, hence his loss of heart and subsequent dismissal of the case.

New Publications.

THE REPORT OF THE ELECTRICAL COMMISSION OF BALTIMORE CITY. 197 pages.

This is a report of the electrical commission of Baltimore appointed to report on the advantages of a general subway system to be owned by the city of Baltimore. The report contains a large number of fine maps and a number of valuable tables.

GRAPHICAL TABLE OF INTEREST RATES. By A. L. Webster. Published by Harold M. Davis, of New York. Price $1.

This table is printed on a card 11 ins. × 13 ins. and designed to show at a glance the net rate of interest yielded by any security for varying market values, without regard to the time of maturity or date of dividends.

ELECTRICITY IN PATERSON. By Wm. M. Brock. Cloth. 65 pages. Illustrated. Published by Edison Electric Illuminating Company of Paterson, N. J.

This is a treatise for practical men on the use of electric units and the practical application of electric currents, by the general manager of the Edison Electric Illuminating Company, for distribution among its customers and friends.

LES TRAMWAYS ELECTRIQUES. Henri Maréchal. Published by Baudry et Cie., Paris. 203 pages; illustrated. Price. $1.50.

This is a simple treatise, well illustrated, upon the mechanical and electrical sides of the electric railway. The different forms of apparatus used at the present time, both abroad and in this country, are described, and there is less historical matter than in most books of this character. The expenses of installation and operation are taken up in a short chapter at the end of the book.

AUTO-CARS. By D. Farman. Translated from the French by L. Serraillier. 249 pages. Illustrated. Published by Macmillan & Company, New York. Price, $1.50.

This is a carefully written work covering all modern forms of small self propelled and self contained vehicles. Considerable space is given such forms of tram cars as are so operated, e. g., the compressed air, steam, petroleum and accumulator cars, but the book is principally devoted to a discussion of the various forms of horseless carriages now in use. The author is an enthusiast upon the subject, and the chapter on petroleum auto-cars, which the writer believes to be the most desirable of any forms now on the market, is especially complete. The volume is well illustrated.

PRACTICAL HINTS FOR LIGHT RAILWAYS AT HOME AND ABROAD. By F. R. Johnson. 31 pages. Illustrated. Published by Spon & Chamberlain, New York. Price, $1.

The "light railway" system so extensively developed abroad, especially in Europe and in the English colonies is practically unknown in America. These railways, as the term is generally understood abroad, are of narrow gauge, rarely over thirty-nine inches, often not more than thirty inches and sometimes with a gauge of only eighteen inches. Steam power has been the universal power used, and usually the carrying of light freight has constituted the major part of their business. Mr. Johnson's book gives valuable hints as to cost, general methods of track construction, station equipment and operation and the text of the recent law passed by the Government of India upon the construction of such lines. Electric railways take the place, largely, of such lines in America, and it would seem that electric power could be used to good advantage upon some of these lines abroad.

Trade Catalogues.

AIR BRAKES. Sixteen pages. Illustrated. Published by the Standard Air-Brake Company, of New York City.

CATALOGUE. 127 pages. Illustrated. Published by the Clonbrock Steam Boiler Company, of Brooklyn. N. Y.

ENGINES. Twenty-eight pages. Illustrated. Published by the Philadephia Engineering Works, Ltd., of Philadelphia.

GREEN'S ECONOMIZER. Eighty pages. Illustrated. Published by the Fuel Economizer Company, of Matteawan, N. J.

H. W. J. ELECTRIC HEATERS. Sixteen pages. Illustrated. Published by H. W. Johns Manufacturing Company, New York.

WILLIAMS' IMPROVED VERTICAL ENGINE. Eighty pages. Illustrated. Cloth. Published by William Tod & Company, Youngstown, O.

Annual Reports.

WEST CHICAGO STREET RAILROAD COMPANY, OF CHICAGO, ILL.

Year ending Dec. 31,	1895.	1896.
Total receipts	$4,201,477	$4,018,948
Operating expenses	2,267,195	2,138,378
Earnings from operation	1,934,281	1,880,569
Deductions from earnings	902,015	1,016,114
Net income	1,032,266	864,455
Dividends paid	791,340	791,340
Surplus	240,926	73,115
Per cent. op. exp. to total receipts	53.9	53.2
Operating expenses per car mile.		
Cable		$.1388
Electric		.1069
Horse		.2077

CHICAGO CITY RAILWAY COMPANY.

Year ending Dec. 31,	1895.	1896.
Total receipts	$4,476,824	$4,808,866
Operating expenses	2,807,726	2,977,208
Earnings from operation	1,669,098	1,831,658
Deductions from earnings	207,877	389,446
Net income	1,461,221	1,442,213
Dividends paid	1,140,000	1,289,787
Surplus	321,221	152,425
Per cent op. exp. to gross receipts	62.8	61.9

The total number of passengers carried in 1896 was 95,238,915, an increase of nearly 6,500,000 over the previous year, while the increase from 1894 to 1895 was 4,000,000. Of the total traffic last year 46,435,411 was carried on cable lines, 45,928,873 on electric lines and 2,874,631 on horse car lines, showing a decrease of 4,043,985 for the cable lines, a decrease of 6,924,418 for horse car lines and an increase of 17,400,857 for the electric lines. The total increase in the number of car miles run during the year was 2,611,000 being an increase of 4,491,260 miles for electric and a decrease of 1,880,260 for horse and cable lines.

NORTH CHICAGO STREET RAILWAY COMPANY, OF CHICAGO, ILL.

Year ending Dec. 31.	1895.	1896.
Total receipts	$2,780,487	$2,913,710
Operating expenses	1,312,107	1,394,387
Earnings from operation	1,468,379	1,519,322
Deductions from earnings	471,251	524,231
Net income	997,127	995,091
Dividends paid	659,922	758,901
Surplus	337,205	236,190
Per cent op. exp. to gross receipts	48.7	49.3
Operating expenses per car mile.		
Cable	$.1255	$.1300
Electric	.1100	.1250
Horse	.2000	.2200

TORONTO STREET RAILWAY COMPANY, OF TORONTO, CAN.

Year ending Dec. 31,	1895.	1896.
Total receipts	$992,801	$997,273
Operating expenses	489,915	507,760
Earnings from operation	$502,886	$489,513
Per cent op. exp. to total receipts	49.3	50.9

List of Street Railway Patents.

U. S. PATENTS ISSUED DEC. 29, 1896, TO JAN. 19, 1897, INCLUSIVE.

DEC. 29.

CAR FENDER.—Matthew Rings, Seattle, Wash. No. 574,044.

CAR FENDER.—W. M. Watts, Philadelphia, Pa. No. 574,081.

A depending barrier comprising a series of lazy tong levers, a support for the upper edge of the said barrier adapted to be secured upon a car, a basket secured to the lower edge of said barrier, and a rock frame for the said basket.

COMBINED FENDER AND BRAKE MECHANISM.—A. L. Kraus, Peabody, Mass. No. 574,097.

A storage tank, and means for charging the same with a fluid, brakes for the wheels, mechanism for setting the brakes by fluid pressure from the tank, comprising cylinders and pistons, a pipe connection from the cylinders to the tank, a valve in the pipe, a lever for actuating the valve, a hinged fender, a connection between the fender and valve actuating lever, and adjustable means for supporting the fender in different positions and for limiting the movement of the valve lever.

ELECTRIC CAR BRAKE.—E. A. Sperry, Cleveland, O. No. 574,120.

In an electric brake, the combination with brake magnets, a storage battery, circuit connections for supplying the magnets and the battery with current from the motor, means for automatically cutting the battery out, when the armature current falls below a predetermined potential, and means for connecting the battery with the brake magnets.

ELECTRIC RAILWAY.—J. A. Roche, Chicago, Ill. No. 574,171.

A supply conductor, a plurality of pivotally supported insulated conductor sections, stationary and movable contact pieces, said con-

tact pieces being located at the side of the conductor sections opposite the pivotal axes of the same, and oscillating arms which are rigidly attached to and move with the conductor sections and which carry the movable contact pieces.

AUTOMATIC CAR SIGNAL.—D. W. Troy, Montgomery, Ala. No. 574,182.

An alarm for attachment to street cars, and an intermittently actuated mechanism for operating the said alarm or signal automatically from the car axle, and provided with means for holding it active while the car is passing over a predetermined distance, whereby the signal or alarm may be actuated at and across the street crossings.

CAR FENDER.—C. E. Rice, Little Rock, Ark. No. 574,344.

A car fender having a pick-up, consisting of an endless rearwardly moving apron, having a body portion of strong fabric and an upper covering of sheet metal, having numerous points or projections struck upwardly therefrom, and carrying and driving rollers for said apron.

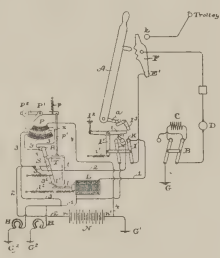
TROLLEY.—N. D. Stanley, Essex, Vt. No. 574,345.

JAN. 5.

ELECTRIC RAILWAY TROLLEY.—E. M. Bentley, New York, N. Y. No. 574,377.

Consists of a supporting arm upwardly spring-pressed, a guideway on the outer end of said arm, a pivoted tip or end section movable on said guideway, a contact wheel on its outer end, and a spring for pressing said wheel into engagement with a line conductor.

PAT. NO. 574,377.



PAT. NO. 574,120.

CAR FENDER.—J. B. Thompson, Philadelphia, Pa. No. 574,462.

CAR FENDER.—D. Rice, Canton, O. 574,494.

Net carrying bars, having shouldered recesses at their rear ends, yielding supports for connecting the said bars to the platform of a car, fixed pins carried by the car for engaging the shouldered recesses, and the lever for actuating the fender to lower it into or raise it out of contact with the track.

TRUCK FOR MOTOR OR CABLE CARS.—H. L. Gee, Kingston, N. Y. No. 574,532.

FENDER FOR STREET CARS.—L. J. Hunter, Covington, Ky. No. 574,541.

RAILWAY TRACTION SYSTEM.—W. M. Caldwell, Seattle, Wash. No. 574,599.

A trough-shaped rail having complimentary and downwardly converging tread surfaces, and a rail having a horizontal upper tread surface, with a frog or incline placed within thetrough of the first named rail.

GEARING FOR CAR TRUCKS.—L. E. Walkins, Boston, Mass. No. 574,646.

A pair of drums, an intermediate driving pulley, and an adjustable idler pulley, with a crossed drive-chain engaging with the drums, the driving pulley and the idler.

CAR FENDER.—J. R. Jacques, St. Paul, Minn. No. 574,735.

CAR BRAKE.—J. C. Devlin, Hernando, Mass. No. 574,787.

A four wheeled truck having brakes adapted to move horizontally against each of the wheels, a transverse rock shaft mounted in bearings adapted to permit bodily lateral movement and provided with suitable rigid arms, near each end, rods connecting the arms at each end, respectively, to the brakes swinging against the corresponding wheels, and means for rocking said rock shaft.

TROLLEY.—W. L. Pepper, Philadelphia, Pa. No. 574,819.

LIFE-GUARD FOR STREET CARS.—A. J. Thornley, Pawtucket, R. I. No. 574,833.

A front guard normally raised and a wheel guard raised normally, and mechanism for dropping said guards, with means for dropping one of said guards indendepently of the other.

JAN. 12.

SAFETY-GUARD FOR STREET CARS.—G. T. Foster, Rochester, N. Y. No. 574,898.

CAR FENDER.—I. D. Moser, Philadelphia, Pa. No. 574,928.

EXTENSION STEP FOR CARS.—D. L. White, Cincinnati, O. No. 574,969.

A step frame, pivoted within the angle of the step and adapted to rotate into position above or below its pivot; and a step frame hinged thereto adapted to swing into position of use of the first frame when the latter swings into a position of non-use.

CAR TRUCK FRAME.—Edw. Cliff, Newark, N. J. No. 574,983.

CAR FENDER.—W. H. Russel, New City, N. Y. No. 575,010.

A fender for a car having a frame, and front bar, formed of thin sheet metal secured to the frame at its lower edge, inclined back at its upper edge, and rounded at its ends which project beyond the track rails, said front bar being oblique to the track rails.

CAR FENDER.—O. W. Brenizer. Allegheny County, Pa. No. 575,023.

ELECTRIC RAILWAY.—L. Dion, Natick, Mass. No. 575,053.

ELECTRICAL PROPULSION FOR RAILWAY CARS.—L. Dion, Natick, Mass. No. 575,054.

Consists of a main electrical conductor having its upper surface grooved longitudinally, and a flexible, helically formed auxiliary electrical conductor adapted to normally rest in the groove of the main conductor.

CAR FENDER —J. A. Erkson, Prattsville, N. Y. No. 575,058.

TROLLEY-HEAD FOR ELECTRIC CARS.—W. S. Troutwine, Indianapolis, Ind. No. 575,080.

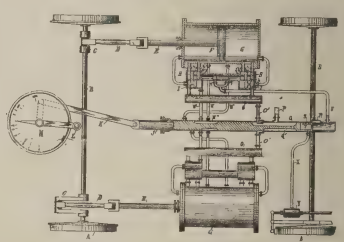
Has the inside notches, a scraper having its end inserted in the notches in the trolley head, and secured in the head by means of the axle on which the trolley wheel ordinarily is mounted, said scraper having an upwardly projected portion extending beyond the trolley head into contact with the wire and terminating with a hollow or notch to keep the scraper on the wire.

JAN. 19.

ELECTRIC RAILWAY.—W. Grunow, Jr., Bridgeport, Conn. No. 575,346.

Comprises a metal trough, a flexible cover or top, composed of flexible metal plates, each of which is secured to the sides of the trough and to the depressible rail, said plates being curved inwardly at their adjacent edges, and securely bolted between strips of insulating material between which is placed a depressible contact rail on a level with the surface of the track, said conduit being also provided with a conductor situated in the bottom of the conduit and in proximity to said contact rail.

CAR FENDER.—T. E. Gregg, Marlborough, N. Y. No. 575,396.



PAT. NO. 575,652.

CONTROLLER FOR AIR MOTORS.—W. H. Knight, New Brighton, N. Y. No. 575,652.

A motor provided with fluid-actuated main and cut-off valves and a fluid chest or holder, a controller valve comprising a throttle valve and cut-off controller valve.

CAR FENDER —M. P. Crawford, Roanoke, Va. No. 575,676.

Consists of a scoop or fender proper, supporting arms or levers and the upper fixed sections and the lower hinged section, the spring supports for said arms or levers, the presser bar and foot piece.

MOTOR SYSTEM.—M. E. Clark, Worcester, Mass. No. 575,681.

A receiver for storing compressed air, an engine attached to the vehicle, adapted to be actuated by the air in said receiver and operatively connected with the axles of the vehicle, a plurality of air compressors adapted to be operated by the axles, and suitably connecting and operating mechanism whereby any or all of said compressors may be worked when the brake is applied, and at other times may be at rest.

We will send copies of specifications and drawings complete of any of the above patents to any address upon receipt of fifteen cents. Give date and number of patent desired. THE STREET RAILWAY PUBLISHING COMPANY, HAVEMEYER BUILDING, NEW YORK.

Financial Notes.

Auburn, N. Y.—The Auburn & Western Railway Company has been incorporated to build and operate an electric railway eleven miles long, from Auburn to the village of Seneca Falls. The directors are Robert Wetherill, of Chester, Pa.; William C. Gray, Jr. and Norman H. Becker, of Seneca Falls; George B. Longstreet, of Auburn; George B. Leonard, William P. Goodelle, W. A. Holden, Hiram W. Plumb and C. D. Beebe, of Syracuse. The company's principal office will be in Auburn.

Boston, Mass.—The West End Street Railway Company will issue $2,700,000, twenty year four per cent bonds.

Bradford, Pa.—The Olean, Rock City & Bradford Electric Railway Company has been organized by H. L. Pierce, of Leominster, Mass.; Frank E. Lowe, of Greenfield, Mass., and other Eastern capitalists, to build an electric railway from Olean to Bradford over the abandoned narrow gauge branch of the Western New York & Pennsylvania Railroad. The company will be incorporated shortly and it will begin construction work on its line as soon as all difficulties are removed. Capital stock, $100,000. Offices, Olean, N. Y.

Brooklyn, N. Y.—The Brooklyn Heights Railroad Company reports earnings as follows:

Year ending Dec. 31,	1895.	1896.
Gross receipts	$4,171,460	$4,733,182
Operating expenses	2,821,501	2,636,153
Earnings from operation	$1,349,959	$2,097,029
Deductions from earnings	2,056,717	2,007,424
Net income	$ 706,758*	$ 89,605

*Deficit.

Burlington, Ia.—The bondholders of the Burlington Electric Railway Company have filed a petition in the district court of Des Moines County, asking that the mortgage on this corporation to the amount of $280,000 be foreclosed, and that the property be sold for the benefit of the bondholders. The suit is brought in the name of the American Loan & Trust Company, of New York, which holds a trust deed to secure $300,000 indebtedness.

Charleston, S. C.—The Charleston City Railway Company has declared a dividend of 1½ per cent.

Chicago, Ill.—The Metropolitan West Side Elevated Railroad Company will issue $5,000,000 first mortgage bonds, in addition to the $10,000,000 outstanding, and it will also issue an additional $12,412,100 of common stock. This will make the capitalization of the company $15,000,000 first mortgage five per cent bonds, and $15,000,000, common stock.

DICKINSON MCALLISTER, of Chicago, has been appointed receiver for the Metropolitan West Side Elevated Railroad Company on the application of Adrain Iselin, Jr., and George G. Haven, representing the New York holders of $15,000,000 of the company's mortgage bonds. It is understood that a judicial sale will soon follow the receivership, and that a reorganization will be effected in the interest of the bondholders.

Columbus, O.—The Columbus Street Railway Company reports earnings as follows:

Year ending Dec. 31,	1895.	1896.
Gross receipts	$629,995	$631,323
Operating expenses	311,594	308,445
Earnings from operation	$318,401	$322,878

THE directors of the Columbus Street Railway Company have declared a dividend of one per cent, payable Feb. 1.

Dallas, Tex.—The Dallas City Street Railway Company will issue $150,000 six per cent gold bonds to cover the expenses of equipping the remainder of its road with electricity.

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of the following countries, comprising practically all the railways of the world, offers an interesting subject of study, namely: Europe, 144,380 miles; Great Britain (England, Scotland, Ireland and Wales), 20,325 miles; United States, 179,784 miles, exceeding the combined lines of Europe and Great Britain; Canada, 15,113 miles; Mexico, 6,625 miles; South and Central America, 21,302 miles. Total, excepting the United States, 207,745 miles. Grand total, 387,529 miles. It should make any manufacturer of Railway Supplies proud to be able to say that he is selling one-half the railways (in mileage) of the United States. It should make him feel quite comfortable to be able to say that, leaving out the United States and Europe, he is selling more mileage than the rest of the earth contains.

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Detroit, Mich.—It is reported that Tom L. Johnson, of Cleveland, and his associates, of the Detroit Electric Railway Company, have now secured full control of the Detroit street railway lines by the purchase of the control of the Fort Wayne & Belle Isle Railway at a price stated to be $1,100,000. The road has $400,000 capital stock and a like amount of bonds outstanding.

Fallsburg, N. Y.—The Fallsburg & Monticello Railroad Company has been incorporated to operate a railway by electricity or other motive power, excepting steam, over the Monticello and Fallsburg Turnpike Road. The directors of the company are B. Van Steenbergh, J. H. Devbe, C. B. Harris, William Dean, John A. Cartlidge, J. H. Van Steenbergh, W. A. Topping, W. C. Bucklen and Lester Rock. Capital stock, $75,000.

Frederick, Md.—A mortgage for $70,000 from the Frederick & Middletown Electric Railway Company to the Maryland Trust Company, of Baltimore, has been placed on record. The money will be used to pay off the floating debt of the company and to make some necessary improvements.

Gettysburg, Pa.—Judge Dallas has made an order in the United States Circuit Court for the taking of testimony with the view of the presentation of a decree for the forclosure of a mortgage given by the Gettysburg Electric Railway Company to the Fidelity Insurance, Trust & Safe Deposit Company, of Philadelphia, to secure $200,000 of bonds.

Glens Falls, N. Y.—At a meeting of the Board of Directors of the Glens Falls, Sandy Hill & Fort Edward Street Railroad Company, the usual quarterly dividend of 1¼ per cent was declared, payable Feb. 1.

Hamilton, O.—The Cincinnati & Miami Valley Traction Company has filed a mortgage in favor of the Finance Company, of Philadelphia, for $650,000. The mortgage covers the entire prospective equipment of the company's road.

Holyoke, Mass.—The directors of the Mt. Tom Railroad Company have decided to lease their electric railway up Mt. Tom to the Holyoke Street Railway Company as soon as it is completed, which will probably be this summer, and the stockholders of the latter company have ratified this lease. The tracks of the street railway Company will be extended to Mountain Park, a distance of ½ mile, so as to connect with the road up the mountain. This road will be similar to the Lookout Mountain road at Chattanooga, that is, there will be two cars operated by electricity, but as a safety device a cable will be attached to each car and will pass over a large drum at the top, thus allowing each car to balance the other. The road will run diagonally up to the south point of the mountain, making a line of about a mile in length, the rise during that distance being about 700 ft. By blasting and filling the grade can be made tolerably uniform, the steepest grade being twenty-four per cent and the easiest fourteen per cent. Wm. S. Loomis, president of the street railway company, is also president of the Mt. Tom Company.

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Henderson, Ky.—The Henderson Electric Street Railway Company has filed a mortgage for $60,000 to the Louisville Trust Company, the object being to refund the present indebtedness of the company and extend its lines one mile.

Kansas City, Mo.—The North East Electric Railway Company has filed a deed of trust to secure the payment of $250,000 bonds issued to the Trust Company of North America and Edmund G. Vaughn as trustee for the bondholders, for the improvement of the road. The deed includes all the property of the new company.

Lancaster, Pa.—Newspaper reports state that George A. Lee, of Buffalo, representing a company of Buffalo capitalists, is negotiating for the purchase of the system of the Pennsylvania Traction Company. The Buffalo syndicate already controls $300,000 of the company's stock.

Lawrence, Kan.—Judge Benson has issued an order directing the receivers of the Lawrence Transportion Company to sell the property of the company at as early a date as possible.

Muskegon, Mich.—Herbert Payson, of Portland, Me., John Crosby, of Bangor, Me., and Weston Thompson, of Brunswick, Me., have bought the property of the Muskegon Railway Company on second mortgage bonds forclosure, paying for it $3700, the expenses incurred since the receivership. The property is taken subject to a $200,000 first mortgage. They will at once reorganize the road.

New Haven, Conn.—The Fair Haven & Westville Railroad Company will issue $300,000 new capital stock for the purpose of paying for the New Haven & Centerville Horse Railroad, recently purchased.

New York, N. Y.—The National Underground Cable Company has filed with the Secretary of State a certificate of increase of its capital stock from $200,000 to $500,000.

Norfolk, Neb.—The Norfolk Street Railway has been sold to H. H. Patterson and E. A. Bullock.

Northampton, Mass.—The Northampton Street Railway Company has declared a semi-annual dividend of five per cent.

Ottawa, Ill.—The Ottawa Electric Street Railway Company has been reorganized after a lapse of several years, by Boston, Chicago and Ottawa capitalists, with a capital stock of $100,000. The officers are: president, W. P. Ellis, of Boston; vice-president, M. T. Moloney, of Ottawa; secrerary and general manager, George P. Paul, of Chicago, treasurer, Al F. Schoch, of Ottawa. It is expected to have the road open for business by Mar. 1.

Philadelphia, Pa.—The Hestonville, Mantua & Fairmount Passenger Railway Company reports earnings as follows:

Year ending December 31,	1895.	1896.
Gross receipts	$523,212	$549,896
Operating expenses	315,762	294,626
Earnings from operation	$207.450	$255,270
Deductions from earnings	97,966	119,620
Net income	$109,484	$135,650
Dividends paid	32,034	65,170
To surplus account	$ 77,450	$ 70,480

Racine, Wis.—The Belle City Street Railway Company has been placed in the hands of Hiram J. Smith as receiver.

St. Louis, Mo.—Reports state that Robert C. Barr, of East Orange, N. J., has purchased the lines of the People's Railroad Company and the Fourth Street & Arsenal Railway Company and will equip them with electricity. At present, the first mentioned road is operated by cable and the second by horses.

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Salem, Ore.—The property and franchises of the Salem Consolidated Street Railway Company have been sold under foreclosure proceedings of the second mortgage to A. L. Barbur, of Portland, for $15,000. The company will be reorganized soon.

San Diego, Cal.—The Citizens' Traction Company has filed a mortgage on all of its property and franchises to the Union Savings Bank & Trust Company, of Cincinnati, for $80,000.

Sandusky, O.—Judge Buckland of the Common Pleas Court has appointed Clark Rude receiver of the Sandusky Street Railway Company on the application of a number of local bondholders of the company. The petition alleges that the company is insolvent and unable to pay its accounts. It also is learned that there is now thought of consolidating the Sandusky Street Railway Company and the People's Electric Railway Company.

Savannah, Ga.—The property and franchises of the Electric Railway Company of Savannah have been sold at auction by the United States Marshal for $210,000 to Herman Myers, of Savannah, and J. H. Fall, of Nashville, representing a syndicate of New York bondholders. The bonded indebtedness of the company is $600,000. The company will be reorganized at once, and a large amount of money spent for new equipment.

Seattle, Wash.—The Seattle Traction Company has been incorporated by Jacob Furth, George B. Blanchard, Manson F. Backus, William A. Walthew, John W. Cathcart, John R. Walthew and Maurice F. Cheal as a reorganization of the Seattle Consolidated Street Railway Company, which was sold recently at public auction. The new company will put the road in first class condition. Capital stock, $1,000,000.

Steubenville, O.—It is reported that the Steubenville Traction Company is negotiating with the Wheeling & Lake Erie Railway for the lease of its Ohio River division between Steubenville and Warrenton, a distance of fourteen miles. If the lease is made, the traction company will equip the steam road with electricity.

Utica, N. Y.—At the annual meeting of the Utica Belt Line Street Railroad Company, the proposition to lease the railroad and park of the Utica Suburban Railway Company for a term of ninety-nine years, and a rental to guarantee the issue of $50,000 five per cent first mortgage bonds on the company, was carried by a large vote.

Westbrook, Me.—An electric railway from Westbrook to Harrison by way of Gorham, South Windham, North Windham, Raymond, Casco and Naples is projected.

West Chester, Pa.—A mortgage for $600,000, given by the Chester County Central Railroad Company to the Fidelity Insurance, Trust & Safe Deposit Company, of Philadelphia, to guarantee the payment in gold of an issue of $600,000 five per cent bonds, has been filed in the office of the Recorder of Deeds. It is announced that over $100,000 worth of the bonds have already been taken, and that the construction of the road will be commenced in a short time. The line will be twenty-two miles in length.

Youngstown, O.—The Mahoning Valley Electric Railway Company has placed a mortgage on record at Youngstown to the Central Trust Company, of New York, for $1,200,000. The amount will be used in taking up bonds aud making extensive improvements to its lines.

Over a Thousand Miles

A WEEK DOES CAPT. PEABODY TRAVEL.

Captain W. W. Peabody, Vice-President and General Manager of the B. & O. S. W., traveled last year, in his private car, the Ohio, just 54,419 miles. The record was kept by C. A. Tonay, who has been in the Captain's private office for eleven years, and who accompanies him on his travels. He keeps a daily record of the car's movements, and can show at just what point on the road the Captain was at any time during the past ten years while out on his car. In 1889 the car, with the Captain, traveled 59,850 miles; in 1890, 43,940 miles; in 1891, 46,682 miles; in 1894, 60,311 miles, and in 1895, 53,230 miles. This record is hardly equalled by any railroad man in the West, and is equal to going twice around the world every year, and half way back again.

For Traveling Salesmen.

W. N. Mitchell, Commercial Freight Agent of the Baltimore & Ohio at Atlanta, has hit on a novel plan of popularizing the B. & O. with the knights of the road by providing accommodations for them during their stay in Atlanta. Mr. Mitchell does not run a hotel and provide sleeping accommodations, but he gives them practically everything else at his office, 40 East Alabama St., as the following invitation received in the city to-day will show:

Knowing that there are a large number of your fraternity that visit Atlanta soliciting orders, but do not remain over night, merely spending the day in our city, and feeling some doubt when you start out as to where you will have your mail sent, I have had a part of my office fitted up for your accommodation and invite you cordially to make use of it. You will find a desk, stationery and an initial rack for your convenience. I extend to you, one and all, whether you stay a day or longer, a most cordial welcome, and assure you that if you desire to accept my offer, that your mail will be taken care of, and you will have a cosy place for your headquarters during your stay in our city.

EMERSON McMILLIN. HENRY B. WILSON

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Street Railway Journal.

Vol. XIII. *NEW YORK AND CHICAGO, MARCH, 1897.* *No. 3.*

STREET RAILWAY SYSTEM OF SYRACUSE, N. Y.

The city of Syracuse, located in the central part of New York State, 149 miles by railroad from Buffalo, and the same distance from Albany, is the center of an extensive trade, including grain, lumber, and other staples, and is also the site of a number of manufacturing industries, prominent among which, during recent years, has been that of bicycles. The manufacture and export of salt has, however, been the most important industry of the city for a long time. The salt springs have been worked for more than 200 years and the business has steadily increased, until now the product amounts to about 10,000,000 bushels annually. The population of the city has grown from 28,000 persons in 1860, to over 88,000 in 1890, and it is now very close to the 100,000 mark.

The city has had an interesting history, from a street railway standpoint. The principal line, up to a year or so ago, was the Syracuse Consolidated Street Railway Company, which had rather an unfortunate financial experience. This road was chartered in 1890 and was formed by the consolidation of some eight smaller roads, but in December, 1893, owing to default in interest charges, it was placed in the hands of a receiver. Early last year the property was sold under foreclosure sale and was purchased by a strong financial syndicate, among which were several prominent banking firms of New York. The system was then reorganized, consolidated with the Syracuse Street Railroad Company, which at that time had nearly the same mileage as the Consolidated Company, and the name changed to the Syracuse Rapid Transit Railway Company. Since the reorganization the work of reconstruction of track and re-equipment of the entire road has been carried on on a very extensive scale, with the avowed purpose of making the system as efficient as possible. Much of the track and overhead line was completely changed, part of the duplicate mileage, due to the fact that two competing systems were formerly in service, was taken up, and the line has been extended in a number of directions. The system presents now, therefore, an example of practically a new line furnished with modern equipment in power station, track and rolling stock.

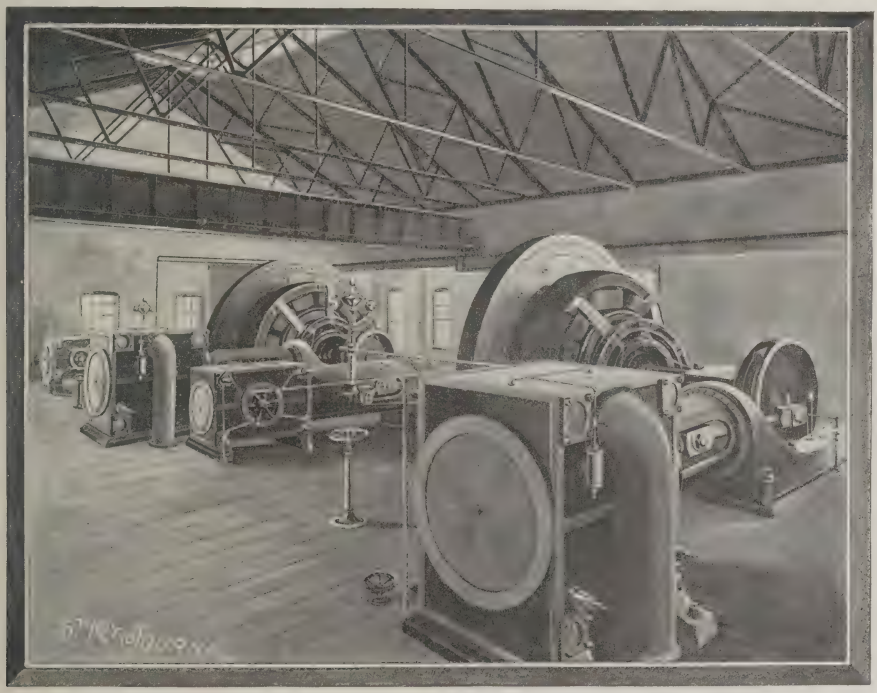


FIG. 1.—INTERIOR OF POWER STATION—SYRACUSE RAPID TRANSIT RAILWAY CO.

POWER STATION.

The power station, as shown on the map (p. 136), is located near the center of the system, about thirty feet from the Erie Canal, from which the feedwater and water for condensing purposes is taken. The station is a brick

structure and is in two bays at present current is being furnished to the cars from the old station equipment. In the new addition which has recently been completed, an entirely new equipment has been installed with capacity for supplying current for the entire line. The new equipment has been installed under the direction of Sheaff & Jaastad, the well known engineers, who acted as electrical engineers of the new station. F. S. Pearson was consulting engineer.

An exterior view of the station, which is given in Fig. 3, shows the large stack, which is the largest in that part of New York State. It is of brick, 170 ft. in height, and with a 7 ft. flue. The station is of brick with iron frame, erected by Riter & Conley.

In laying the foundations for the building and machinery, a space was excavated to a space of ten feet below the water level in the canal. Here a bed of stiff clay was found making a most desirable bed for the support of the foundations. Upon this clay a bed of concrete, seven feet thick and extending over the entire area covered by the power station, was laid. The foundations for the generators and engines were then erected upon this.

Coal is received from the tracks of the New York Central Railroad, a siding from which is carried on a trestle which extends entirely through the boiler room, as shown in Fig. 2. The fuel is then dumped from the cars on to the floor, whence it can be fed into the boilers. The ashes are removed by manual labor to the entrance of the boiler room, whence they are taken for filling purposes.

The new equipment of boilers consists of 1500 h. p. of Stirling boilers in 250 h. p. units. The old equipment is composed of 1000 h. p. of return tubular boilers, supplied by the Cleveland Ship Building Company. These

FIG. 2.—METHOD OF DUMPING COAL IN BOILER ROOM.

are in four units, of 250 h. p. each. Worthington and Snow pumps are used.

The piping system is illustrated in Fig. 4. As will be seen, while not in duplicate, each engine is fed directly from the steam main, so that it can be cut out of service at any time. Each engine can also be operated with the high or low pressure cylinder independently, by use of a reducing valve. It can also be run either non-condensing or condensing, as conditions may require. A steam pressure of 125 lbs. is used.

A view of the new portion of the engine room is given in Fig. 1. Here are contained two independent direct connected units. The engines are of the Allis type, with cylinder dimensions 26 ins. and 50 ins. × 48 ins., are cross compound and at one quarter cut-off will develop 1000 h. p.

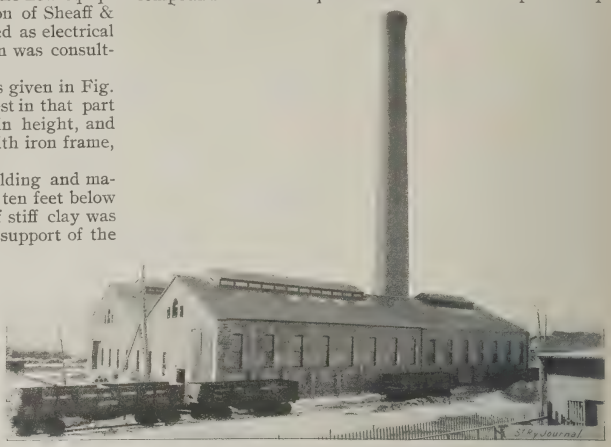


FIG. 3.—EXTERIOR OF STATION.

each. An interesting feature of these engines is their use of plate steel flywheels. A cross section and half side vertical section and elevation of this flywheel are given in Fig. 5. As will be seen, the wheel is made of a large number of rolled plate segments bolted together. The speed at which this wheel will run is 80 r. p. m. The total weight of the flywheel is distributed approximately as follows:

Center cast iron	20,000 lbs.
Web	30,000 "
Rim	50,000 "
Total	100,000 lbs.

The hub shown in Fig. 5 is 7 ft. in diameter with 22 in. bore and is fitted at one side with brackets to hold the armature of the 800 k. w. generator. To the center of this hub are connected the web plates, sixteen in number on each side, or a total of thirty-two, extending to the extreme outside diameter of the wheel. These plates are 1 in. in thickness and are faced along their edges so as to form a good joint. Outside of these segments are two circular plates, bolted through each segment by five 1½ in. bolts and through both plate and hub by three 2½ in. bolts. The segments are braced by truss pieces 1 in. in thickness by 8 ins., held in the center by two 1¾ in. cross bolts which act as struts. The center of the rim between the web plates consists of eleven 1 in. plates each 7 ft. 4 ins. long and 22 ins. deep joining on the ends, as shown in the engraving. Each plate covers six joints of other plates and no joints occur where the web plates join. Outside of the web plates surrounding the rim is a strip of 1 in. plate, 12 ins. in depth, riveted through the rim every 12 ins. and outside of this is another strip of 1 in. plate, 5 ins. in depth, also riveted through the rim.

The rims of the wheels were turned down after the wheels were assembled on the shaft. To accomplish this a circular internal rack was bolted to one side of the wheel and the wheel was then slowly revolved against a turning tool.

The generators are of the Walker type, and of 800 k. w. each. The armature is bolted direct to the cast iron hub of the flywheel, and is also keyed on to the engine shaft. The frame of the generator is mounted on slide ways, so that it can be slid parallel with the shaft and so provide access to the armature should occasion require.

The switchboard is of the panel type, and consists of five Walker Company's panels, and seven General Electric Company's panels for the generators in the old portion of the equipment. The condenser is of the Allis vertical, independent jet type and the main feedwater heater is of the Wheeler type, and the auxiliary heater of the Goubert type. The piping is entirely below the floor. A Sweet direct separator and a gravity return system are used. The station also contains a twenty ton traveling crane.

The piping was installed by the Walworth Company.

The feedwater, which for the new portion of the equipment is taken from the Erie Canal, was considered too impure for use directly in the boilers. It is therefore, first passed through an electric purifier manufactured by the Consolidated Purifier Company. This purifier acts electrically upon the feedwater and will, it is claimed, precipitate the impurities therein and deposit them in a drum from which they can be drained.

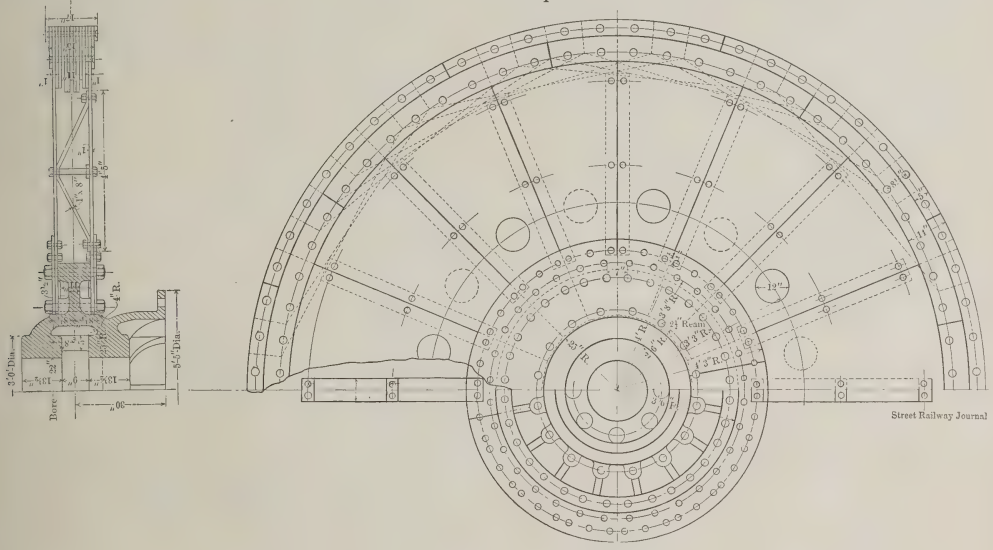


FIG. 5.—PLATE STEEL FLYWHEEL.

The old portion of the station consists of three vertical cross compound engines built by the Cleveland Ship Building Company, and with cylinder dimensions 16 ins. and 31 ins. × 24 ins. The engines operate at 150 r. p. m. each, and are belted directly to one G. E. 300 k. w. generator. The engines are used with a surface condenser to avoid possible trouble from foul feedwater.

The capacity of the present surface condenser being inadequate to the recent output of the plant, an auxiliary air condenser for temporary use until the new portion of the station shall have been completed, was recently erected by the company. This condenser is contained in a tower 25 ft. × 10 ft. × 18 ft. high, and is made of short sections of tile. Air is forced through this by means of two fans, one forty-two inches and the other six feet in diameter, the former being used as a relay. These fans are operated respectively by a W. P. and a G. E. 1000 motor.

TRACK CONSTRUCTION.

The track construction previous to 1893, upon the system now forming the Syracuse Rapid Transit Railway, shows various types of materials and construction. The first railway track was built in 1860 and from that time until the summer of 1893 rails of all weights and sections, beginning with a twelve pound T, including various sections and weights of tram and girder rails, were used.

In 1890 the Johnson girder section No. 161, 66½ lbs., was selected as the section to withstand the traffic of electric traction. The rail was laid on chairs spiked to ties spaced five feet center to center, no ballast other than earth being used. The bonding was riveted No. 6 copper wire, a supplementary wire of the same size being laid.

During the summer of 1893 4500 lin. ft. of single track of seven inch rail was laid. This section of rail weighing eighty pounds and having a tram head, was laid on ties spaced three feet centers. Earth ballast was used. This rail was laid upon a part of the system operated during the summer season, and at present is in good condition.

In the fall of 1894, the first nine inch rails were laid. The rails were the Johnson Company's section No. 206, ninety pounds, and the Wharton Company's section No. 2, ninety pounds, and were in lengths of thirty feet. The joints were thirty inches long fastened by twelve one inch bolts provided with nutlocks. The ties used were sawed oak 6 ins. × 8 ins. × 7 ft. The ballast used was broken stone of such a size as would pass a two inch ring. The type of construction was as follows: a trench eighteen feet wide and twenty-one inches deep was excavated below the finished grade of the street and thoroughly rolled with a corrugated roller. Upon the bottom of this trench was placed broken stone ballast spread to a depth of six inches and then rolled. Upon this foundation were placed the ties spaced two feet center to center excepting at the joints where the spacing was sixteen inches center to center. Upon the ties were laid the rails butted tight with joints suspended. The rails were then spiked to the ties, each tie being fastened to the rails by eight 5½ ins. × $\frac{9}{16}$ in. hook-head spikes.

The track was then surfaced and tamped by using gravel ballast, after which the track was lined and the nutlocks placed on the bolts. Tie rods were placed at intervals of ten feet. Each joint was bonded with one No. 0000, forty-one inch Johnson bond and a small supplementary trolley wire bond connecting the trams of the rails. Cross connections with the bonds were made every 400 ft. The trench was then refilled with earth and the paving material replaced.

This type of construction was continued during 1895 with addition of two inches in depth to the ballast, making eight inches of broken stone under the tie. The use of

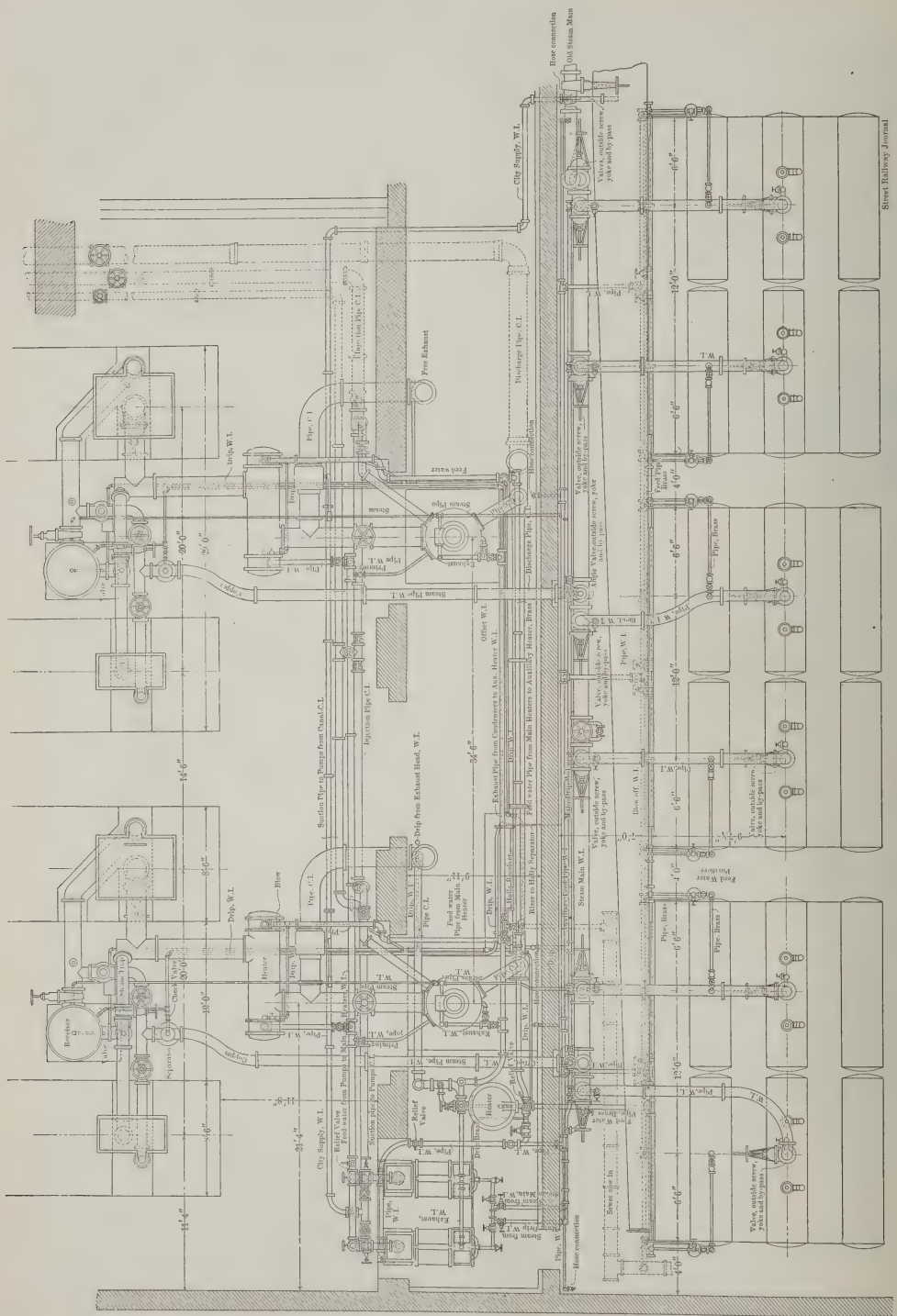


FIG. 4.—PLAN OF POWER STATION—SYRACUSE RAPID TRANSIT RAILWAY COMPANY.

gravel ballast for surfacing and tamping was discontinued, broken stone being used throughout the construction. Broken stone was also used as filling between ties and up to the bottom of the foundation of the pavement. Double brace plates were substituted for tie rods. During the summer of 1895 the Johnson Company half-grooved section No. 204, ninety-four pound, was tried as an experiment and with such success that it was adopted for 1896 construction. In the fall of 1895, when it was determined to consolidate the existing companies and rebuild all roads not then built of permanent construction and equip electrically the roads then operated with horses, the following type of construction was adopted as standard and the construction during 1896 has been carried on in accordance with that plan:

The section of rail is the half-grooved Johnson Company No. 317, ninety pound, in sixty foot lengths. The composition of the metal in the rail differs from that

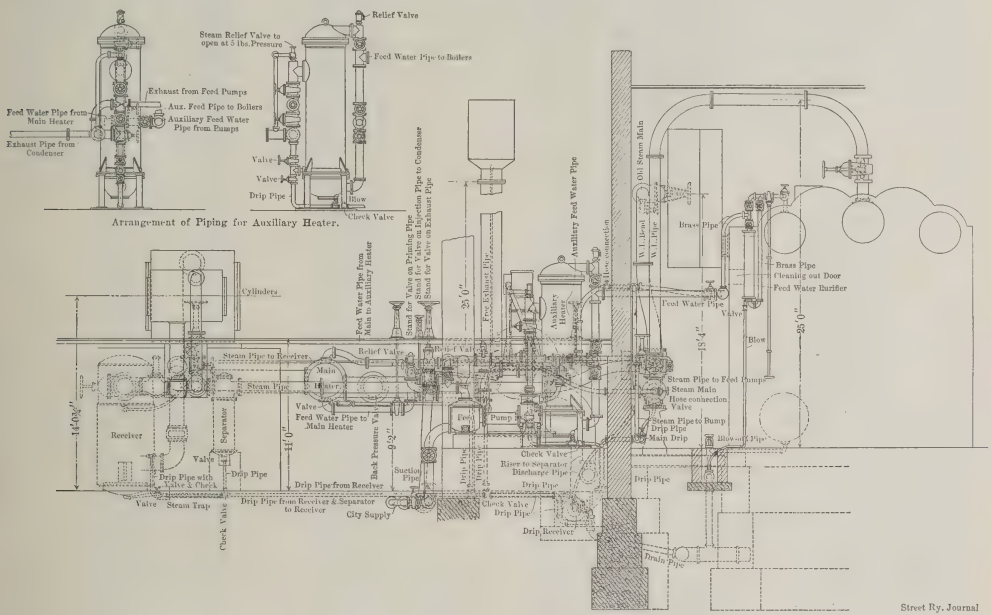


FIG. 6.—SECTION OF POWER STATION.

which is known as Standard Bessemer rail steel. The following is the composition of the rail:

Carbon from .53 per cent to	.63	per cent.
Phosphorous not to exceed	.095	" "
Sulphur " " "	.07	" "
Manganese .80 per cent to	1	" "
Silicon .10 per cent to	.12	" "

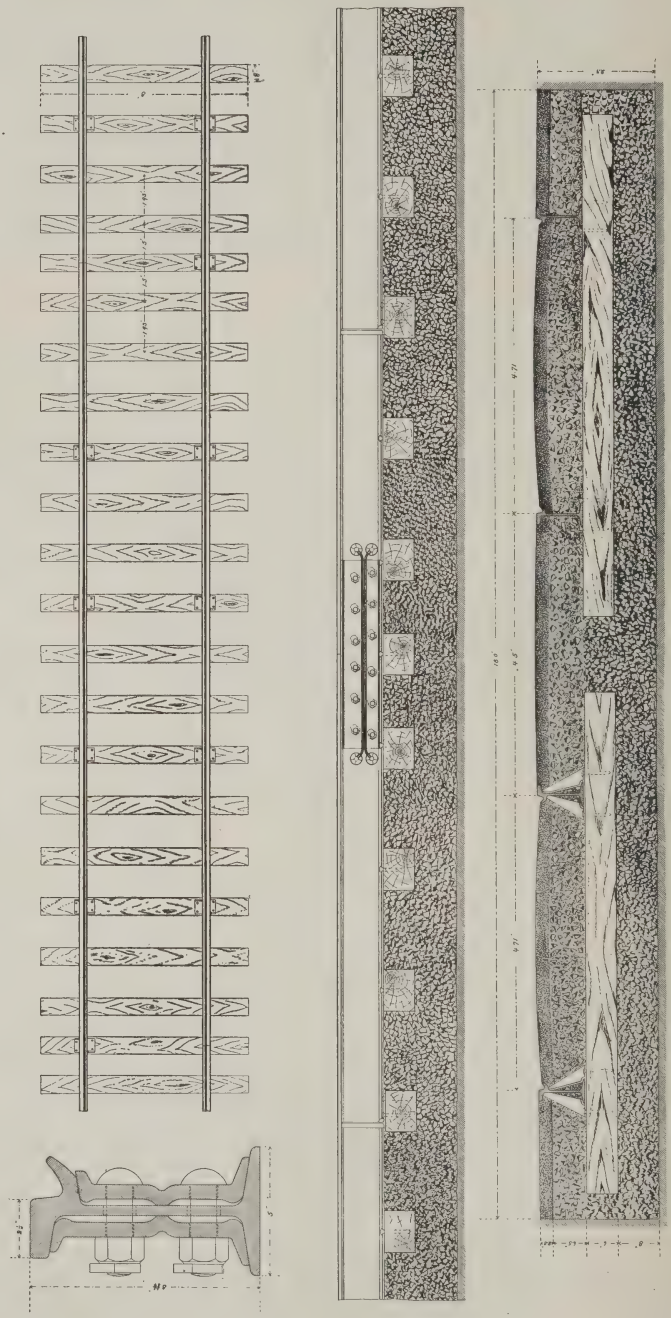
The joint has ribbed plates thirty-six inches long with twelve bolts, 1 in. × 3½ ins., having hexagon nuts. The joint complete with plates, bolts, nuts, and nutlocks weighs 107 lbs. The brace plates are malleable iron and are manufactured by the Mark Railway Equipment Company. The rail bonds are 4 in. × 41 in. bonds invented by the electrical engineer of the company, H. S. Newton, and manufactured by the Central City Brass Company. The ties are sawed Southern yellow pine, 6 ins. × 8 ins. × 8 ft.

The method of track construction is as follows: a trench is excavated twenty-three inches below the finished grade of the street, the bottom of the trench being thoroughly rolled by a ten ton steam roller which readily finds any soft spots in the subgrade. Great care is taken to obtain a firm foundation on which to place the ballast and track structure, and it is with great difficulty that this is obtained. In Syracuse, there is an unwritten law that the sewers shall occupy the center of the street, the gas and water mains being located ten feet on either side of the center. When these underground structures are built and the proper connections to the curb lines from each structure have been made, there is little of the subgrade that is in a stable condition. This condition coupled with the poor manner in which the backfilling of trenches, excavated for these necessary connections, is at present carried on presents a subgrade quite different from that on which are placed the tracks of a steam road. Considering that a good condition of subgrade will give better support to the railroad structure any soft spots or depressions that appear in the subgrade after the steam roller has passed over it are removed and the space filled with suitable material.

Upon this subgrade the ballast consisting of broken stone of such size as will pass a two inch ring is placed to such depth that after it has been rolled with the ten ton steam roller it will measure six inches in depth. The rolling of the ballast is continued until the roadbed is firm. Upon this ballast are placed the ties spaced thirty-two to sixty linear feet of single track. The rails are then placed upon the ties with broken joints, the ends of the rails butted tight, the ties being placed so as to form a supported three-tie joint. Before the joint plates are adjusted, the ends of the rail and the joint plates are thoroughly cleaned with a stiff wire brush; the plates are then placed in their proper position and bolted tight. This is followed by placing the brace plates which are spaced eighteen to sixty linear feet of single track. The ties are then spiked, eight spikes per tie for ties on which are placed braceplates and six spikes per tie for all others, two being driven on the inside and one on the outside of each rail. The spikes used are hook head 5½ ins. × $\frac{9}{16}$ in.

When the spiking is completed the track is surfaced to grade and tamped with broken stone ballast of the same size as that used in the foundation. The track is then

STANDARD TRACK CONSTRUCTION
SYRACUSE RAPID TRANSIT R'Y CO.



thrown into proper line. The bolts in the joint plates are finally tightened and the nutlocks bolted on. The ballast of broken stone is then filled in to the height required to reach the foundation of the street paving.

Track drains are placed at breaks in the grade to drain off surface water, the drains being connected to the sewers.

At the rolling mill the company has drilled in the web of the rails two holes, ½ in. in diameter, 2 ins. center to center and 2 ins. from the end of the joint plate for electric bonding. When the track structure has been lined and ballasted the surface of the web surrounding these holes on one side of the rail is faced by means of a milling facer and a ratchet, when the four holes at a single joint are faced. The surface, brightened, is washed with soldering salts and the bonds attached. Two No. 0000 Newton bonds are used at each joint, the contacts being made thoroughly tight and fitting closely to the faced spots on the web of the rail by means of a bolt and spring washer. This bond, which was described in the January issue of the STREET RAILWAY JOURNAL, has broad contacts, making excellent mechanical contact with the rail. A gasoline blow-torch is then applied to the contacts, and after thirty seconds the solder at the contacts has melted, the rail and the bond becoming firmly united.

Each bond of a joint is inspected after it has become cool; the bolts holding the contacts to rail are removed and the contacts tested by hammering. After being thoroughly tested, the bolt and spring washers are replaced and the bonding of the joint is complete. Cross bonds connecting the rails are placed at intervals of 400 ft.

SPECIAL WORK.

The street railroad system of Syracuse, by reason of the layout of the streets and roads, requires a large amount of intricate special work. The company has used the nine inch "Guarantee" construction of the Johnson Company, some pieces of the "Hardened Center" of the Pennsylvania Steel Company. Fig. 7 shows an intricate piece made by the Johnson Company, and Fig. 8 shows one manufactured by the Pennsylvania Steel Company.

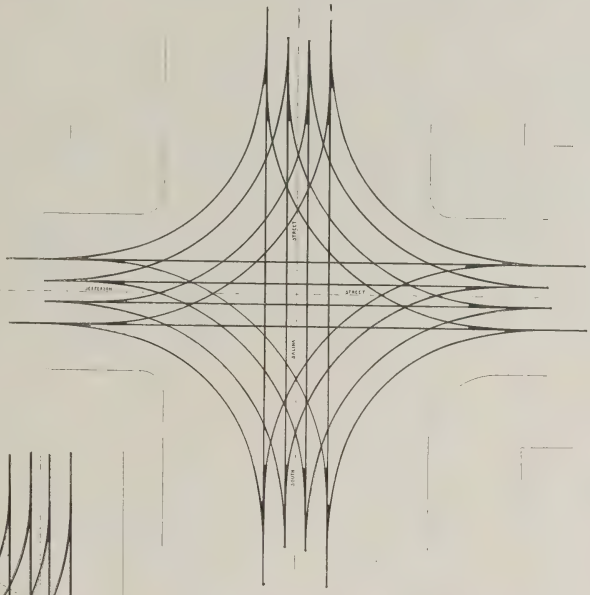


FIG. 7.—RIGHT ANGLE DOUBLE TRACK CROSSING.

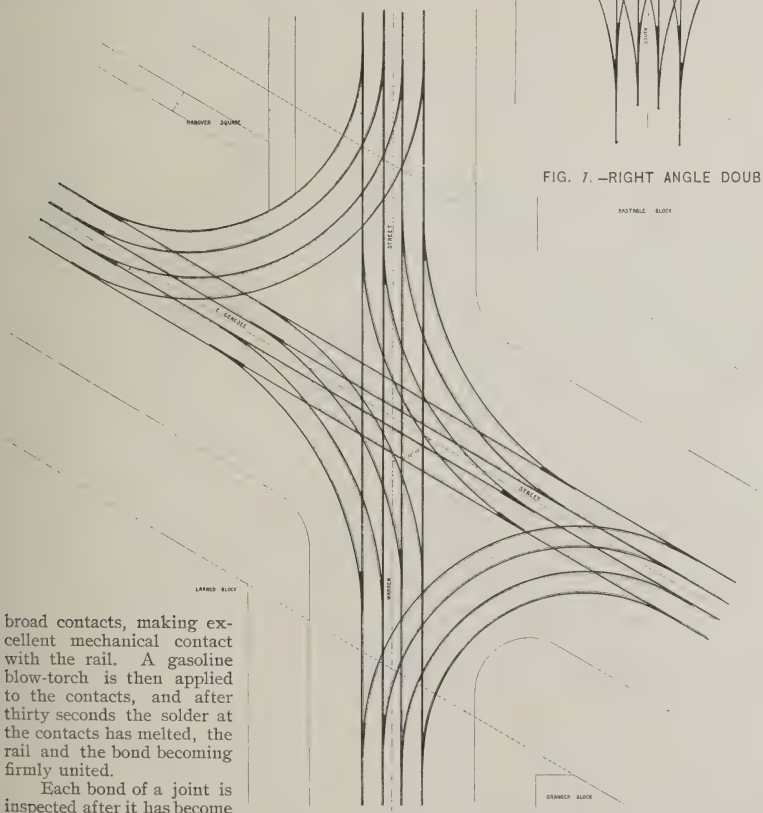


FIG. 8.—OBLIQUE ANGLE DOUBLE TRACK CROSSING.

Easement curves are used upon all curves having a shorter radius than seventy-five feet, the easement adopted being the Johnson Company's standard spiral. In designing the special work for 1897 construction, easements will be used on all curves under 200 ft. radius.

The present type of track construction was adopted after a thorough study of the conditions which were to be met, and the company's engineers are looking for good returns for the money expended in track construction.

Cars have been in operation for two years on divisions where the first nine inch construction was placed. The surface and alignment of the track are good, the joints are holding up well, and the cost of maintenance of way on these divisions has been nothing.

The high carbon rails of the 1896 construction show less wear in a given time than the rails of standard Bessemer specification. To demonstrate this the company has one piece of double track laid with rails of each specification, and the car that passes over the high carbon rails passes over the rails of standard specification. The difference in the wear on the head of the rail in the first six weeks was preceptible.

Besides its nine inch permanent construction, the company built during 1896 one mile of T rail track, the rail used being the Johnson section No. 284, eighty-five pound T rail in sixty foot lengths. The method of construction was the same as that given above, except that the joints are laid spaced $\frac{3}{16}$ in. as the track is exposed. The company has relaid in the suburbs such of the 66½ lb. girder rail as was considered useful, spiking the rail spaced twenty-two inches centers direct to the ties and holding the joint with the Weber joint. This has had a wonderful effect in improving the joints and in making a poor riding track very easy riding. This last structure was planned to last such a time as the construction of sewer, etc., shall have been completed.

OVERHEAD SYSTEM.

The arrangement of the overhead feeders and return feeders is shown in Fig. 9. The outgoing circuit is figured for a maximum drop of seven per cent and the return circuit for a maximum drop of three per cent. No grounds are made at either the station or along the line, and the return circuit is kept separate from the sub-surface pipes as much as possible. The bonding is made as described by the two No. 0000 bonds and six 500,000 c. m. return feeders are run from different points in the track to the power station. The track is cross bonded every 400 ft. with a No. 0000 copper wire.

For the last two years overhead line appliances of the West End type, manufactured by the Ohio Brass Company, have been used.

FIG. 9.—DIAGRAM OF OUTGOING AND RETURN FEEDERS.

ROLLING STOCK.

The rolling stock of the company includes thirty new closed cars with doors close to the platform, built by the Barney & Smith Car Company, thirty-five side aisle, cross seat cars, with side doors on each platform and center door, built by the J. G. Brill Company, and twelve cars reconstructed from the old rolling stock. The new cars are mounted on Diamond trucks, which seem to be giving very good satisfaction. The side aisle cars are mounted on 21B Brill trucks. The Barney & Smith cars are equipped with G. E. 1000 and the Brill cars with G. E. 800 motors. The former use K10 and the latter K or K2 controllers.

In comparing the different types of cars, the electrical engineer of the company stated that the side aisle, cross seat cars are popular with the public who seem to prefer to ride facing the front platform. The fact that they can be readily changed to open cars in summer is also a desirable feature of their use. The cars have, however, the disadvantage that they can be operated in only one direction. This involves the use of either loops, turntables, or three-way switches at the termini. It has also been found that in single ended cars the pinions and gears wear more on one side than on the other, and that the commutator bars also show irregular wear on one side, due to one direction of running. The company has therefore adopted the two-entrance car with doors close to the steps as a standard in closed cars. The standard specifications of the company for both closed and open cars are given elsewhere in this issue.

The equipment of the cars includes New Haven and Sterling registers, and Consolidated heaters. Rochester and New York car wheels are used, and give an average of about 45,000 miles of service, although no exact records are kept of the mileage. Steel gears and pinions are used and have a life of from four to six months. Trolley wheels last about two months and are of brass.

The cars are all painted alike—a yellow being now used as a standard body color. The destination of the car is shown in two ways: by colored deck signs which are interchangeable and by signs carried on the dash. The lighting circuits of every car include ten lamps—nine inside the car, and one on the dash, where a changeable electric headlight is used.

CAR HOUSES.

The company has three car houses, one on North Salina Street, one on Wolf Street, and one recently completed on South Salina Street. The interior of the latter is shown in Fig. 11. Every track has an entrance curve and is fitted with a pit. In each pit is a track for a hydraulic jack by which the motors or wheels can be lowered. The pits are all connected at the rear of the car house by a track for the jack carriage, running on the pit floor at right angles to the car tracks. A turntable is located at each junction of the pit tracks with this horizontal track, so that the jack can be run from one part of the car house to another. The capacity of the car house is fifty-five cars.

The company believes in keeping its car house warm, thinking that the men can work to much better advantage without gloves and in a comfortable temperature than in a chilly place. Steam pipes are therefore carried along the sides of nearly every pit and around the car house walls. The location of the repair shops will be adjoining the car house and the company will install here a car wheel press, large lathe, small lathe, miller, planer, etc.

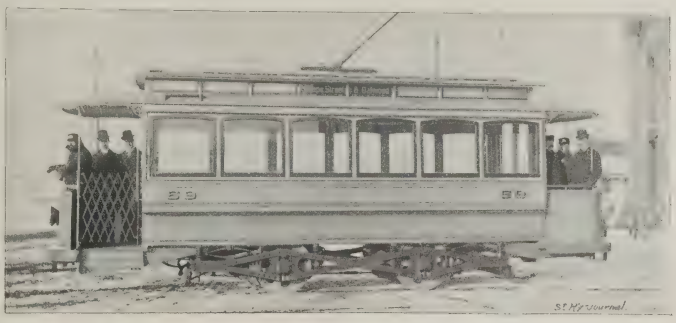


FIG. 10.—STANDARD CLOSED CAR.

The Wolf Street and North Salina Street car houses are of an earlier construction. The former has a capacity of eighty cars, the latter being simply a storage house. The present repair shops of the company are at the former car house and are notably very small, as but little repair work has been required on the equipment now in use, and but two or three men are employed here. At the North Salina car house a very comfortable set of rooms for the motormen has been furnished.

FIG. 11.—INTERIOR OF SOUTH SALINA STREET CAR HOUSE.

PARKS.

The company's lines lead to two parks, one on Chenango Lake where an extensive iron pier was built about 1889. This is now leased to outside parties, who furnish concerts every afternoon and evening during the three summer months, besides providing other attractions.

This pier is a very favorite resort in the summer for the residents of Syracuse, and the line running to it is one of the most profitable owned by the company.

A second park has recently been secured about four miles from the center of the city in an entirely different direction. This is called Hopper's Glen, and is operated directly by the company. It is maintained as a temperance resort and is very popular for Sunday school picnics.

FIG. 12.—WOLF STREET CAR HOUSE.

OFFICIALS.

The officials of the Syracuse Rapid Transit Railway Company are: president, E. T. Perine; secretary, J. B. Summerfield; treasurer, W. J. Smith; general manager, J. H. Moffitt; engineer track construction, C. L. Allen; electrical engineer, H. S. Newton.

SYRACUSE EAST SIDE RAILWAY COMPANY.

This is a small road, the control of which is largely with the owners of the Syracuse Rapid Transit Company. At its city terminus it runs a short distance from the tracks of the latter company and serves the region to the east of Syracuse, extending as far as East Syracuse, a distance of about ten miles.

The station, which was built several years ago, is a good example of a belted plant for a small road. The engine equipment consists of two Allis-Corliss single noncondensing engines with cylinder dimensions 16 ins. × 42 ins. Each is belted directly to a 100 k. w. G. E. generator. The engines exhaust into a pipe heater and the feedwater is pumped in a battery of two 125 h. p. return tubular boilers. The power house and car house are under the same roof.

The rolling stock consists of seven open and four closed cars, all of the American Car Company's make. The cars are mounted on Peckham trucks which are equipped with G. E. 800 motors. The track is of 9 in. girder rail within the city limit and of 45 lb. T rail outside.

SYRACUSE & SUBURBAN RAILWAY.

The Syracuse & Suburban Railroad Company is a new enterprise, and as it promises to be put in operation during the coming year should be referred to in a description of the street railway system of Syracuse. It will be built in a southeasterly direction from the city to the thriving villages of Fayetteville and Manlius. These, with the immediately surrounding country, contain in all a population of not less than 14,000 inhabitants, whose only means now of reaching Syracuse is by a daily stage, connecting with the New York Central at Monoa and three trains on the Chenango Valley Railroad.

The road was chartered June 29, 1895, and received all necessary rights from the Railroad Commissioners late in 1896. Work was immediately begun on the plans and specifications and all have been completed, but as the contracts have not yet been let, it is possible to state in a general way only, of what the machinery and construction will consist.

Its charter gives the company the right to build and operate a line beginning at the corner of Salina and Fayette Streets in the very heart of Syracuse, and thence easterly through Fayette Street to the city line, thence through Crowley Street to Genesee turnpike and along this much traveled thoroughfare to and through Fayetteville and Manlius to the south line of the latter village.

Within the city of Syracuse the track will be double, of 9 in., 90 lb. girder rail. Outside of city it will be 60 lb. T, single track with turnouts. In all there will be about fourteen miles of single track. The overhead work will be mainly cross suspension. Iron poles will be used within the city, but both cross and bracket construction with wooden poles will be employed outside. Double trolley wire, size No. 00, will be used the entire length.

The most interesting feature of the road is, that it will be operated by water power, the company owning a valuable franchise at Edwards Falls on Limestone Creek in the town of Manlius, together with several acres of adjoining property. Part of this property is particularly suited for a pleasure resort, and can easily be made a most attractive place for picnics, etc. It is important to note that the power is absolutely unfailing. The stream is a feeder for the Erie Canal and has its source in the De Ruyter reservoir, a body of water extending over 600 acres and having a mean depth of sixty feet. This reservoir is part of the Erie Canal system and was constructed by the state for the purpose of supplying the canal with water during the time of drought. Therefore, the greater the drought, the larger the volume of water that must pass down this stream, all of which is at the disposal of the railway com-

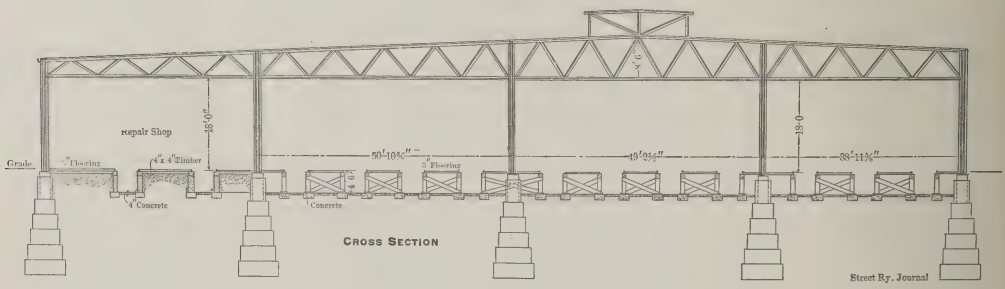


FIG. 13.—SECTION OF SOUTH SALINA STREET CAR HOUSE.

pany. After being used, it is discharged into the stream again, causing no waste whatever.

The scheme for developing this fine power, embraces the building of a dam of stone, timber and earth, about 400 ft. long, also an open canal some 1200 ft. in length, capable of carrying the average flow of the stream. This canal is supplied with the necessary bulkheads, gates, etc., and runs to a point further down the stream where a head of 90 ft. is obtained, furnishing approximately 1000 h. p.

In the ravine, just under the termination of the canal, is located the power station, the plan and elevation of which are shown in Figs. 14 and 15. When the station is completely equipped, it will contain four 200 k. w. generators direct connected to two turbine wheels, as shown. The connection between the bulkhead at the end of the canal and the wheels, will be by steel pipes 48 ins. in diameter and $\frac{5}{16}$ in. thick. The water will discharge through stone arched tail races into the main tail race and thence into the stream. Access will be had to the station from the bluff above, by a foot bridge and elevator. The latter will be operated either by water or by an electric motor, and will be built first to afford an easy means of handling the machinery that is being installed. The power house will also be equipped with a three ton traveling crane.

The car house, which is to be 56 ft. × 125 ft. long, will be located on the high ground but a short distance from the power station, so that the whole plant can be under the eye of one superintendent. It will have four tracks, giving ample room for the storage of cars. Part of the building will be partitioned off into a waiting room, office, store room, machine shop, etc. The shop is to be completely equipped with lathe, planer, drill press, bench, vise, etc., necessary to make all repairs. Advantage is taken of the sloping ground to form a cellar at the rear of the car house. In this will be placed the boiler for heating the rooms and for drying the motors. It will also have ample room for storing coal, tools, etc. Hatches in the floor above provide for lowering the coal. The front of the car house will be closed by two large sliding doors, one to each two tracks. These doors will be run on patented anti-friction rollers at the bottom, thus avoiding the annoyance caused by the breaking of the hinges of swinging doors, and the sagging and binding of those operated by overhead mountings.

The feeder system has been designed to meet the the requirements of the road as shown in Fig. 16. There are a number of grades in the road. The heaviest is about 10 per cent and is in Syracuse, almost at the end of the line furthest from the power station. It has therefore, been decided to carry about 650 volts at the station and to deliver the current on the line at from 500 to 550. Advantage has been taken of a short route to the city along which to carry the feeders, thereby saving considerable on copper and lessening the drop. The trolley wire has been divided into sections by line breakers, each section being supplied by a feeder. The feeders, however, are tied together so that any part of the line may have the benefit of the carrying capacity of all; but the connection is made

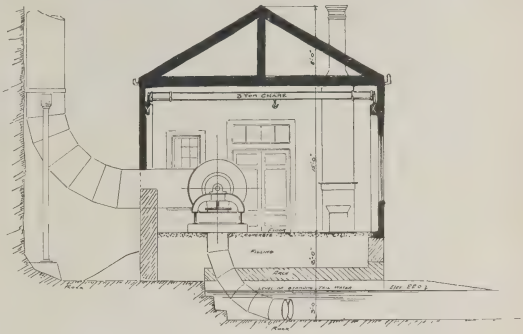


FIG. 14.—SECTION OF POWER STATION—SYRACUSE & SUBURBAN RAILWAY.

by circuit breakers so that should a short circuit occur on any section, the breaker connecting it with the rest of the system will open, leaving it dead, but not interfering with the rest of the road. The cause of the trouble can therefore, be easily located and removed in a short time.

The line will be equipped with a telephone system for its more perfect operation. The telephones will be placed in the company's office at each end of the line, and pole or emergency boxes will also be placed at each turnout. The terminal offices will be able to communicate with each other, but the conductors, who will be supplied with portable instruments, will be able to communicate with only one office, through which all orders must come.

The cars for suburban travel will have 26 ft. bodies, double trucks and four motor equipments. The city cars will have 18 ft. bodies, single truck and double equipment. All equipments will be 30 h. p. each. There will also be double truck freight cars with equipments of the same power as the large passenger cars, as the company has the right to carry freight and express matter. From the service a large revenue is expected.

The officers of the company are all residents of Syracuse. They are as follows: president, A. Cady Palmer;

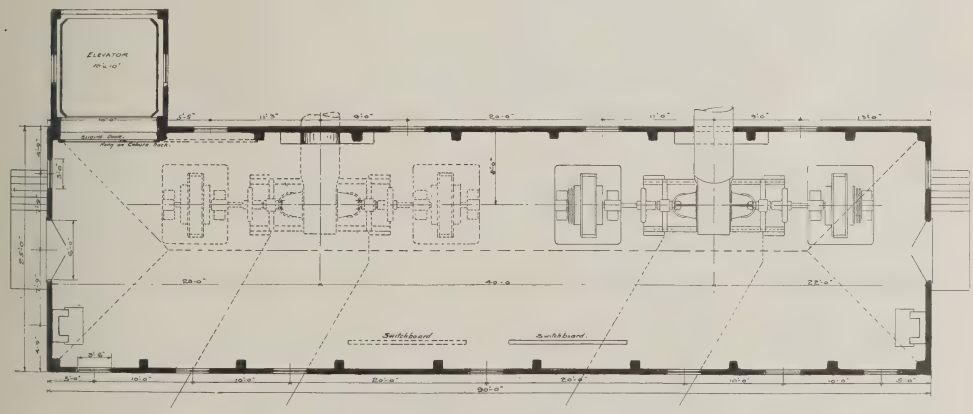


FIG. 15.—PLAN OF POWER STATION—SYRACUSE & SUBURBAN RAILWAY.

vice-president, Arthur Jenkins; secretary, treasurer and attorney, Giles H. Stillwell.

Macartney, McElroy & Company prepared all plans, specifications, etc., and are the company's consulting engineers.

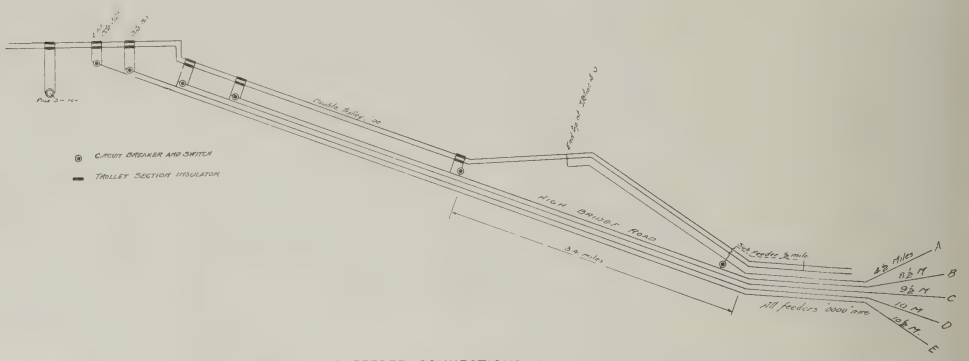


FIG. 15.—DIAGRAM OF FEEDER CONNECTIONS—SYRACUSE & SUBURBAN RAILWAY.

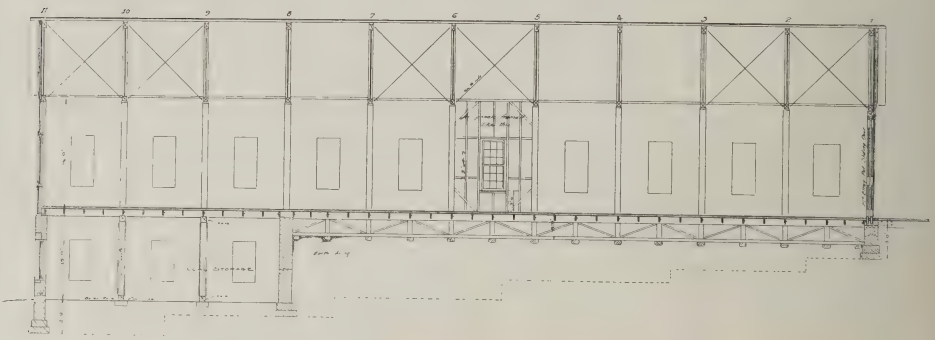


FIG. 16.—SECTION OF CAR HOUSE—SYRACUSE AND SUBURBAN RAILWAY.

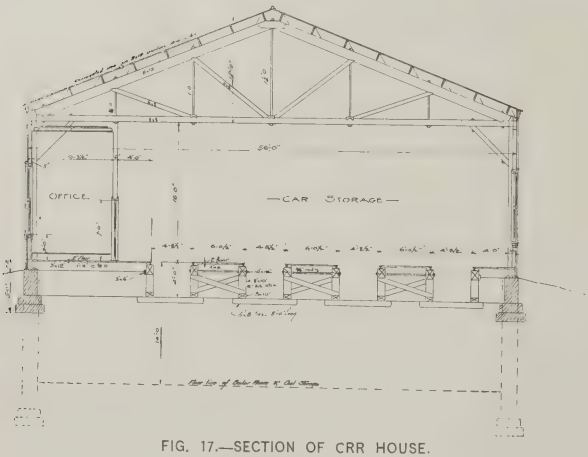


FIG. 17.—SECTION OF CRR HOUSE.

Work is to be pushed forward as soon as spring opens, in order to take advantage of the heavy summer travel which the managers expect that the road will be required to handle.

Car House Heating in Albany.

The officials of the Albany Railway have recently increased the heating facilities of their principal car house by putting in a new boiler, and placing additional steam pipes in the repair pits and along the floor between the rails of the storage tracks. The surface pipes are 1½ ins. in diameter and are placed in groups of four on each side, just inside the rail. The object of this position is to so distribute the heat that it shall melt the snow and frozen dirt that may cling to the running gear of the cars as they come in from a trip, and also that it may take the frost from the metal and dry the motors and insulation of the conducting coil. It is claimed that a saving is effected by this arrangement in many ways. The saving embraces fewer broken wheels and axles than when these parts are left exposed to continuous cold. The woodwork of the body and floor is dried out, and the thorough drying of the insulation reduces the tendency to leakage and grounds in the motors and connection. Besides, when the cars go out in the morning they are already warm and require less coal for making them comfortable than when they come out of a cold house. Another economical feature is the comfort of the employes in and about the place, for they are able to perform more and better work, in the inspection and repair of motors and trucks, than when the materials and tools are full of frost and the tem perature too low for comfort.

The Irregular Wear of Wheel Treads and Flanges.—The Causes and Some Remedies.—II.

By H. S. Cooper.

In the last issue of the Street Railway Journal seventeen common causes for the irregular wear of wheel treads and flanges were given. The three chief divisions under which these were classed were "defects in tracks or rails," "defects of wheels" and "defects of running gear, truck or motors or in adjustment of same." Below are presented a number of additional causes of irregular wear, due to defects in braking apparatus and in operation.

IV. Defects in braking apparatus.

18. Brake shoes not pressing evenly on all wheels. This defect has already been discussed under "lack of parallelism of truck axles, caused by wear or lost motion," but its importance merits more than a passing notice. It can occur on any truck and with any arrangement of wheel brake, but it is especially prevalent on trucks where the brake rigging is not compensating or equalizing, i.e., where the braking mechanism is not arranged so as to distribute the braking pressure equally among all the wheels braked, when the brake is applied. Any brake mechanism that will tend to pull the two wheels on one side towards one another, or (if the brakes are between the wheels) to push them apart, will cause the axles to lose parallelism by the total amount of the lost motion in the journal brasses, journal boxes and frame on that side, unless the brakes on the other side of the truck are pulling those wheels together or pushing them apart with an equal force. This effect is one that is easily noticed on a car, and it is also one that is well known to drivers, gripmen or motormen, as by it they are enabled to give certain cars a "twist" or "lead" to make them take a refractory switch. When cars descend long grades under brake, the above becomes a potent cause of undue wear, and any car that shows that it can be influenced in direction by the application or release of the brakes should have its braking apparatus looked after. Such a car if used largely under brake will develop thin flanges on all its wheels.

It is, of course, a mechanical impossibility to so regulate and keep regulated the braking mechanism of a car or truck, that exactly equal pressure will be brought to bear on all the wheels, but great inequalities in pressure can be easily avoided and with advantage to wheels, axle bearings, truck and body. A further advantage of equal braking pressure is that skidding or sliding of the wheels, is much less liable to occur; a simple test of this fact can be made with any car, by making two emergency stops, one with the brakes unequally adjusted and the other with them equally adjusted. In the former case it will be found impossible to stop the car in the same distance as in the latter, and one or more pairs of wheels will skid.

19. Brake shoes not bearing on entire wearing surfaces of wheels.

20. Brake shoes of uneven hardness across the face.

The evil of these two defects is very apparent on consideration of the fact that both of them tend to "score" the surface of the tread and so make a starting point for false or double tread. The use of a brake shoe that touches the wheel only on the flange, or on the flange and a small portion of the tread, or only on a portion of the tread is a legacy from horse car days and is utterly unadapted to these times of high speeds, heavy traffic and frequent quick stops. One would think that the above defects were so apparent that no manager would allow the use of shoes having them. Within a year I have seen in use—and seen testimonials in regard to—shoes which braked only on the flange and a small portion of the tread, shoes which braked only on part of the tread, shoes which had holes or wooden plugs, or hard or soft metal pieces arranged in the breaking surface in lines parallel with the tread, all tending to wear grooves of greater or less width in the wheel tread surface, or to wear it rounding or hollow or "cone" it the wrong way.

Where the use of foreign substances in the brake shoe is believed to be beneficial to either the shoe, the wheel or the accident fund, it would be wise to so stagger their locations in the face of the shoe that they will not groove the wheel face.

As to the use of the shoe which brakes only on a portion of the chilled surfaces of the wheel, all experience goes to show that where mechanical obstacles do not interfere the best shape for a brake shoe, both for braking effect and for the conservation of the wheel wearing surfaces, is one that covers and touches both sides of the wheel flange and the whole chilled width of the tread. To have the best effect of such a brake shoe its contour of face should always be the same as that of the wheel face when new and its length of braking surface should not be less than one-sixth of the circumference of the wheel.

So much of both safety and life of wheels is dependent on the proper proportioning, adjustment, use and care of the brake shoe that novelties in shape, size, materials or adjustment should be conservatively tried and retried before being adopted. In respect to brake shoes, steam railway practice has little for urban street railways to follow. The function of the wheel flange on a steam railway, or on any wheels running entirely on a track with full T rail construction and fittings, is simply that of keeping the wheels from leaving the rail. On the urban street railway, however, the wheel flange has the additional duty of acting the part of guard rail, switch and crossover and it is therefore necessary to its best performance of these duties that it retain as near as possible its original shape and size and that it keep pace with the tread in its amount of radial wear. This shape, size and wear can be best conserved by a shoe that tends always to make the flange maintain its original contour and its relative location to the tread—such a brake shoe as has been indicated above as the proper one.

V. Defects in operating.

21. The running of cars one way, viz., continuous running of the car over same route without turning it "end-for-end." This practice will accentuate any unusual wear due to excess of grades or curves in one direction, or to any irregularities between the two sides of the track or of the truck. On belt lines and on any route where the curves preponderate in one direction it will cause irregular wear. Many well developed cases of such wear have

been prevented from recurring by a simple turning of the car. It is easily remediable on cars which are intended to be run from either end and in either direction as regards their route, as the regular turning of the car at the end of a certain number of miles or trips run will equalize the wear from this cause.

No road—cable, electric or horse—should run its cars continually one end on where the cars will permit of their being turned. If there are places convenient in the route or routes of the cars, or on the system, which will act as a Y and turn a car if run over them in a certain direction (as there are in many cities), then the simplest and easiest way is to run each car over this route at the end of a certain mileage. If no such route exists, the construction of a rough turntable at a car barn, or of a Y out of old rails will pay good interest on its cost, in lengthening the life, not only of the wheels, but of the brake shoes, gears, and in fact of all moving parts.

On most double track roads and on belt lines, and even on some single track roads, it is now the custom to run cars with platforms having an entrance only on one side—that nearest the sidewalk or farthest away from the cars on the other track or turnouts. It is impossible to use such cars if turned as a whole. In such cases all that can be done is to reverse the axles in the trucks, or the trucks under the bodies. The former is of doubtful expediency and requires readjustment and perhaps changing of brake shoes, while both are expensive, necessitating as they do the jacking up of the car body. There are times, however, when this has to be done for other causes and it is wise in such cases to reverse the trucks if it is possible and if the wheels show decided signs of irregular wear.

Where it is impossible to turn the cars the mileage period spoken of above as the limit of their being run one way should not be made too large. As soon as any wheel shows signs of false or double tread, the truck should be turned and the minimum mileage made by new wheels before this occurs should be made the turning period.

22. Stopping and starting on curves. Unless actually necessitated by the exigencies of the travel and the schedule or by peculiarities of the route, this practice should not be allowed or followed, especially on curves of small radius or on those using an inner grooved guard rail. On curves of such large radius as to render the use of guard rail unnecessary, there is generally elevation enough on the outside rail to make the wheels free their flanges when the car is started from a complete stop on such points. On curves using an inner rail of grooved guard form, especially on those where, owing to the contour of the streets, no elevation can be given to the outside rail, the starting of a car from a full stop subjects the body, trucks and machinery to tremendous extra strains and tends very strongly to injure the wheels and rail much more than if the car had been run around the curve without stopping. The reason for this is, that the wheels of a truck moving on a curve have a different relative position, both to each other and to the rail, than they have when the truck is stopped on the same curve. On starting the car from this last position the instantaneous attempt of the wheels to regain their normal running positions on the curve, subjects them and the rail to very severe wear until that normal position is fully attained. The body and truck are, at the same time subjected to severe and unusual strains, and owing to the large amount of power required the propelling machinery is very heavily taxed.

The above occurs on single-guard curves, and when the curve is double-guard, i. e., has a guard inside both rails, the evil effect is much greater. Luckily, very few curves are now put in with double guard, as it has finally come to be understood that in a properly constructed curve the guard to the outside rail is a superfluity, the centrifugal force of the moving car being amply sufficient, even at very slow speed, to keep the hind wheels from running off inside the curve.

Where the inside of the head of the inside rail is new or rough, or where the flange of the inside hind wheel is in the same condition, or where, owing to the slipping of the front wheels, the driving is done entirely by the rear ones, it is sometimes the case that in starting a car on a curve the inner hind wheel will climb over and off the rail. This, however, is not a reason for putting in an outside guard rail, but it is a good reason for putting the curve and wheels in good condition, and for not stopping in that place.

23. Dry curves and turnouts. By this is meant the practice of using such without lubricating the surfaces where the wheel flange rubs or presses.

The economy of this practice is a mooted point among street railway men, and the practice is "according." On the one hand it is said that the expense is not remunerative; that on roads with heavy and continuous traffic the necessary outlay for men, materials and implements to lubricate and keep lubricated all surfaces needing it, is out of all proportion to the saving effected in the wear of wheels, rails and fittings; that the lubricant is very apt to get on the wheel and tread and cause skidding, and to get on to the brake shoes and lessen or destroy the braking power; that on dry days the lubricant collects dust and grit and actually causes more wear than the dry metal, and that on wet days it is not needed, and the men so employed are a useless expense.

On the other hand, it is urged that the expense is remunerative, that the heavier and more incessant the traffic, the greater the loss and expense of renewal of track and fittings, and the less the ratio of expense to savings, that it simply needs proper materials and supervision or inspection to prevent its misuse on wheel tread and brake shoe, that even when covered with grit the lubricated surfaces are less liable to destruction than when dry, that on wet or snowy or frosty days the labor can be profitably employed in sweeping and cleaning turnouts and curves or in salting or sanding them, and that outside of all economies of wear of rail and wheels, the service is rendered more pleasant to passengers, and consequently, to the company by the greater ease with which the cars enter and leave the turnouts and curves and by the absence of the jarring, chattering and squealing which accompany the passing of unlubricated surfaces.

As is usual, "truth lies neither to the right nor left;" each side is right in certain cases and under certain conditions. The fundamental truths are, that the wear of wheels, rails and fittings is lessened by proper and timely lubrication of the frictional surfaces, and the destructive effect of the jarring, chattering and squealing on the truck and body, and their unpleasant and deterrent effect on the patrons of the road are nearly all eliminated. There is no question that dry curves and turnouts absorb much power, unduly wear the wheel flanges and the rail and fittings, aid the disintegration of the body, trucks and motors and lessen the comfort of the passenger. The question of the advisability of lubricating—as an economical measure—is, like the tariff, a local issue, to be carefully settled by each manager and mainly by his judgment, as it is doubtful if any urban street railway can show accurate figures either for or against it. As a matter of personal judgment I have always practiced the lubrication of curves, turnouts and crossings on all roads with which I have been connected, and believe that it has paid to do so, although I have nothing tangible to show as proof except generally excellent results as to wheel and track wear. These results, however, may have been due to other causes.

Besides the above reasonable reasons, I have had some given which were ridiculous, unreasonable or, like the Scotch verdict, not proven, such as "the magnetic direction in which a car ran", the "grounding or escape of current through certain wheels of the car", "the unequal distribution of the load of passengers", etc.

Without going into such depths, there are ample proven causes for the irregular and unequal wear of wheel wearing surfaces and all of them are remediable under favorable circumstances, although in some instances the local conditions prevent the remedying of all of them.

In first taking up this matter I was much puzzled by the fact that some roads which should have had trouble

with their wheel wear, were entirely free from it, while others, under much better conditions, were badly afflicted. There were also the curious cases of several roads having been free from it under wretched conditions of management, operation and equipment, and suddenly developing it when conditions were actually bettered. Without knowing all the exact conditions in each case it is impossible to point positively to the cause of these seeming contradictions, but from recent experiences I am decidedly of the opinion that the immunity in the above cases was due to the fact that there were defects, but that conditions were such that they neutralized each other, and in the cases where worse results in this respect were obtained under improved conditions, it was doubtless because one or more of the defects which paired had been obviated, leaving the wheels to the full effects of the others. This may sound like a far-fetched reason, but in my own personal experience I have had worse results after remedying what I knew to be a defect and this led me to still farther researches in the matter, with the result that I found causes which were, until then, totally unsuspected.

As a rule, any conditions that continually or preponderatingly force one or both sets of wheels of a truck towards one rail, will eventually cause false or double tread and thin or sharp flange on some one or more of the wheels. The conditions being many and complex, it may be, and very often will be, difficult to locate the exact cause or causes, and for reasons given above, the first results may be negative or even adverse; but persistency in eliminating any unbalance of direction between the wheels on opposite sides will finally result in success, provided that the local conditions of the road are not such as to prevent all remedies being tried.

Local conditions will greatly govern the extent of the defects; several of them are active only under certain circumstances, such as a car being "driven" all the time, while another will only come into action while it is drifting or coasting. In the case of a car being driven for a majority of the time—as on a level road, at good speed and with few stops—certain of the above defects would come into action with full force, whereas on a road with long, steep grades they would have no effect for one-half the time (i. e., while descending the grades) and during this half other and entirely different defects would come into play, perhaps increasing, perhaps neutralizing, the effects of the others. For this reason any road where the cars float or coast to any great extent differs very greatly in its conditions of wear from a road where the cars are driven all the time; in the former the braking apparatus and its defects will preponderate, in the latter other and entirely different causes should be first looked for.

Too much stress cannot be laid on a few preventive points. The first is the selection of wheels of size, shape, contour of wearing surfaces and character of metal and chill, all best adapted for the service to be performed, and to the rail or rails on which they are to run. The second is the selection of brake shoes of the size, shape and metal best adapted for their service in stopping the car promptly, and with the least possible pressure, and at the same time preserving and conserving as much as possible the size of the wheel and its original contour of flange and tread. The third is the track. It should be as good as it is possible to have it with the means and material available. If old, it can at least be kept vertical, in surface and in alignment on the straight track, and the curves and turnouts made and kept in order and repair. If the track is to be new it should be adapted for the traffic it is to carry, and both straight and curved rail and all turnouts and special work should be selected with especial reference to the shape and size of wheel that is to run on them. Fourthly and lastly, and most important of all, is the full inspection of all points in wheels, trucks, machines, brakes or track that would tend in any way to disturb the perfect lining and tracking, or to shorten the life of the wheels. All inspection should be preventive first and remedial afterwards; the proverbial value of the ounce of prevention is never so plain as in the effects of good inspection, especially in matters like wheel and rail wear which are virtually irremediable. I have never been able to eradicate irregular wear of wheel or rail surfaces once they were thoroughly and definitely formed, except by further destruction and expense in the shape of grinding. To place a defective wheel in pair with a good one is to make a pair of defective ones, and to pair wheels already defective in the hope of effecting a mutual cure has never been a success. Grinding, or the scrap pile, are the alternatives for wheels, and for the rail there is only one—the scrap pile—that monument of poor judgment, worse management and worst inspection.

Brake Rigging for Electric Cars.

By C. F. UEBELACKER.

The brake rigging is the most important part of the running gear of the modern street railway car and at the same time it has probably undergone less change since the days of the horse car than any other portion of the truck. Speeds of fifteen and seventeen miles an hour and cars weighing 20,000 lbs. and upwards are the ordinary rule, and yet with these increased speeds and weights we are still depending on the hand brake which was used in the days of the horse car.

It is not the writer's intention, however, to discuss the advisability of power brakes as opposed to the ordinary hand rigging. This is a question which will work itself out as practice becomes general along certain lines. It is simply intended to call attention to some of the more prominent conditions which brake rigging in general must meet.

The first question that arises is the amount of pressure which it is desirable to obtain through the mechanism for applying the shoes. To get at this it is necessary to begin by considering the friction which we can expect to obtain from the ordinary brake shoe when forced against the wheel. This is a question of experiment pure and simple and the information desired must be sought among experimental data. Probably the most thorough investigation of the properties of the brake shoes is that which was made two or three years ago by a committee of the Master Car Builders' Association of America. Their published reports show that against a chilled iron wheel, a soft grey iron shoe gave the highest co-efficient of friction, namely, $31\frac{8}{10}$ per cent. At the same time, however, this shoe showed the greatest loss of weight in service, while shoes, for instance, B and D, in the tabulated report of the tests, which showed, as compared to cast iron 86 per cent and 10 per cent of the wear, gave results for friction under the same conditions of $20\frac{1}{10}$ per cent for shoe B, and $16\frac{3}{10}$ per cent for shoe D, or the increase in wearing properties seems to be universally attended by the decrease in the co-efficient of friction. Figures just given are for the average friction from a speed of forty miles an hour down to a practical stop, and while this subject is under consideration attention should be drawn to the vast difference in various kinds of shoes in respect to the variation of the co-efficient of friction.

In some shoes this increases very largely as the speed decreases, consequently with these shoes there is a marked tendency to lock and slide the wheels. Take for instance, shoe J, in the tabulated report of the Master Car Builders' committee, the co-efficient for this shoe at forty miles an hour is about eighteen per cent while just prior to stopping the co-efficient has risen to thirty-two per cent or an increase of fourteen per cent. Compare this result to that given by shoe K, which at a speed of forty miles an hour gives a co-efficient of friction of $37\frac{8}{10}$ per cent or an increase of only four per cent. However, it is not desirable to digress too far into the question of the properties of brake shoes. The subject is decidedly too large to be treated in a brief article like the present one. The figures above are given simply with a view to show about what minimum must be calculated upon in considering the

proper leverage to be given to a brake rigging. Let us assume the friction of the shoe at sixteen per cent of the pressure applied to it as this figure seems to be about the minimum.

Now turn to the consideration of the amount of the retardation necessary to stop a car in an emergency case when it is desired to come to a standstill as quickly as possible. The limit, of course, is the grip of the wheels upon the rail. This is much greater so long as the wheel continues to roll than when it once begins to slide. Just how much the difference amounts to, it would be impossible to say as there seem to be no well authenticated results for rolling friction under heavy pressures such as those which occur between the small surface of a cylindrical car wheel in contact with the rail. Practical experience has taught every railroad man from the motorman up to the general manager that the moment the wheels cease to revolve, the speed of the car is checked very slowly. It is the custom in electric railroading to sand but one rail, while but one half of the weight of the car which it is required to stop is carried upon the sanded rail. Such data as we have would point to the rolling friction between sanded rail and track amounting to about forty per cent of the weight bearing on the wheel, and on an unsanded track to about twenty per cent, both taken under average conditions. This would give us for the available retardation (or more correctly, negative acceleration) about thirty per cent of the whole weight of the car. If it were possible to apply immediately the whole retarding effect and maintain it until the car was brought to a stop the equation $S = \frac{W V^2}{64.4 F}$ would give us the correct solution of the distance to make a stop, where S is the space in feet required for the stop, W is the weight in pounds of the car to be stopped, V is the velocity at the beginning of the stop in feet per second and F is the retarding force or negative acceleration. This question solved for a car weighing complete with motors and truck 20,000 lbs., and receiving the full maximum retardation of thirty per cent of the weight, would give us about forty-five feet as the shortest possible stop under average conditions. This result compares fairly well with that obtained experimentally by the writer, which is about forty-seven feet for the shortest possible stop with a mechanical brake rigging which applies the full retarding force nearly instantaneously.

To begin now at the other end of the brake rigging, namely, the brake handle, and work toward the figures which have been assumed, namely, sixteen per cent friction for the brake shoe and thirty per cent of the gross weight for retardation. We can depend upon the ordinary motorman to pull about 200 lbs. on the brake handle if we assume the brake handle to be about 14 ins. long, and the spindle to which it is attached 1½ ins. in diameter. A ⅜ in. brake chain will then give us a leverage of about 9⅓ to 1, making as it does around a 1½ ins. staff a wrap about 3 ins. in mean diameter. Or, the ordinary dimensions of the windlass used in practice will enable the motorman to put a strain of about 2000 lbs. on the brake chain. With the friction of shoe and weight of body assumed above it would be necessary, in order to obtain the maximum retarding effect, to apply a pressure of 10,000 lbs. to each shoe (40,000 lbs. in all) and to do this with a strain of 2000 lbs. on the brake chain, the leverage of the brake rigging must be ten to one. Examination of different designs of single trucks would point to the fact that practice is pretty well settled on a leverage over all, of nine or ten to one for this portion of the apparatus. Heavier double truck cars, of course, require more leverage than this, but their requirements can be obtained by the same process of reasoning and it is unnecessary to repeat it.

Practice has pretty well settled that these proportions are the most suitable. They enable a motorman to slide the wheels under most conditions, in fact, they give him, if anything, too much power in this direction, as slid flats are one of the heaviest individual items in the repair account of the Northern roads. This trouble seems to be mainly due, however, to locking the wheels first, then applying sand and allowing the tightly locked wheels to slide onto the sanded rail. The results of this process can, of course, hardly be blamed on the brake rigging.

Some roads have recently been driven, by reason of the enormous number of slid flats, to take such extreme measures as removing the sand boxes from the cars entirely, and supplying sand from special cars run at regular intervals over the track. Whether this can be done with safety or not remains to be seen. That it will almost completely

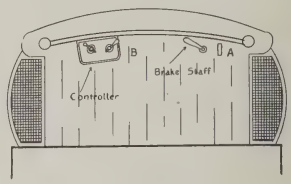


FIG. 1.

stop slid flats is unquestionable. But it may lead to an increase in the number of accidents that would be still more undesirable. Even the regular use of sand cars, without the removal of the sand boxes, would—in fact, in the writer's own experience has—shown a reduction in the cost of wheels. In this connection it might be suggested that our car builders might help out in this matter materially if they would give a little more thought to the location of the lever controlling the sand valve. Almost without exception the lever will be found located at A, as shown in Fig. 1, which may be supposed to represent a plan of a car platform.

In applying the brake the motorman must use his right hand on the handle, his right foot on the dog and swing his body toward the controller. All of these motions bring him away from his sand lever and he has no choice but to apply his brake, hold it with the dog, and then reach over to apply sand. He cannot by any possible contortions apply both brake and sand at the same time. Again, if he wishes to use the reverse he is out of reach of sand and must first reverse and then sand the rail, thus losing time which may be of vital importance in an emergency. If however a simple rockshaft is introduced below the platform and the sand valve lever is transferred to a position just to the right of the controller (as B in Fig. 1) the motorman can reach it with his left hand when apply-

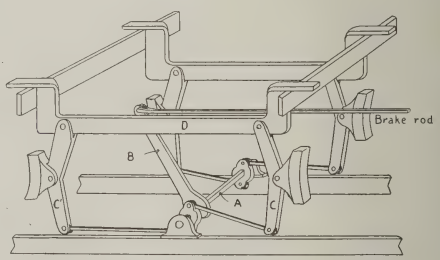


FIG. 2.

ing the brake or his right when applying the reverse, and the chance of locking the wheels before they reach the sanded track will be much reduced.

Even with a brake properly proportioned as to leverage there are several causes which may practically render it unsatisfactory. One of the most frequently encountered of these is spring or give in the parts of the brake rigging or its supports. The magnitude of the final pressures dealt with is frequently not appreciated by designers and consequently parts are so proportioned that increasing the

strain on the brake handle beyond a certain point instead of increasing the pressure on the shoes merely springs some member of the truck. This spring will probably be well within the limit of elasticity of the piece in question and so no permanent set will be produced and unless the parts are closely watched as the brake is applied, it will be very puzzling to tell why it is inefficient. Fig. 2 will illustrate an example of this.

In this rigging the leverage was ample and yet the car could not be stopped in a reasonable space nor could it be held on a steep grade. Investigation showed that in the first place the rockshaft, A, twisted under the strain of the lever, B, so that the shoes in the farther side received scarcely any pressure. In the second place the levers, C and C′, sprung slightly, and lastly the hanger bar, D, humped up in the middle when the pressure was applied. All summed up and multiplied by the leverage, these various levers permitted the brake handle to be turned two or three times around before the strain reached an amount that had any appreciable effect in retarding the wheels. Spring or give of this nature must exist, of course, to some extent. It is impossible to make a brake without some give. It would, in fact, be undesirable to do so. But it must be remembered that every $\frac{1}{16}$ in. lost at the shoes becomes ten times that much or $\frac{5}{8}$ in. more to wind up on the brake chain. There are two points where some lost motion is unavoidable, namely, the space between the shoes and wheels and the play of the boxes in the pedestals. We must allow at least $\frac{3}{4}$ in. ($\frac{3}{8}$ in. between each wheel and shoe) for the shoes for clearance and wear before adjustment is necessary, and probably $\frac{1}{4}$ in. for the play of the two boxes. In all, under the best conditions the play that must be taken up, without allowing for any spring, before pressure can be brought to bear on the wheels is at least one inch, or at the brake chain ten inches, or about one turn of the brake handle.

In connection with the amount of movement comes in another point in which a brake rigging, otherwise perfectly constructed, may fail.

Let Fig. 3 represent the simplest possible brake rigging, composed merely of a brake rod, A D, and lever, A C, two shoes, E and F, and rods, E C and B F, connecting them with the lever. Let the line, H I, represent the vertical. Should now a strain, M, be put on the brake rod, A D, in the direction indicated by the arrow head there would result in the lever, A C, two stresses, one of which would be transverse, tending to draw the two shoes, E and F, together by the movement of the lever. This strain would be equal to M sin D A C. The second strain would be one tending to compress the portion of the lever, A G, and would simply bear upon the point of support G. This strain would be equal to M cos D A C, in other words, if the lever, A C, were to fall back so far that it lay horizontal, A, being next to the shoe, F and C, next to the shoe E, the strain M, along D A, would not be multiplied by the leverage at all, it would all tend to press the lever, A C, against its point of support, G; or sin D A C, would then be equal to zero, and cos D A C equal to unity. As the strain on the brake rod draws the lever from the horizontal position just mentioned, toward the vertical position where it would coincide with the line, H I, the cos decreases; first very slowly, and later, as the lever approaches the vertical position, rapidly, O or the pressure on the point G, decreases and becomes zero when D A C equals a right angle. Likewise, as the lever rises from the horizontal to the vertical position sin D A C increases, first very rapidly, and later, as the lever approaches the vertical position, quite slowly. Now it is M sin D A C that represents the force, which multiplied by the leverage, tends to pull the shoes, E and F together, and, to put the above statements in other words, should the strain on the brake rods, D A, be constant, this force would increase as the lever, A C, rose from a horisontal position to a vertical one, becoming a maximum and equal to the whole strain, M, when the lever stood in a vertical position. When, however, the lever passes beyond a vertical position and the point A, begins to fall toward the shoe, E, the condition of things is reversed. Cos D A C changes sin B and increases very rapidly. The longitudinal force, M cos D A C, along the lever, A C, consequently tends now to pull the point, G, up instead of pressing it down as before, while sin D A C, the moment the lever passes the vertical position, becomes less than unity and continues to decrease more and more rapidly. Consequently, M sin D A C, which is the force that multiplied by the leverage tends to pull the shoes together, becomes less and less, and a point is soon reached where the rate of decrease in the value of the sin more than offsets the additional force applied along the brake rod, D A; in other words, the condition is arrived at of which motormen often camplain, namely, that pull as hard as they may, the brakes seem to take no better hold. The effect is increased beyond what it would be under the conditions just assumed by the fact that the point, D, on the brake rod where it is attached to the spindle, remains stationary the same elevation throughout, and consequently, the angle, D A C, increases much more rapidly after the lever, A C, has passed the vertical position then it does before. This is especially the case if the brake rod, D A, is short.

We have just seen above that it is necessary to provide at least ten inches of movement for the point, A, in order to take up the slack which must necessarily be allowed for the clearance of brake shoes from the wheels and box in the pedestals. We ought also to allow at least six inches more movement at this point for taking up the spring and

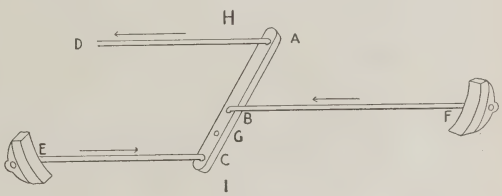


FIG. 3.

lost motion in the remainder of the brake rigging. It does not seem desirable that the lever, A C, when the brakes are released, should fall back much further than to the position of 45 degs. with the horizontal as, if it does, it falls into a segment of the circle of its swing, in which the sin decreases very rapidly and, consequently, into a position where the strain along the brake rod, D A, will much of it be ineffective for drawing the shoes up against the release springs. Taking this into consideration, it would seem that the length of the lever, A G, would not be shorter than the radius of a circle in which sin 45 degs. is equal to sixteen inches. In other words the length, A G, should not be much less than twenty-three inches in simple brake rigging similar to that shown in Fig. 3.

When we leave the four wheel truck in which the wheels are supported on each side by a solid slide frame which must be, in order to meet other requirements, amply stiff to resist the pressure of the shoe tending to force the wheels together without appreciable spring, and look at the problem presented to us by the double truck, we find the allowance of sixteen inches between the off position of the lever and that which it must assume when the brakes are applied with a maximum pressure, must be much increased. This is due to the fact that the whole strain on the rods leading from the lever to the brake rigging of each truck is tending to pull the trucks together. This action is similar to the tendency of the shoes in a single truck to pull the wheels together, and its effect on the working of the brakes of trucks such as those of the maximum traction class, which are held by slides instead of king pins, is very marked. If a tram be placed between the centers of the outside axles on the two trucks of a pair and the brake then applied. these axles will be found to move toward each other $\frac{3}{4}$ in. or 1 in. after the shoes have

actually come in contact with the wheels. As the cars carried on this class of truck are uniformly heavier than those carried on four wheel trucks, the leverage must of necessity be greater in order to apply the proper pressure to the shoes, consequently the lost motion would be multiplied by more than the leverage assumed when speaking of Fig. 3, and the time consumed in winding up the brake becomes proportionately greater. For this reason, if for no other, it would seem desirable to connect our double trucks to our car bodies through a king pin at the center on which the truck swivels. This is the only device which can be depended upon to hold the truck in position with little wear, and consequent lost motion.

The class of trouble referred to in explaining Fig. 3 is frequently met with where the design of the brake rigging is perfect in this respect as well as in others. It is due in such cases to neglect or ignorance on the part of workmen adjusting the brakes. It is frequently the case that repair men in order to get the shoes close to the wheels or perhaps simply to get rid of slack will hook up the brake chain so short that it is impossible for the lever to fall back any further than the vertical position when released. Consequently the first strain on the brake rod throws this lever beyond its position of maximum efficiency and by the time the shoes are brought fairly up to the wheels practically no more pressure is brought to bear on them than that acting along the brake rod itself. It seems strange that a workman with ordinary mechanical ideas should fail to grasp this idea at once, but the fact is that this has been, in the writer's experience, the most frequent cause of "bad brakes."

A New Snow Plow.

The following is a description of a new snow plow recently designed and put in operation by E. P. Baum, chief engineer and electrician of the Galesburg Electric & Motor Power Company, of Galesburg, Ill. It is thought by the inventor that this plow will solve the difficulty of deep snow on a street railway line.

The car is 16 ft. long and 6 ft. 1¾ ins. wide and has a height of 7 ft. from the rails to the top of the roof. The framework is of heavy oak timber, and the sills 5 ins. × 8 ins. are placed where the strain of the plows comes with the greatest force. The body of the car is finished in pine as light in weight as possible so that the car may not be too heavy. The trucks were made by the McGuire Manufacturing Company. Westinghouse No. 3 motors with type D controllers are used and the converters and connecting wires are all placed inside the car, leaving simply the motor connections beneath. As the plows are the main features of the car the whole thing is constructed with a view to the best workings of these. They are placed at either end of the car and are made of quarter inch steel. They measure four feet in height and run 8 ft. 4 ins. from the point of the nose to the heel. They are raised and lowered in guides by a ratchet lever and screw located inside the car. The plows are so constructed that they run back to a point close to the truck, doing away with the up and down movement common to cars having single trucks. On either side of the plow at the rear and coming close up to the truck is a very convenient part of the machine. This consists of a wing worked through a space of sixteen inches by levers also located inside the car. The principal use of the wing is in bucking large drifts, for when the plow is run into a big bank the wings are brought into the side of the car and so it may be easily backed. The plows may be raised and lowered through a space of several inches. The need of the lift is occasioned by the brick pavement with which Galesburg is plentifully supplied.

Inside the car there are two sand boxes with a rotating valve which allows of three different sized flows. Each box is independent of the other and can be worked by small levers from either end of the car. A drawbar is run through the rear end of the plow to which passenger cars may be attached. The car is fitted with two headlights worked in series with a three light chandelier placed in the top of the car. On the right side of the car is placed a door 2 ft. 3 ins. wide and 6 ft. 6 ins. high. Plenty of light is given the inside of the car from five windows and these also give a full view of the street.

Speed Ordinances.

For the purpose of learning what restrictions, if any, are put upon the speed of electric and cable cars in the principal cities of the United States, by special ordinances or provisions in the franchises, a letter of inquiry was recently sent by the Street Railway Journal to the chief municipal officers in every city having a population of 50,000 or over. From the cities to which letters were sent 46 replies were received. Of these replies nine cities reported that the speed of trolley cars was not restricted. The others stated that the speed was either limited by ordinances or franchises, and that in most cases different speeds were allowed in different parts of the city. The cities reporting that they have no ordinances regulating the speed of street cars, are Reading, Pa.; Fall River, Mass.; Chicago, Ill.; Pittsburgh, Pa.; Milwaukee, Wis.; Lynn, Mass.; Scranton, Pa.; Troy, N. Y., and Detroit, Mich.

The replies received, stating that restrictions are put upon the speed of the cars, are as follows:

Allegheny, Pa.—F. Goettmann, Jr., Clerk to the Mayor, states that the speed of electric cars in Allegheny is restricted by ordinances to 15 miles per hour in all parts of the city.

Atlanta, Ga.—C. A. Collier, Mayor, writes that the speed of electric cars in Atlanta is governed by ordinances. The different maximum speeds allowed are 4 miles an hour on crossings, 6 miles within a radius of ¼ mile from the center of the city, and 15 miles beyond that radius.

Baltimore, Md.—Charles G. Leonard, Secretary to the Mayor, writes that the speed of street cars in Baltimore is limited by ordinances to 6 miles in the business district and 10 miles in all other parts of the city.

Boston, Mass.—Thomas A. Mullen, Secretary, reports that the speed of electric cars in Boston is governed by ordinance. The maximum speeds allowed are: 7 miles in the business section, 10 miles in the section just beyond, 12 miles in the outlying districts and on curves anywhere not more than 4 miles an hour.

Brooklyn, N. Y.—W. M. Palmer, Secretary to the Mayor, states that the speed of cars in Brooklyn is governed by a number of ordinances. The maximum speeds allowed are 6, 8 and 10 miles per hour, depending upon the distance from the thickly settled districts.

Buffalo, N. Y.—Edgar B. Jewett, Mayor, reports that the speed of electric cars in Buffalo is not governed by ordinances, but is limited, however, by a contract between the city and the railway company, known as the "Milburn" agreement. By this agreement the maximum speed is 6 miles per hour in the business district and 10 miles per hour elsewhere.

Cambridge, Mass.—E. A. Connihan, Clerk to the Mayor, writes that the speed of electric cars in Cambridge is governed by a standing regulation of the Board of Aldermen. Maximum speed allowed differs from 8 to 12 miles per hour in different portions of the city.

Camden, N. J.—J. L. Westcott, Mayor, states that the speed of electric cars in Camden is limited by ordinances to 8 miles per hour in all parts of the city.

Charleston, S. C.—R. G. O'Neale, Clerk to the Mayor, states that the speed of electric cars in Charleston is limited by ordinances to 15 miles per hour except on one business street where it is five miles per hour. When turning all curves, 4 miles per hour is the maximum speed allowed.

Columbus, O.—The ordinance which regulates the speed of electric cars in Columbus is as follows: "The rate of speed at which cars may be run on High Street between Goodale Street and Mound Street, including stops, may equal, but shall not exceed, 8 miles per hour. On High Street except between the points above named, and on all other streets the rate of speed, including stops, may equal, but shall not exceed, 14 miles per hour."

Dayton, O.—John A. Hahne, City Clerk, writes that the speed of electric cars in Dayton is limited by ordinances to 10 miles an hour in all parts of the city.

Denver, Col.—T. S. McMurray, Mayor, writes that the speed of street cars in Denver is governed by a provision in the franchise. The maximum speeds allowed are 9 to 15 miles per hour in different parts of the city.

DES MOINES, IA.—John MacVicar, Mayor, reports that the speed of electric cars in Des Moines is limited by ordinances to 8 miles per hour in the business portion and to 12 miles per hour in other portions of the city.

EVANSVILLE, IND.—A. C. Hawkins, Mayor, states that the speed of electric cars in Evansville is restricted by a clause in the franchise to 12 miles per hour in all parts of the city.

GRAND RAPIDS, MICH.—Henry J. Felker, City Attorney, writes that the speed of electric cars in Grand Rapids is limited by ordinances to 7 miles in the business portion of the city and 15 miles in the suburban districts.

HARTFORD, CONN.—Miles B. Preston, Mayor, writes that the speed of electric cars in Hartford is limited by ordinances to 8 miles per hour within a radius of ½ mile from the City Hall and to 10 miles per hour, outside of that radius.

INDIANAPOLIS, IND.—T. Taggarth, Mayor, reports that the speed of street cars in Indianapolis is limited by an ordinance to 6 miles per hour in all parts of the city. This ordinance, however, was passed in 1876 before the introduction of electricity and there is no recent law on the subject.

KANSAS CITY, MO.—The City Controller states that the speed of cars in Kansas City is governed by provisions in the franchises. The maximum speed allowed is 12 miles.

LOUISVILLE, KY.—Geo. D. Todd, Mayor, writes that the speed of electric cars in Louisville is limited by ordinances to 9 miles per hour in the business district and 12 miles per hour in other parts of the city.

MINNEAPOLIS, MINN.—F. H. Forbes, Secretary to the Mayor, writes that the speed of electric cars in Minneapolis is restricted by ordinances to 6 miles per hour in all parts of the city. These ordinances, however, are not strictly enforced in the suburbs.

NASHVILLE, TENN.—M. McCarthy, Mayor, writes that the speed of electric cars in Nashville is limited by ordinances to 4 miles per hour on street crossings and to 9 miles per hour in all other places.

NEWARK, N. J.—J. C. Mundy, General Superintendent of Public Works, states that the speed of electric cars in Newark is limited by ordinances to 8 miles per hour in all parts of the city.

NEW HAVEN, CONN.—E. P. Lyon, Secretary to the Mayor, writes that the speed of electric cars in New Haven is limited by ordinances to 10 miles per hour within a radius of one mile from the center of the city and to 12 miles per hour beyond that radius.

OMAHA, NEB.—R. B. Howell, City Engineer, reports that the speed of electric cars in Omaha is limited by ordinances to 10 miles per hour in the business district, and to 15 miles per hour in all parts.

PATERSON, N. J.—Christian Brain, Mayor, states that the speed of electric cars in Paterson is limited by ordinances to 10 miles an hour within a radius of ¾ mile from the City Hall, and to 15 miles per hour outside of that radius.

PROVIDENCE, R. I.—E. D. McGuinniss, Mayor, reports that the speed of electric cars in Providence is regulated by ordinances, and varies in different parts of the city. The maximum speeds allowed are 6 miles, 9 miles, 10 miles and 12 miles per hour.

RICHMOND, VA.—Richard M. Taylor, Mayor, states that the speed of the trolley cars in Richmond is limited by ordinances, but is not different in different parts of the city. The maximum speed allowed is 4 miles an hour when on a curve, and not greater than 8 miles an hour at any other time.

ROCHESTER, N. Y.—T. S. Pulver, City Clerk, writes that the speed of electric cars in Rochester is limited by ordinances. The maximum speed allowed differs from 7 miles an hour in some districts to 15 miles an hour in others.

ST. JOSEPH, MO.—Charles F. Shepherd, City Clerk, states that the speed of electric cars in St. Joseph is limited by ordinances. The maximum speeds allowed are 8 and 10 miles per hour.

ST. LOUIS, MO.—Robert E. McMath, President of the Board of Public Improvements, states that the speed of all cars in St. Louis is regulated by special ordinances for each road. Maximum speeds allowed differ in different parts of the city, and are from 8 and 10 miles to 12 miles per hour.

ST. PAUL, MINN.—Frank B. Doram, Mayor, reports that the speed of electric cars in St. Paul is limited by ordinances to 8 miles in some sections and 12 miles in other districts. The ordinances, however, are not rigidly enforced.

SYRACUSE, N. Y.—James K. McGuire, Mayor, writes that the speed of electric cars in Syracuse is limited by ordinances to 8 miles an hour in all parts of the city.

TOLEDO, O.—G. G. Major, Mayor, writes that the speed of electric cars in Toledo is limited to 7 miles per hour in all parts of the city.

TRENTON, N. J.—Emery N. Yard, Mayor, states that the speed of electric cars in Trenton is limited by ordinances to 6 miles an hour in the heart of the city, and to 8 miles an hour in the outskirts.

WASHINGTON, D. C.—The ordinance regulating the speed of street cars in Washington reads as follows: "No street car shall move at a greater rate of speed than 12 miles an hour in the city of Washington, nor at a greater rate of speed than 15 miles an hour outside of said city; street cars shall not exceed a rate of speed greater than 6 miles an hour at street crossings."

WILMINGTON, DEL.—C. R. Jefferis, Mayor, states that the maximum speed of electric cars permitted in Wilmington is from 5 to 7 miles per hour.

WORCESTER, MASS.—A. B. R. Sprague, Mayor, writes that the speed of electric cars in Worcester is limited by ordinances to 8 miles an hour in all parts of the city.

Some Statistics on the Life of Brake Shoes, Gears, Pinions and Trolley Wheels.

The results secured by different railway companies in the life of the apparatus in their service, is, as may be expected, extremely varied. This difference should not be attributed solely either to the kind of apparatus employed or to the care taken of it, as local conditions necessarily enter largely into the question of wear and life. Statistics of the wear of railway parts are interesting, however, as they give in a general way the practice of operating companies and so are of some value to any operator.

The following particulars are the result of an inquiry instituted among a few companies by the STREET RAILWAY JOURNAL as to the life of motor gears, pinions, brake shoes and trolley wheels. The investigations of the Journal showed that while many companies are giving the matter the attention which it deserves, some were unable to give the desired information, and others reported such very high records as to suggest some possible error in the method of computation. A large percentage of those keeping no records expressed the intention of commencing to do so and will be prepared to report at a later date. The questions asked were: What kind of motor pinions do you use and what is their life? What kind of gears and what is their life? What kind of trolley wheels and brake shoes and the life of each?

The conditions varied so widely that the answers did not admit of publication in the form of a table, so the replies are given under the names of the different companies just as they were received. It will be noticed that the lives of the different parts are given in some cases in terms of car miles run and in others in terms of actual duration of time. Not all of the figures given are exact averages, some of them being stated as approximations. The experience of other railway companies is earnestly desired by the editors of the STREET RAILWAY JOURNAL, who will be glad to publish them.

BRISTOL & PLAINVILLE TRAMWAY COMPANY, BRISTOL, CONN.

Pinions.—Iron; nine months.
Gears.—Iron; eighteen months.
Trolley Wheels.—Solid; two or three months.
Brake Shoes.—"Composite"; three months.

CHICAGO CITY RAILWAY COMPANY, CHICAGO, ILL.

Pinions.—Steel and rawhide; steel, twenty-four to thirty months; rawhide, eight to twelve months.
Gears.—Cast iron, malleable steel and steel; cast iron, twelve to fifteen months; malleable steel, fifteen to twenty months; steel, twenty-two to twenty-eight months.
Trolley Wheels.—Brass; fourteen to eighteen months. Life of graphite bushings, six to nine weeks.
Brake Shoes.—Cast iron with steel lugs set in bearing surface; eight to ten weeks.

CINCINNATI, NEWPORT & COVINGTON RAILWAY COMPANY, COVINGTON, KY.

Pinions.—"Hot pressed"; eleven months.
Gears.—Malleable iron; in use three years, none worn out.
Trolley Wheels.—Composition; eight to nine months.
Brake Shoes.—Special pattern; five weeks.

COLUMBUS STREET RAILWAY COMPANY, COLUMBUS, O.

Pinions.—Cut steel; one year.
Gears.—Cast iron and cast steel; two years.
Trolley Wheels.—Company's own make; three months.
Brake Shoes.—Cast iron with soft steel plugs in face; seventy-five days.

ALTOONA & LOGAN VALLEY RAILWAY COMPANY, ALTOONA, PA.

Pinions.—Steel; 70,000 miles.
Gears.—Steel; 160,000 miles.
Trolley Wheels.—Different makes; 6000 miles.
Brake Shoes.—Cast iron; three to five months.

BIRMINGHAM RAILWAY & ELECTRIC COMPANY, BIRMINGHAM, ALA.

Pinions.—Cut steel, General Electric; 54,000 miles.
Gears.—Cast iron, General Electric; 54,000 miles.
Trolley Wheels.—General Electric; one month.
Brake Shoes.—Cast iron; 13,500 miles.

CARBONDALE TRACTION COMPANY, CARBONDALE, PA.

Trolley Wheels.—Thomson-Houston; 2450 miles.
Brake Shoes.—Cast iron; 7950 miles.

CITY & SUBURBAN RAILWAY, BALTIMORE, MD.

Pinions.—Four kinds are used, with great difference in life. The records of the different makes of pinions are given below:
Manufacturer A, 13,682 miles,
Manufacturer B, 11,114 miles.
Manufacturer C, 7557 miles.
Manufacturer D, 7699 miles.

COLUMBUS CENTRAL STREET RAILWAY COMPANY, COLUMBUS, O.

Pinions.—Westinghouse; two years.
Gears.—Westinghouse; two years.
Trolley Wheels.—Central Electric; four weeks.
Brake Shoes.—Ohio Pipe Company; four weeks.

CONNELLSVILLE, NEW HAVEN & LEISENRING STREET RAILWAY COMPANY, CONNELLSVILLE, PA.

Pinions.—Six years;
Gears.—Cast iron; two years.
Trolley Wheels.—"Anderson"; 8000 miles.
Brake Shoes.—"Composite"; eleven months.

DETROIT CITIZENS' STREET RAILWAY COMPANY, DETROIT, MICH.

Pinions.—Hammered steel.
Gears.—Cast steel.
Trolley Wheels.—Company's own make.
Brake Shoes.—Johnson Company; 6000 miles.

EASTON TRANSIT COMPANY, EASTON, PA.

Pinions.—Pressed steel; 120,000 miles.
Gears.—Malleable iron; 70,000 miles.
Trolley Wheels.—Brass;
Brake Shoes.—Cast iron; 5500 miles.

ELMIRA & HORSEHEADS RAILWAY CO., ELMIRA, N. Y.

Pinions.—Rawhide, New Process Rawhide Company, Syracuse, N. Y., and steel, A. Mertes Manufacturing Company, Allegheny, Pa.; rawhide, 36,000 miles; steel, 62,750 miles.
Gears.—Steel, A. Mertes Manufacturing Company, Allegheny, Pa.; 62,750 miles with steel pinions.
Trolley Wheels.—"Ajax"; 4500 to 5500 miles.
Brake Shoes.—"Corning", Corning Brake Shoe Company, Corning, N. Y.; 23,000 miles.

FORT WORTH STREET RAILWAY COMPANY, FORT WORTH, TEX.

Pinions.—Raw hide and steel; raw hide, 73,000 miles; steel, 44,500 to 73,000 miles.
Gears.—Iron and steel; iron, 36,000 miles; steel, 91,250 miles.
Trolley Wheels,—Brass and bronze; 27,000 miles.
Brake Shoes.—"Lappan"; 36,500 miles.

HOUSTON ELECTRIC STREET RAILWAY COMPANY, HOUSTON, TEX.

Pinions.—Steel; 24,000 miles.
Gears.—Cast iron; 24,000 miles.
Trolley Wheels.—Bronze; 1800 miles.
Brake Shoes.—Soft cast iron; 7200 miles.

LITTLE ROCK TRACTION & ELECTRIC COMPANY, LITTLE ROCK, ARK.

Pinions.—Steel, 30,000 miles.
Gears.—Steel and cast iron; steel, 60,000 miles; cast iron, 45,000 miles.
Trolley Wheels.—Company's own make; 10,000 miles.
Brake Shoes.—Cast chilled; 10,000 miles.

MAHONING VALLEY RAILWAY COMPANY, YOUNGSTOWN, O.

Pinions.—United States Projectile Company and Nuttall Kapp; nine to eleven months.
Gears.—Westinghouse and General Electric; Westinghouse, in service eighteen months and some still in use; General Electric, ten to twelve months.
Trolley Wheels.—American Brass Company; twenty to thirty days, 3500 to 5000 miles.
Brake Shoes.—Gray iron; 3500 to 4000 miles.

MIDDLETOWN STREET RAILWAY COMPANY, MIDDLETOWN, CONN.

Pinions.—General Electric; two years and still in use.
Gears.—General Electric; two years and still in use.
Brake Shoes.—"Composite" with wooden plugs in face.

NORWALK TRAMWAY COMPANY, NORWALK, CONN.

Trolley Wheels.—General Electric; 4000 miles.
Brake Shoes.—Cast iron; 10,000 miles.

NORWICH STREET RAILWAY COMPANY, NORWICH, CONN.

Pinions.—United States Projectile Company; eighteen to twenty-four months.
Gears.—Cast iron and steel; cast iron twelve to eighteen months; steel, two to two and one-half years.
Trolley Wheels.—"West End", 6000 miles.
Brake Shoes.—Composition; three months in summer, four and one-half months in winter.

RICHMOND TRACTION COMPANY, RICHMOND, IND.

Pinions.—Milled steel; 50,000 miles in mesh with cast iron gears; 70,000 miles in mesh with steel gears.
Gears.—Cast iron and steel; cast iron, 61,000 miles; steel, 125,000 miles and still in use.
Trolley Wheels.—Bronze; 6000 miles.
Brake Shoes.—Gray iron; 28,000 miles.

SIOUX CITY TRACTION COMPANY, SIOUX CITY, IA.

Pinions.—Rawhide and steel; rawhide, four to six months; steel, none worn out.
Gears.—Davis & Cowgill, Omaha, Neb.; two to three years.
Trolley Wheels.—"Home Made", Novelty Manufacturing Company, Sioux City, Ia.; three to four months.
Brake Shoes.—"Home Made", three months.

SUTRO RAILROAD COMPANY, SAN FRANCISCO, CAL.

Pinions.—Steel; one year and still in use.
Gears.—Steel; one year and still in use.
Brake Shoes.—Cast iron.

TERRE HAUTE RAILWAY COMPANY, TERRE HAUTE, IND.

Pinions.—Steel; 47,000 to 59,000 miles.
Gears.—Steel; 59,000 to 71,000 miles.
Trolley Wheels.—Bronze; 11,700 miles.
Brake Shoes.—Cast iron with wooden plugs in face; 5950 to 7800 miles.

WEST CHICAGO STREET RAILROAD COMPANY, CHICAGO, ILL.

Pinions.—Steel, General Electric; seven months.
Gears.—Cast iron, General Electric; seven months and still in use.
Trolley Wheels.—McAndrews, Chicago; 16,155 miles.

WEST SIDE RAILROAD COMPANY, ELMIRA, N. Y.

Pinions.—Milled steel, General Electric; 9480 miles.
Gears.—Milled steel; 16,320 miles.
Trolley Wheels.—1100 to 1900 miles.
Brake Shoes.—1050 to 1700 miles.

Possible Elevated Railway Consolidation in Brooklyn.

President Uhlman, of the Brooklyn Elevated Railroad Company, made the prediction last month that, if the proposed plans for running elevated trains over the Bridge are carried out, the Brooklyn and Kings County elevated roads will combine, and operate their entire systems under one management. He said that a combination of this kind would be of great advantage to both roads, and for some reasons would be almost necessary. He was not ready to give any of the details of the combination, saying that the the details could not well be decided upon until it was certain that the roads would have access to the Bridge.

Proposed Street Railway Commission.

A bill has been introduced in the Connecticut State Legislature to establish a State Commission on Street Railways, whose powers as to electric street roads will be similar to those exercised by the present Board of Railroad Commissioners over the steam roads. The bill creating the new commission, defines its duties, and provides that the commissioners shall receive $5 per day and expenses.

Street Railway Parks and Pleasure Resorts.—2.

In the February issue of the STREET RAILWAY JOURNAL there were published a number of reports from different cities giving the experience of several street railway companies with parks and pleasure resorts. A large amount of additional information regarding this subject has been received. Information and reports from a number of cities are given herewith, and still other information will be published in the April number.

CHAMPAIGN, ILL.

The Urbana & Champaign Electric Railway Company in the fall af 1892 had to make a two mile extension of its line through a residential district and then on into property not yet built up. The company put down a splendid track, and realizing that it had to artificially build up travel until people located along the line and gave a regular traffic, the company built West End Park which is located about two miles west of the business center of Champaign, and about six miles west of the business center of Urbana. The park was opened in July, 1893. It covers about seven acres of ground, and is surrounded on all sides by a seven foot fence. All the buildings are thoroughly well built and nicely painted and cost together with the other improvements in the park about $17,000. The walks are made of cinders. The trees were all planted in 1893, and are now of good size.

WEST END PARK—URBANA & CHAMPAIGN ELECTRIC RAILWAY CO.

The company does not charge admission to the park except for baseball games, etc. Residences have been built up along the new line and street pavements and sidewalks have been extended out to the park. The company intends for the season of 1897 to sell a three-coupon ticket for ten cents, which will cover street car fare to the park and return, and admission to the park. The street railway company operates a casino at the park in which shows of different kinds are given, admission to which varies from ten to thirty cents. Regular theatrical companies usually play on a percentage basis. At other times the street railway company employs teams or show companies at a stated price per week. The street railway company operates a switchback railway at its own expense, but the bowling alleys, shooting gallery, refreshment and similar privileges are let on a percentage basis, or preferably at a stated sum for the season. The railway company operates an arc light stereopticon which has proven a great feature. Advertisements and views are shown alternately, and the advertisements more than pay the cost of operation. The company states that the people never seem to tire of this exhibition. The company gives about three band concerts a week, and frequently lets the park grounds for baseball and football games, shooting matches, picnics, etc. The directors are thinking of adding a bicycle track around the borders of the ball field, and may also construct a small lake, 200 ft. × 75 ft., which can be used for a natatorium in summer and for ice skating in winter. Fireworks draw very well indeed, and the company buys a large quantity at a time, giving an exhibition about once a week. The tone of the park is kept very high so that the best people use the grounds for outings, etc., and no intoxicating liquors are allowed. The street railway company estimates that in a good season the summer railway passenger receipts will be increased thirty-five per cent. No cars are run on Sundays. The president of the company states that he would not advise a street railway company to build or own a park if it can induce outside persons to do so. He states that a park is a great deal of bother and that the public does not give the credit to the street railway company that it should.

GRAND RAPIDS, MICH.

The Consolidated Street Railway serves two parks, one of which, known as Rudo Lake Park, is situated on the lake of that name and fitted with a handsome pavilion, an excellent stage, etc. The other, which is known as North Park, is on Grand River. This park is also provided with a good pavilion. Rudo Lake Park is owned by the railway company and contains about twenty acres. It is situated about four miles from the city. North Park contains about sixteen acres. No admission fees are charged to the parks, but the company is contemplating making a small charge to bicyclers, but not to patrons of the cars. At Rudo Lake first class vaudeville shows are frequently given, and small steamboats, naphtha launches, sail and row boats are in operation on the lake. The company owns the dock and wharfage privileges and leases the privileges of the boats to outside parties. The vaudeville shows have always drawn very large crowds which have sometimes taxed the capacity of the road to the utmost. The restaurant privileges are all leased. The increase in the traffic on lines leading to the park has been found to be from 15 to 25 per cent, varying according to circumstances and to the popularity of the attractions provided.

LOWELL, MASS.

The Lowell & Suburban Street Railway Company owns a park, which is situated five miles from the center of the city. Entertainments of different kinds are provided at the park and vary from a summer opera in the theatre, to which a nominal admission fee is charged for the purpose of defraying expenses, to outdoor attractions consisting of Japanese jugglers, hot air balloon ascensions, fireworks, swimming and many other attractions, all outdoors and free. The cost of the entertainment in each case is kept so low that the additional riding will more than compensate for the outlay. There is a lake in the park on which two launches and fifty row boats are operated. The privileges of these are leased to outside parties. The aim of this company has been to make the park self-sustaining, and in this it has been entirely successful, as the park has been from the first, considered solely as a business proposition, a paying investment.

MT. VERNON, O.

The Mt. Vernon Electric Railway Company owns and operates one park upon which it has spent a large amount of money in improvements, etc. Fifty very pretty cottages have been built at this park, for rent by the week, month, or season at low prices. Fine boating and good black bass fishing are provided, together with a number of other amusements of a high character. The park contains very fine athletic grounds.

ATCHISON, KAN.

The Atchison Railway, Light & Power Company owns a park situated about two miles from the city. No admission is charged to visitors. Band concerts are given Sunday afternoons and evenings, and other entertainments through the week. The company intends to provide an artificial lake next season. The company usually leases all restaurant and other privileges for about $500 per year. It finds that fireworks or theatrical performances are unsuccessful financially, but reports that the street railway traffic is doubled when the park is opened.

FORT WAYNE, IND.

The Fort Wayne Consolidated Railway Company serves four parks, of which one, Robinson Park, containing 270 acres, is owned by the company. The company charges a double fare on its park line. Novel outdoor entertainments, naphtha launches and merry-go-rounds are provided at Robinson Park and leased to outside persons on a percentage of the receipts. The company states that the receipts more than pay the running expenses and the cost of attractions. It also thinks that it pays to give exhibitions of fireworks and theatrical performances. The restaurant privileges are leased for from fifteen per cent to thirty-five per cent of the receipts. The company finds that the traffic increased over forty per cent the first year the park was operated.

VIEWS NEAR ROBINSON PARK—FORT WAYNE CONSOLIDATED RAILWAY CO.

SAN FRANCISCO, CAL.

The Sutro Railroad Company serves two parks, one of which, Golden Gate Park, is owned by the company, and the other, Sutro Heights, is owned by a private individual. Golden Gate Park is about three miles from the city, and Sutro Heights is about six miles. The attractions at the parks are the Sutro Baths, Cliff House and the Seal Rocks. At Sutro Heights, athletic entertainments, swimming matches, etc., are frequently held. About one-half of the traffic of the entire line goes to the western terminal where the parks are located.

KANKAKEE, ILL.

The Kankakee Electric Railway Company owns a park which contains about thirty acres, situated about 2½ miles from the city. Vaudeville programmes are given in the evening, admission to which is usually fifteen cents. The company leases all privileges of the park, except restaurant privileges, for twenty per cent of the receipts. The restaurant privileges are leased for twenty-five per cent of the receipts. The company finds that fireworks and theatrical performances give excellent results, and that the traffic is about doubled when the park is open.

CAMDEN, N. J.

The Camden, Gloucester & Woodbury Railway serves two parks, both of which are owned by private persons. The owners of these parks derive their income from the sale of liquors, from amusements of various characters, and from dining and lunch counters. These parks increase the railway traffic about thirty per cent on the lines that serve them.

WILMINGTON, DEL.

The Wilmington City Railway serves one park which it owns. The park contains a large pond and the company has gone to considerable expense toward fitting this up for skating purposes. The pond is a new venture, but after about ten days of skating it was demonstrated that the investment was one of unusual profit. The officers of the company state that about twenty days of good skating in a season will more than pay the total cost of construction. Good skating days increase the receipts of the line to the pond seventy-five per cent. The construction of the pond consists of a stone wall built across a small creek. The cost of wall and excavating was about $2000. The large number of skaters which come to the pond every evening soon cut the ice quite badly, and as it is impossible to flood the ice successfully, the company sprinkles it with a garden hose and sprinkler similar to those used to sprinkle grass. It is found that this sprinkling fills the small cracks and skate marks sufficiently to render the ice perfectly smooth. Posts fifteen feet high are set in the margin of the pond thirty feet apart, and upon each one of these posts is placed a five-light cluster of lamps supplied with current from the trolley circuit. Fireworks are provided occasionally and prove a strong drawing card. The company supplies fires by which the skaters can warm themselves, skates to hire, straps to sell, etc., and coats and bicycles are checked for a small sum. A man is stationed at the gate to allow no one to enter who is not a car passenger, and another man is kept on the ice to see that order is maintained among the skaters. This pond will be provided with boats during the summer season.

WEBB CITY, MO.

The Southwest Missouri Electric Railway Company owns two parks, and has managed them itself for two seasons. During the coming season, however, the company will lease one of these parks to private individuals, who will supply all attractions and pay all expenses, deriving all the profit they can from the use of the park, the com-

pany supplying only the lights. It has been the experience of this company that parks are only indirectly profitable, and it prefers to retain the additional fares obtained from the park travel, permitting the lessees to derive any other profits there may be in the business. Musical and theatrical entertainments are the kind usually provided.

SAGINAW, MICH.

The Union Electric Street Railway Company serves a park situated on the Tittabawasse River, about five miles from the center of the city. This park is known as Riverside Park, and contains about sixty acres of ground, which is covered with a beautiful grove. It is owned and equipped by the Union Electric Street Railway Company. The company provides attractions of various kinds, including balloon ascensions, parachute jumps, merry-go-rounds, swings, croquet grounds, luncheon tables, boating, bathing, etc. A grand opera company is also engaged for the summer season, together with musical entertainments of various kinds. A good band is usually provided. The company makes a special point of inviting churches, fraternal societies and all similar organizations to hold excursions and picnics at Riverside Park, and as the park is inside the city limits, it is thoroughly policed, and no intoxicating liquors are sold, thus insuring the best of order at all times. The restaurant privileges are leased for $2500 per year, and the income from the various entertainments, merry-go-rounds, etc., is $500 per season. This company has found that fireworks are usually successful, but that theatrical performances, as a rule, do not pay. The company states that this park increased the passenger traffic 50 per cent for three months, on the lines running to the park.

VIEWS IN PARK OF FORT WAYNE CONSOLIDATED RAILWAY CO.

OTTAWA, ONT.

The Ottawa Electric Railway serves two parks, one of which is owned by the city of Ottawa and the other by the Ottawa Electric Railway Company. No admission fees are charged to either of the parks, and riding galleries, swings, band concerts and variety entertain-

ments of various kinds are provided at both places. A small admission fee is charged for the entertainments and also for the swings and riding galleries. This company has found that fireworks and theatrical performances are very successful, and is making arrangements to build quite an elaborate building in which theatrical performances will be given. The present structure is a temporary one and was built as an experiment. For several weeks, starting with the opening of the season, Edison's vitascope was exhibited accompanied by variety specialties. Outside of the park enclosure, the company has a refreshment pavilion which is leased for 20 per cent of the gross receipts. The lessee binds himself to conduct the place in a manner satisfactory to the company, and is prohibited from selling intoxicating liquors. The riding gallery and the swings are conducted by the company's own employes. The company states that the increase in traffic derived from the parks has been very large.

SAN DIEGO, CAL.

The Citizens' Traction Company owns a park and pavilion located at the north end of its line on the bluff of Mission Valley. The pavilion overlooks the Linda-Vista Highlands on the north; the old Mission erected in 1769 and the Cujamasa Mountains on the east, and the Pacific Ocean on the west. The elevation above the sea is 500 ft. The ordinary attractions of a summer garden with refreshments have made a large increase in the daily travel, and the managers state that the road has a large traffic on Sundays and holidays.

DAVENPORT, IA.

The Tri-City Railway Company serves one park of twenty-five acres which is owned by the railroad company and one park of thirty acres which is owned by a German shooting society. These parks are situated at the ends of different lines. No admission is charged to the street railway park, but on special occasions ten cents to fifty cents is charged at the shooting park. The company provides music and free shows, and also provides light operas, for which nominal charges are made. The company leases the privileges of boats, chutes, riding galleries, shooting galleries, etc., to private parties. About twenty per cent of the gross receipts are derived from these leases. The company charges ten cents fare and finds that free amusements, judiciously selected for Sundays and holidays especially, are quite profitable, owing to increase in traffic. The restaurant privileges are leased for from $1000 to $2000 per annum. The company's park line has little else to depend upon besides pleasure riding, and hence the attractiveness of the park and entertainments are important factors in increasing the receipts of the road.

SHEBOYGAN, WIS.

The Sheboygan Light, Power & Railway Company serves eight parks, one of which is situated in the heart of the city, the rest being situated at distances varying from one to two miles from the center of the city. One of the parks, which is owned by private parties, charges ten cents admission, and one other, a baseball and bicycle park, usually charges twenty-five cents admission. The others are free. One of the parks is owned by the officers of the Sheboygan Light, Power & Railway Company. At this park, fireworks, music, a menagerie, dancing, and a summer hotel are provided by the company, and the company states that the income from its park is from $25 to $100 a day in the summer, according to the attraction provided. The company thinks that fireworks and theatrical performances if displayed at an attractive resort and judiciously invested in, are quite profitable. It always finds that music is very attractive, and when bands are engaged quite frequently, they can be secured at much less than the usual charge. Definite figures are not known, but the company states that the park traffic forms a material portion of the total revenue of the road during the summer months.

DULUTH, MINN.

The efforts of the Duluth Street Railway Company to create travel have heretofore been centered entirely upon a summer theatre, "The Pavilion," which consists of a two story building with balconies on the side towards a lake. The lower floor is fitted up with a dining room, cigar and candy counters, etc., and the upper floor has an auditorium, having a seating capacity of 1500 people, and fitted with a complete stage and all necessary arrangements for the convenience of operatic, dramatic or vaudeville performances. This pavilion is situated at the head of an incline railway, some 600 ft. above the level of Superior Street, and commands a view of many miles of scenery in Minnesota and Wisconsin, including the Superiors, etc. The excellent view and the cool breezes always to be found here, are the chief attractions, aside from the theatre itself.

The pavilion, including the theatre and all of the privileges, have usually been leased to private parties, although it was operated by the street railway company for one season. The company has a very attractive public park, which is reached by one of its lines, built last season. There is also an attractive park at the terminus of the Lakeside Railway Company's line, which is operated by the Duluth Street Railway Company. There have been no attractions provided by the street railway company at either of these parks, although they are very popular for picnics, which fact increases the receipts considerably.

PORTLAND, ME.

The Portland Railroad Company serves a number of parks and recreation grounds. Fort Allen Park, fronting the bay, is a very attractive resort, commanding a very fine view of the harbor and shipping, and directly back of the city is another very attractive resort, Deering Park, which is owned by the city, and tastefully laid out. In addition, there are a number of smaller parks and promenades which are served by the lines of this company. The Portland Railroad Company, in addition, owns a large park, of thirty-six acres, on the Presumpscot River, about five miles from the center of the city, which contains a great many natural attractions. The company is operating an electric launch here with great success.

RUTHERFORD, N. J.

The New Jersey Electric Railway Company serves seven parks. This is quite an extensive system, running through four cities, three boroughs, one town, four townships and four villages, and passing through three counties. Some of the parks are just outside the city limit, others three to four miles from the centers of population. The company owns but one of these parks, which covers five acres. Two of the parks can be rented at stated terms, and the others are free. The private parks are supported by hotels connected with them. Bands, balloon ascensions and concerts are provided at the different parks. There were ninety-four church picnics last year at the park owned by the New Jersey Electric Railway Company, at which there was an average attendance of 400 persons, making the gross receipts about $40 for each picnic. Restaurant privileges are leased for $90 per season of four months. The company thinks that a very large increase in traffic can be made from parks.

LOS ANGELES, CAL.

The Los Angeles Railway Company serves five parks, three of which are public; one is owned by an athletic association and one by an agricultural park association. The source of income of the private parks is the gate and grand stand receipts. The company provides a brass band of twenty-three pieces at the principal park every Sunday afternoon. The company occasionally gives an exhibition of fireworks, which is found to pay well. Light refreshments only are served.

ANDERSON, IND.

The Anderson Electric & Street Railway Company owns a park covering about forty-four acres situated one

mile from the center of the city. The park has not been in operation very long and has not yet been provided with many attractions. An admission fee of ten cents is charged to persons who do not ride to the park on the cars of the company. Admission tickets are issued free to passengers on the cars. The park was opened by an entertainment given by Alphonso King's Water Carnival, including tight rope walking and an exhibition of fireworks. A large crowd was attracted on the opening night, and it is expected that the park will considerably increase the traffic.

VIEWS IN PARK OF THE BIRMINGHAM RAILWAY & ELECTRIC CO.

BIRMINGHAM, ALA.

The Birmingham Railway & Electric Company serves four parks, one of which it owns. It has the free use of the other three. The one owned by the company is five acres in extent and for colored people. The others are owned by land companies established along the company's lines. They contain about 100 acres each. The parks are located at a distance from two to seven miles from the city. No admission fee is charged. Summer opera, balloon ascensions, fireworks, etc., are provided. The company states that these features are financially successful.

LETTERS AND HINTS FROM PRACTICAL MEN.

A Method of Obviating Head-End Collisions on Single Track Roads.

The Southwest Missouri Electric Railway Company.
Webb City, Mo., Jan. 23, 1897.

Editors Street Railway Journal:

We are operating a single track interurban electric railway, and to companies having such a road head-end collisions are a constant menace, and sometimes a cause for insolvency.

Collisions will happen only in places where motormen on cars approaching each other in opposite directions cannot see the approaching car a sufficient distance to stop, and will not occur when all cars are on time and are meeting at regular passing places. But when cars are off time the tendency of the motorman is to drive his car ahead in order to make time, and the danger of coming into collision with an approaching car in some cut is obvious.

I considered several expedients for removing this danger on our road. A double track through curving cuts, a system of electric signals from switch to switch and a telephone system were all considered and all were discarded for the plan I have adopted, which is as follows: at either entrance to a curving cut is placed a signal in large letters "slow." In the middle of the cut is the signal "stop," and at either exit is the signal "let go." Where the cut is on a grade the car on the down grade has same signals as above; but the car going up grade is not signaled. Motormen are required to observe the signals whether they are on time or off time, so that the habit of going slowly and stopping at the places of danger becomes a fixed one. When the injunctions above given are obeyed a head collision could hardly occur.

A. H. Rogers, President.

The Life of Gears.

Schenectady Railway Company,
Schenectady, N. Y., Feb. 1, 1897.

Editors Street Railway Journal:

In regard to the question of life of gears and pinions, I have finally settled down to rawhide pinions and cast iron or steel gears (the latter being unattainable for some makes of motors) wherever the pinion is sufficiently large to allow of its being made of that material. The pinions of some makes and styles of motors are so small in diameter of body and so large in bore that there is not "stock" enough left after the keyway is cut, to admit of their being made of anything but a tough metal.

Before coming to the above determination I tested—for six years and on nine different kinds and sizes of motors—everything that misdirected genius has tried to put into gearing, including wood, fibre, leather, pasteboard, paper, laminated sheet iron and steel, "composite" and "wave-line composite," brass, bronze and combinations of all; and the results obtained make me say that, with the one limitation of size of pinion, there is no condition of running that would, at present, make me use any other combination than a rawhide pinion and a metal gear. My reasons for this determination are as follows:

1. They are practically noiseless either with or without gear case, and will remain so until worn out.

2. By reason of the comparative softness and elasticity of the material of the pinion they obviate to a great extent the crystallization and breaking of the armatures and field wires.

3 For the same reason, they, to some extent, "cushion" the starting and stopping of the car.

4. The rawhide pinion teeth can be worn down to the breaking point without fear of injury to the teeth of the gear, or of bending the armature shaft or of breaking frames or bearings.

5. They will pass small objects such as nails, wire, screws, etc., between their teeth without very great injury to them and with none to other parts of the motor.

6. When rawhide pinions are used, the useful life of the gear is prolonged from three to five times beyond what it would be if steel pinions were used.

As a recent proof of the validity of the above reasons I give the following: we have in use several No. 16 Edison 20 h. p., single reduction motors, having rawhide pinions and cast iron axle gears. The motors are not built so as to use a gear case and consequently the gears run absolutely open and unprotected from dust, mud, snow, slush or water, and we have plenty of each in season. Our track is in fair condition, but the route is quite a crooked one, necessitating many curves and reverse curves, all of which are on grades from 3 per cent to 12 per cent.

Our cars are heavy, eighteen foot, full vestibuled, and make an average of about one hundred miles per car per day. We have a number of bad railroad crossings and other points which necessitate many stops, besides those for passengers. At certain times during the day the cars are heavily loaded, and in summer our travel is quite heavy. The road is, therefore, one that is especially hard on gearing, and yet, in three years' running, we have had only one accident due to the gearing, and that was caused by a horseshoe thrown into it by a car wheel—result, a slightly bent armature shaft and a ruined pinion, gear not injured. We have had absolutely no trouble at all with crystallization of armature or field wires, although we have armatures that have been running nearly three years. Our cars always run quietly, and we obtain a life of from 25,000 to 40,000 miles from the pinions, and are still running the original gears put in with them three years ago, and they look as if they were good for a year or so more.

I have had equally good results on double reduction motors, and on single reduction with gear case. In the latter case, the gears were steel instead of cast iron and the results as regarded them were even better as far as I followed them up.

We use the best make of rawhide obtainable; the rawhide portion is the same width of face as the gear and is reinforced with a thick flange of soft, tough brass on each side riveted through all, the teeth, bore and keyway being cut through flanges as well as rawhide. The pinion is bored so as to press on armature shaft with from three to five tons pressure, the shaft and interior of bore of pinion being previously lubricated with fine dry graphite well rubbed in with the finger. The key is accurately fitted and driven home with a 1½ lb. copper hammer. The gearing is kept as free as possible from oil or grease as either is injurious to the rawhide. As a running lubricant for the teeth we use a very small quantity of the finest (both in quality and size of powder) powdered graphite, sprinkling a small quantity out of a little pepper box on the teeth as the gears are slowly revolving. This is done once or twice a day, and in using it on gears without a gear case, care must be taken that it be done at a time and place that will not allow it to be blown over the armature or brushes. In gear cases the use of the graphite is the same, except that it can be used more freely and with less care. Great care is taken that the armature shaft always runs parallel with the axle and that it remains so. Equal care is taken to see that the gears mesh to exactly the right depth and that the wear on the bearings is not allowed to

become so great as to make the gear teeth run either "out of pitch" or "out of line."

As to cost, the use of the rawhide pinion with metal gear, taken by the combined mileage of pinions and gear, is a *little* more costly than with steel pinions, on account of the very much greater first cost of the rawhide, but the advantages of the former are so great in indirect ways that the comparison by cost of gears per mile is not an economic one, nor a true one. The beneficial results of the use of rawhide pinions as shown above, would be hard to reckon in dollars and cents, as some of them might, in particular cases come from other causes.

The matter of cost of labor in renewals is one of the indirect advantages spoken of, where the replacing of the gear is reduced one-third to one-fifth, the saving in the cost of labor, loss of use of car, tools, etc., should be a credit to the cause of this saving, i.e., the rawhide pinion. With cut teeth steel pinions and steel gears, using gear case and grease, I have had very fair success as compared with other roads, the mileage comparing favorably. This, I think, has been due more to the fact of keeping the gearing in line and in pitch than to any special make of pinion or gear, or shape of tooth or kind of steel. Lubrication of these is also a very important item. I am aware that next to track grease, gear case grease or "dubbing" is the cheapest thing in the world (of grease), but after considerable experience with "dubbing"—and especially at high speeds—I have found that a fairly good quality of a stiff non-saponifying mineral grease, heavily filled with flake graphite is not only cheaper per mile run than the very cheapest "dubbing" but it also perceptibly lengthens the life of the gears and makes them less noisy.

With hot pressed pinions and malleable iron gears I have had no experience at all. With metal pinions running in metal gears there is a "critical point," after which the teeth of either pinion or gear are liable to break, bend or "slip by," bending armature shafts, tearing axle bearing bolts out by the roots, wrecking frames and disabling the car; and to run either metal pinions or gears after this critical point has been reached is poor economy and worse operation.

H. S. COOPER, Supt.

Power Station Records.

THE TRENTON PASSENGER RAILWAY COMPANY.

TRENTON, N. J., Feb. 9, 1897.

EDITORS STREET RAILWAY JOURNAL:

I enclose the report for our power house for the year ending Dec. 31, 1896. In the fuel item it will be noticed the cost for July was $473. The low cost in that month was due to our taking account of stock of coal on hand. The cost for power includes the expense of lighting of our park, and the heating and lighting of our cars.

In our station we have one 800 h. p. and two 400 h. p. Watts-Campbell compound, tandem, condensing engines, six 100 h. p. return tubular boilers, four Short 100 k. w. generators and one General Electric 750 k. w. generator. Our generators are belted to the engines. Our boiler pressure is 110 lbs.

Our method for the distribution of power is as follows: we run the two small engines and the four Short generators until two o'clock in the afternoon, at which time we start our large engine and run it until two o'clock in the morning, when we start one small engine to supply us with light and power at our car barn during the night.

We use condensers and pump the water direct from the creek, which flows before our power house. We use a feedwater heater, which is simply a small boiler filled with small pipes through which the water is pumped to the boilers. The steam from the pump exhausts into this small boiler around these tubes, and when we took the temperature of the water last summer it was 180 degs. upon entering the boilers.

We employ seven men in our station, two engineers, two oilers, two firemen and one coal handler and, with the exception of the coal handler, they work in 12 hour shifts.

We have always paid particular attention to our return currents; and we have received excellent results from the use of the Roebling bond. We think that this bond has considerable to do with the low cost of operating our station. HENRY C. MOORE, President.

Car Construction.

NEW YORK, Feb. 23, 1897.

EDITORS STREET RAILWAY JOURNAL:

In the February issue of the STREET RAILWAY JOURNAL you have on page 108 an illustrated article on car construction. While the photographs show the general line of design they do not exhibit the accuracy of the framing of the roof, sides and vestibule hood. The stiffness of the sides, a point upon which you comment favorably, was largely due to the good workmanship. This, it might be said, is characteristic of the Jackson & Sharp Company, who were the manufacturers of the car illustrated in your last issue. Selection of the material and the use of long sticks without splices, also contributed to this result.

Not enough railway men appreciate good workmanship in car construction. While many can judge of the quality of plush and the polish of varnish the general appearance of an interior and the "style" of a car body, the work which goes to make up a good car frame has very little interest for them. Your work in describing and illustrating the fundamental points of car construction is a good one, and is enabling men who are practical in other lines to know something about car construction, and to be able to recognize good work when seen. E. C. D.

REPORT OF POWER STATION OF TRENTON PASSENGER RAILWAY COMPANY. JANUARY 1—DECEMBER 31, 1896.

Month	Supt.	Engineer	Oiler	Firemen	Helpers	Rep'ng Engine	Rep'ng Boiler	Rep'g Dyn'o	Rep'g Pipe	Rep'g Pump	Fuel	Oil, Waste & Packing	Light	Extra Labor	Total for Month
January . .	$50.88	$122.67	$86.10	$91.94	$35.00	$15.22	$63.91	$6.55	. .	. .	$1,010.99	$70.87	$5.28	$76.86	$1,636.27
February .	48.24	114.75	81.24	86.00	36.25	108.57	32.50	. .	. .	. .	963.60	133.37	5.33	23.74	1,633.59
March . . .	50.87	122.68	86.85	91.94	38.75	48.07	2.55	. .	. .	. .	1,003.48	73.29	. .	20.87	1,539.35
April	49.56	118.71	84.04	88.97	37.50	21.72	6.00	. .	. .	. .	798.17	61.73	5.13	39.11	1,310.64
May	50.88	122.67	86.84	91.94	38.75	2.22	6.55	. .	. .	. .	778.73	118.03	. .	31.11	1,327.72
June	49.55	118.72	83.97	88.95	37.50	21.26	. .	. .	. .	. .	744.93	75.51	4.98	21.99	1,247.36
July	50.88	122.67	86.84	91.94	38.75	3.68	4.50	. .	$1.83	$4.95	473.00	96.65	. .	17.71	883.40
August . .	50.87	122.67	86.85	91.93	38.75	9.35	67.59	. .	. .	. .	917.15	121.39	4.97	12.82	1,524.34
September	49.56	118.71	84.04	88.97	37.50	5.30	19.95	. .	. .	. .	887.82	125.27	. .	10.75	1,427.87
October . .	50.88	122.67	86.84	91.94	38.75	5.16	52.64	. .	. .	. .	1,026.36	97.77	1.25	16.47	1,590.73
November	49.55	118.72	84.05	88.97	37.50	1.11	81.80	. .	. .	. .	744.02	63.30	4.89	12.75	1,286.66
December	50.88	122.67	86.84	91.94	38.13	5.79	46.03	5.63	. .	. .	904.30	144.51	4.94	6.75	1,508.41
Total . .	$602.60	$1,448.31	$1,024.50	$1,085.43	$453.13	$247.45	$384.02	$12.18	$1.83	$4.95	$10,252.55	$1,181.69	$36.77	$290.93	$17,026.34
Per C. M.	.0004	.0010	.0007	.0007	.0003	.0002	.0003	.0000	.0000	.0000	.0068	.0008	.0000	.0002	.0114

Miles run, 1896, 1,499,083. Cost per mile $1.1. Entire cost $17,026.34.

Maximum Traction and Perfect Trucks.

J. G. Brill Company.
Philadelphia, Feb. 20, 1897.

Editors Street Railway Journal:

Will you allow us a small space in your columns for the purpose of correcting an erroneous impression which appears to be prevailing in regard to our maximum traction truck and our Perfect passenger truck, the No. 27. These trucks are designed for entirely different kinds of service. We consider each truck the most perfect yet built for its own special work.

The place for the maximum traction truck is in heavy city service where there are short curves, sharp grades, where the greatest possible tractive force is required, the heights of car steps are a consideration and a standard truck is necessary for both closed and open cars. With the ordinary center pivotal truck it is necessary to make a wide car body so as to accommodate the truck between the sills, or to set the car high enough to allow the truck to swing beneath the sills, necessitating two or three steps. This in an open car is, of course, out of the question because on double track roads there is not sufficient space for the steps between the two lines of rails. Here is where the maximum traction truck has its special field and under these conditions, especially during heavy snows, the maximum traction truck becomes invaluable.

The Brooklyn Heights Railroad Company has a large number of maximum traction trucks and also the center pivotal trucks. President Rossiter, of this road, says that during the present winter in many snow storms, they were obliged to take in their center pivotal trucks and the only cars that they could operate were those fitted with our maximum traction trucks.

In the No. 27 truck we have solved the problem of the city and suburban service which has troubled railway men since the first application of power upon street railways. The difficulty was to find a truck which would meet the requirements of high speeds when T rails are used and when a wide tread and deep flange seemed indespensable and at the same time be operated over city tracks where, owing to tram rails with paving close to the rail head, it is absolutely necessary to use narrow tread wheels and shallow flanges. Railway men had no alternative and the narrow treads and shallow flanges had to be used on the T rails. The result was much difficulty in keeping them on the tracks, and frequent accidents have followed.

Our No. 27 truck by its peculiar construction has solved this problem and allows us to use the city wheels on the T rails at high speeds and with perfect safety. An instance of this is found in the experience of the Buffalo & Niagara Falls road which has seventeen cars mounted on these trucks, which have never been off the track. This company has ordered a changing of the trucks of its nineteen remaining cars to this type. We now have 160 cars mounted on these trucks.

From this statement our friends can readily see that in urging the claims of one of these trucks we are in no wise lessening the importance of the other; each one has its own peculiar field.

Jno. A. Brill, Vice-President.

Long Cars in Buffalo.

The Buffalo Railway Company employs about thirty-five eight wheel cars, and the different officials state that this type of car has many advantages over the four wheel car and that it is the intention of the company to make this type of car a standard on the entire system. The present cars are to be built over and spliced so that the new body shall be from twenty-seven feet to thirty feet in length. It is claimed by the master mechanic of this system that there are many less repairs to trucks, motors, car bodies and line work with the long cars than with four wheel trucks. It is also thought they are less destructive at the rail joints, while there is no question that they are more acceptable to the patrons. In these cars side seats are employed which from the company's standpoint have advantages over the cross seat method. All the cars of the Buffalo system have deck lights which are lettered with the name of the principal route on which the cars run. At night the illumination makes the sign plainly visible from the street as the lettering is large both on the ends and sides of the deck. Nearly all the cars of this system have long platforms, the standard being four, and four and a half feet and all are railed in on one side. In the design of the framework of the platform a provision is made for placing the floor boards so that they do not interfere with the brake or mechanism, and when worn the floor can be removed and replaced without interfering with the framing or any of the metal hangers.

Thirty of the eight wheel cars are equipped with the Standard Air-Brake Company's brakes which have been in service a little more than two years and are considered more efficient than hand brakes in stopping heavy cars. The cost of repairs from collisions, with trucks and in the cost of accident cases has been reduced in a marked degree since the introduction of air brakes.

All the cars of the Buffalo railway are being equipped with wooden hand rails; these are placed in a vertical position near the edge of the car and are held in place with metal sockets. In the repair shop an air compressor of the Standard Air-Brake type is operated by power to provide for air blast purposes which is used for cleaning motors and cushions and for other purposes about the shops.

For removing snow the lines have a large equipment of plows, sweepers and scrapers, the latter consisting of the well known Louisville scraper which was the invention of H. H. Littell, now general manager of the Buffalo system. In addition to the ordinary cleaning equipment the company has placed about eight miles of portable snow-fencing along vacant lots and exposed places within the city limits. These fences consist of ordinary fence panels placed in the form of the letter A, each panel being braced against the end of the adjoining panel with plugs driven into the ground to hold the base in position. In the springtime these fences are removed and stored under cover. The car houses of the Buffalo system are thoroughly warmed, the company believing that the men can work to much better advantage in a comfortable than in a cold temperature. The company builds its own trucks and sand boxes. A new type of metal sand box has recently been adopted, having a peculiar valve which was designed by the master mechanic of the company. A large number of the cars have recently been equipped with the Sterling brake.

On the suburban line running between Buffalo and Niagara Falls, long eight wheel cars are employed. The distance is about twenty-eight miles; in the open country between the two cities a high rate of speed is attained, the line being noted as one of the fastest suburban lines in the country.

The Gorge road in Niagara Falls is another system on which long cars are employed. The route of this line has already been described and it will be recalled that it passes along the gorge below the city very near the water's edge to Lewiston, a distance of about seven miles; the grade at the first descent is about four per cent. The speed is about twelve miles an hour and during the year and a half in which the line has been operating no one has been hurt and not one of the motors has had an armature burned out. Twenty open cars are employed during the summer season and up to Dec. 1, 475,000 passengers had been carried. During the month of August last the line transported 161,000 people.

A Bridal Electric Car.

The Staten Island Midland Electric Railroad Company will shortly put into operation a bridal car for the use of wedding parties. The car will be elegantly furnished, with reclining sofa and chairs, and will have a dining apartment. The car has already been engaged for several parties.

LEGAL NOTES AND COMMENTS.*

Edited by J. Aspinwall Hodge, Jr., and George L. Shearer, of the New York Bar.

Special Verdicts as a Protection for Defendants in Actions Arising Out of Negligence.

A general verdict is one by which the jury pronounces generally in favor either of the plaintiff or of the defendant. A special verdict is one by which the jury finds the facts only, leaving the court to determine which party is entitled to judgment thereupon.

So much for definitions.

The jury system was originally founded upon the theory that the pleadings in an action would reduce the controversy between the parties to the action in most cases to a single issue of fact; and perhaps if this were always done, better and more consistent results would be obtained.

Under our modern practice, cases are often submitted to juries in which they have to determine not one issue of fact, but a number, oftentimes to their infinite confusion. Having decided the issue of fact which appears to them to be the principal issue, they fail to carefully weigh the evidence as to other issues, and misapplication of the law and miscarriage of justice result. In cases based upon negligence, after the fact has been established by evidence, which is seldom disputed, that injury has resulted to the plaintiff through some act, negligent or otherwise, of the defendant, three questions which are generally hotly contested are submitted to the jury.

Was the act of the defendent negligent? Was the plaintiff guilty of any negligence which contributed to the injury? If the first of these questions is answered in the affirmative and the second in the negative, then and then only, the jury are asked to consider and pass upon the third question, to wit, the extent of his injuries. In rare cases a fourth question as to punitive damages may arise.

Every lawyer who has tried negligence cases, and who after the verdict has been rendered has conferred with members of the jury, as to the discussion that was carried on in the jury room, knows that oftentimes the controversy between the twelve men as to one of the issues (for example, the question of the defendant's negligence), leads them to forget and totally ignore the other issue, to wit, the question of the plaintiff's contributory negligence. The importance of that issue is lost sight of, and a conscientious jury fail in their duty by inadvertence.

A further complication arises when these questions are each split into two or more. For example, in a case where it is alleged on the part of the plaintiff that a defendant street car company was negligent, in that the tracks were not properly laid, and a car left the tracks at a point where the driver applied the whip unduly to the horses' backs. Here, of course, the jury might be instructed that if the defendant did not have the tracks properly laid, inspected, and in proper order, it was negligence, or if the tracks were properly laid and the defendant's driver carelessly and without reason whipped his horses and caused the car to start so suddenly as to leave the track, then that would constitute negligence.

A jury might easily in a discussion as to whether or not the witnesses who contradicted each other as to the fact of the driver's whipping the horses, forget all questions in reference to the tracks, and the case might terminate very differently, if their attention had been directed to each of the two acts of the defendant upon which the plaintiff based his claim. This would be manifestly, in many cases, to the benefit of the plaintiff, although a careful study of the subject leads the writer to believe that it would oftener result in benefit to the defendant; but whether for the benefit of the one or the other, it would invariably result in a nicer, clearer, juster and more certain application of the well founded principles of the law.

In some jurisdictions it is not uncommon to have special verdicts directed, but in others, as, for example, in New York, judges are at present loath to allow, in the ordinary negligence case, the submission of specific questions to be passed upon by the jury. For the reasons already stated, and for others, which will occur to every one connected with this sort of litigation, we believe, that this reluctance on the part of the trial justices is ill founded, and the present state of feeling, the sympathies which are openly expressed by juries, the many miscarriages of justice, the liberality of our legislators in raising the amount to be recovered in death cases, all should and will lead to some reaction, and if the special verdict is the proper means and the simplest method of placing safeguards around the parties to the ordinary negligence action and procuring the enforcement of the law as laid down by the judge that it will be adopted.

No discussion of the subject will be complete without referring to the opposite extreme which is fraught with quite as much danger. We refer any one interested in this subject to a case reported in the last number of the Journal (*Pittsburgh E. Ry. Co.* vs. *Kelly*, *46 Pac. R. 945*). In that case the plaintiff while engaged in paving one of the streets of the city of Pittsburgh was run over by a street car. Upon the trial of the action the defendant submitted forty-five questions to the jury! These questions, practically, constitute an argument. We give the first five as indicating the character of them all: (1). "Had the "plaintiff been working on Broadway in Pittsburgh and in "and between the street railway tracks for from thirty to "sixty days prior to the accident? (2). Did plaintiff "know at about what intervals the street cars were pass- "ing up and down the street? (3). Did the street cars "during the time the plaintiff was working on the street "pass up and down by the plaintiff at intervals of half an "hour? (4). Did the plaintiff know this to be the fact? "(5). Were there other men working with the plaintiff?" Each of the forty-five questions the jury answered. One of them, the 28th, was answered as follows: "Was the "plaintiff guilty of negligence which contributed to his in- "jury? A. Yes, to some extent." But notwithstanding this, they rendered a verdict in favor of the plaintiff, and the court on appeal held that such a verdict could not stand as being contrary to the specific answer to the 28th question. This in some jurisdictions, would have compelled the court to go further and to have rendered judgment absolute for the defendant upon the special finding that the plaintiff was guilty, to some extent, of contributory negligence. But the multiplication of special questions beyond a certain limit, to be fixed in each case by the sound discretion of the court, tends, unduly, to confuse the mind of the jury.

We have been discussing an intensely practical question, because it requires no legislation to put the suggestions, we have made, in force. It only requires the concerted action of the bar and the bench under the laws as they at present stand in almost all the states of the Union. If the bar will ask and the judges will grant reasonable requests to submit and limit three or four questions to the jury in negligence actions, then all parties may be the more certain that the verdict rendered will be in accordance with the charge of the court and the law of the land.

*Communications relating to this department may be addressed to the editors, No. 32 Nassau Street, New York.

LIABILITY FOR NEGLIGENCE.

WASHINGTON.—Failure of a street railroad company to provide means for informing the operatives of a car passing over a switch where two tracks unite whether another car, which should have passed that point a few minutes earlier, from the opposite direction, had done so, is negligence.

Whether a passenger who, in the absence of any rule forbidding it, rides on the front platform of an electric car, as he and others have been accustomed, and whose fare is there taken, is guilty of negligence, which will preclude a recovery for injuries received in a collision with another car, is a question for the jury.

The question of submitting special interrogatories is addressed to the discretion of the trial court, and will not be reviewed.

Hoyt, C. J., dissenting.—(Bailey v. Tacoma Traction Co., 47 Pac. Rep. 241.)

NEW YORK.—The question as to whether an injury to plaintiff was caused by a car should be submitted to the jury, when he testifies that he was on the track and heard a car behind him, just as he was struck.

One riding a bicycle on a street car track need not look behind him for overtaking cars.—(Rooks v. Houston W. S. & P. F. R. Co., 41 Supp. 824.)

PENNSYLVANIA.—It appeared that, as plaintiff and her sister were riding on defendant's west bound track, they were warned to turn out, by the bell of a car following them. Plaintiff testified that they could not go forward, because of an open manhole, and could not turn to the right, because the avenue was blocked with wagons; that as they turned off to the left, across the east bound track, they saw an east bound car; that the motorman did not apply the brake, or give time to cross the track, and that the car struck the wagon. She was corroborated in the main by other evidence. Plaintiff's claim, that the motorman made no effort to stop the car before the collision, was to some extent, supported by two of defendant's witnesses. *Held*, that the questions of negligence and contributory negligence were for the jury.—(Leukner v. Citizens' Traction Co., 36 At. Rep. 228.)

PENNSYLVANIA.—Cars of two street railway companies which were approaching from different directions, on a wide, level and well-lighted street, collided at a crossing, breaking a passenger's arm. There was no distinct arrangement between the companies as to right of way at crossings, and there was a dispute whether the passenger had his arm out of the window, or whether it merely rested on the ledge inside the sash, and was broken by his fall. *Held*, that the liability of the companies, or either of them, was a question for the jury.—(Goorin v. Allegheny Tr. Co., 36 At. Rep. 207.)

NEW YORK.—A boy seven years old attempted to cross a track immediately in front of a horse car. The driver promptly turned the horses off the track, but the dashboard knocked the boy down, and he was killed by a passing cart. *Held*, that negligence could not be inferred from the driver's failure to apply the brake instantaneously with the primary duty to save the child from the horses. Williams and O'Brien, J J., dissenting.—(Flynn v. Met. St. Ry. Co. 41 Supp. 750.)

CALIFORNIA.—On a trial for personal injuries, where the issue was whether defendant street railroad company was exercising ordinary care, which was all it owed to plaintiff, the issue was to be determined from a consideration of what actually occurred at the time of the accident, and it was error to instruct the jury that they might take into consideration the fact that the motorman "had only been at work about twelve days, according to his own testimony, and was a new hand on the road."

The instruction would have been correct had defendant been bound to exercise the highest care.

On a trial for personal injuries, it was error to charge that defendant street railroad company was bound to provide "proper cars and appliances, and to provide safe, skillful, watchful and competent agents or servants to manage the same," without the qualification that so far as its obligation to plaintiff was concerned, who was injured while on the track, it was bound to exercise only ordinary care in the selection of such servants.

What precaution, under given circumstances, constitute the ordinary care of parents for their young children, is a question of fact for the jury, and should not be determined by the court as a question of law.—(Cunningham v. Los Angeles Ry. Co., 47 Pac. Rep. 452.

NEW YORK.—It is not negligence per se for a mother to allow a child less than five years old to ride with the driver of an open delivery wagon.

The permission granted by a mother, to a child less than five years old, to ride with a driver of a delivery wagon, is not the proximate cause of an injury received by the child in a collision between the wagon and an electric car.

The negligence of a driver of a vehicle with whom a child non sui juris is permitted by its mother, to ride is imputable to the child.

Ward J., dissenting.—(Metcalf v. Rochester Ry. Co., 42 Supp. 661.)

PENNSYLVANIA.—It is a question for the jury whether defendant street railway company was negligent in running an electric car, the platform of which was crowded with passengers, at the rate of fifteen miles an hour down grade and around a sharp curve.

A passenger standing on the rear platform of an electric car, near the steps, holding to the rail behind him with one hand, a position the conductor told him to take because the car was too crowded to allow the passenger to enter the car is not as a matter of law guilty of contributory negligence—so as to prevent his recovery for injuries from his being thrown from the car by reason of the company's negligence in running around a sharp curve, of the location of which the passenger was aware, at a high rate of speed.—(Reber v. Pittsburgh & B. Tr. Co., 36 At. Rep. 245.)

MINNESOTA.—On the trial of an action for the recovery of damages for personal injuries alleged to have been sustained by the plaintiff by reason of the collision of defendant's street cars while the plaintiff was a passenger on one of them, in which action the plaintiff's allegation of negligence resulting in such injuries was denied by the defendant, the plaintiff's attending physician was permitted, against objection, to testify that, four or five days after the time of such injury, the plaintiff stated to him "that he was sitting in the back part of the car, and did not see this other car that came in collision with this one until it was almost onto them; and that he rose, and grabbed hold of a window, or the side of a window, and just at that time the car struck and wrenched him around, and threw him partly on the floor and partly on the opposite side of the car." *Held*, error.—(Webber v. St. Paul City Ry. Co., 69 N. W. Rep. 716.)

NEW YORK.—A verdict for $10,000 for personal injuries is excessive where the evidence showed that the plaintiff, a teacher in a public school, was cut in the forehead and bruised on body and limbs, by which she was confined to her bed two weeks; that she had not recovered at the trial from brain irritation and congestion developed at the time of her injury; that she suffered more when making mental efforts, and that after school she was exhausted, and had to go home and lie down; that she slept but little, day or night; that she was absent from work four months, but lost little in salary or money.—(Smith v. 3d Ave. R. Co., 41 Supp. 977.)

NEW YORK.—In an action for personal injuries it is error to admit the amputated foot of the injured child in evidence to show the size of the child at the time of the injury, where the child was present at the trial, and defendant admits that the foot was properly amputated.

It is error for the court, in an action for personal injuries, to call the attention of the jury to the amount of the demand in the complaint, and state that they could award no more than the claim, and to charge the jury in such a manner as to authorize them to award the full damages claimed, and to charge that they are to give the full damage that will be adequate to the money loss sustained.—(Rost v. B'klyn Heights R. Co., 41 Supp. 1069.)

NEW JERSEY.—When one attempts to cross a street railway track, in view of a trolley car, about 300 ft. away, and coming in his direction at great speed, it is a question for the jury whether his act in attempting to cross under such circumstances was prudent or not; for he has a right to assume that the car is furnished with appliances to reduce speed and to stop, and with a motorman to make use of such appliances, and that the car will not continue to be run in violation of the law which limits the speed of vehicles using public streets to that which is compatible with the safe use thereof by other vehicles, and he is not bound to refrain from crossing for fear that the motorman will not make use of the appliances provided to reduce speed.

Evidence of opinion in respect to the probable duration of physical suffering or disability, given by medical experts, is admissible, although based in part upon statements made by the suffering or disabled person relating to his past or present symptoms.

Where there is actual physical injury, damages resulting from the incidental fright may be recovered.—(Con. Tr. Co. v. Lambertson, 36 At. Rep. 100.)

MARYLAND.—A plaintiff who, after alighting from a street car going east, went behind the car, and while attempting to cross another track, three feet north of the one on which the car stood, was struck by a west bound car and injured, there being no obstruction to prevent him from seeing the approaching car if he had looked, was guilty of contributory negligence precluding his recovery for the injury.—(Baltimore Tr. Co. v. Helms, 36 At. Rep. 119.)

NEW YORK.—The driver of a street car which is not going at a rapid rate, and is well under control, cannot be held negligently responsible for the death of a child who falls upon the track in an attempt to cross the street eighteen feet in front of the car, the brake having been applied, so that the car had almost stopped when it reached where the child lay, and the horses having been successfully turned aside.—(Lavin v. 2d Ave. R. Co., 42 Supp. 512.)

CALIFORNIA.—For one to attempt to board a street car, the speed of which has merely been slackened in response to his signal that he wished to get on, cannot, in the absence of exceptional circumstances, be declared negligence, as matter of law; and that though the attempt is to get on the front platform, especially where there is a rule of the road that persons smoking should ride thereon, and the person attempting to get on is smoking at the time.

Nor can it be declared negligence, as matter of law, for the driver of a street car to merely slacken its speed for one to get on, especially where the person, without indicating any desire that it be stopped, attempts to board it while it is in motion.

Whether failure to put guards in front of the wheels of a street car, as required by an ordinance, is negligence, and, if so, whether the absence thereof was the cause of injury to one who, trying to get on the front platform while the car was moving, missed his footing, and got his foot under the wheel, while holding with both hands on the railings, are questions for the jury.—(Finkeldey v. Omnibus Cable Co., 45 Pac. Rep. 996).

GEORGIA.—Where, in the prosecution of its business, a corporation employs a wire which, because of its being charged with a powerful and dangerous current of electricity, is liable, upon coming in contact with the wires of other corporations, to cause injury or death to employes of the latter while engaged in the performance of their duties, the corporation first referred to is, relatively to such employes, under the duty of observing at least ordinary diligence, not only in preventing such a contact, but also in discovering and preventing its continuance, even when occasioned by the negligence of others, including that of a corporation whose employes are thus exposed to danger.—(Atlanta Con. St. Ry. Co. v. Owings, 25 S. E. Rep. 377.)

ALABAMA.—On the question of contributory negligence, defendant is entitled to the charge that if plaintiff was acquainted with the tracks and operation of defendant's street railway where the injuries were received, and without looking in both directions, or, if his view was obstructed, without listening for approaching trains, drove on the track on a trot, when by pausing and listening, he could have discovered the train in time to prevent injury, then he was guilty of negligence.

The running of a dummy locomotive backward at a greater rate of speed than that prescribed by a city ordinance was a violation thereof, though the speed was within the limitation for running forward, and it was safer to run backward than forward.—(Highland Ave. & B. R. Co., v Sampson, 20 South, Rep. 566.)

UNITED STATES COURT.—One L. brought an action against a cable street railway company for damages for personal injuries. It appeared that L. was sitting on the front seat of a cable car which was going up a hill; that an ice wagon which was coming down the hill on the down car track turned on to the up track; that the car and wagon collided, and L. was injured. Repairs were being made to the street and the part of the roadway between the down track and the curb was barricaded, and at the time of the accident, which occurred at dusk, a red lantern was hung on the barricade. The gripman of the car testified that the wagon turned out from behind a car on the down track, when not more than ten feet behind such car and twenty feet ahead of his own car; that he had not seen the wagon before, because of the car on the down track; that as soon as he saw it he released his grip and applied his brake, and stopped his car within six feet; that the wagon, after starting to cross the up track, turned back and ran into his car while it was standing still. The driver of the wagon testified that he was driving at least two blocks behind the down car; that his horse shied at the red light, and turned partly onto the up track; that the car came up at a fast speed, and did not slow up when the horses turned onto the up track. There was also some evidence to show that the wagon was traveling at about five miles an hour, and some that it was traveling much faster. *Held*, that it was not error to refuse to direct a verdict for the defendant.—(Mt. Adams & E. P. Inc. Ry. Co., v Lowery 74 Fed. Rep. 463.)

FRANCHISES, ORDINANCES, RIGHTS, ETC.

TEXAS.—After a street car company has accepted a franchise authorizing it to operate its lines upon certain streets, and has undertaken the operation thereof, the public acquires a right to the operation of such lines, which may be enforced by mandamus.

It is no defense to mandamus to compel a street car company to continue operating cars over a portion of its lines, after it has accepted a franchise authorizing such operation, and had undertaken to operate the lines thereunder, that the city could forfeit its franchise for failure to so operate.

Officers of a street railroad company who cause a portion of its tracks to be torn up, pending an appeal from an order granting a mandamus to compel them to continue operating that portion of their line, are guilty of a contempt of the appellate court.—(S. C. St. Ry. Co. v. State, 38 S. W. Rep. 54.)

TEXAS.—A municipal ordinance which seeks to confer on individuals a franchise to construct and operate a street railway for private purposes is void.

A municipal corporation may be enjoined from turning over one of its public streets to a private street railway, and from aiding in the construction and operation of the nuisance.

Where the grant for the franchise of a street railroad was void because it was sought to use a public street for private purposes, an assignee of the franchise acquired no rights, and the charter of the assignee is inadmissible on the issue of what use of the street was intended.—(City of San Antonio v. Rioche, 38 S. W. Rep. 388.)

U. S. COURT.—A railway right of way in a public street, whether granted by legislature or city council, or in any other valid mode, is an easement, and as such is a property right, capable of assignment, sale, and mortgage, and entitled to all the constitutional protection afforded other property rights and contracts.

Under a general incorporation law for street railways, which requires the charter to set out the termini and general route of the proposed road, and provides that no streets shall be occupied until the "consent" of the city authorities is first obtained by an ordinance, prescribing the "terms" thereof (Mill. & V. Code, §§ 1920-1925), the power of the city to so consent is limited to the streets included between the termini and in the general route described in the charter; and a further grant, purporting to give a right of way over all the streets of the city, present or prospective, thereby delegating to the company the power to elect from time to time the streets which it will occupy, is invalid. 70 Fed. 729, reversed.—(Mayor, etc., of Knoxville v. Africa, 74 Fed. Rep. 501.)

NEW YORK.—When a proposed street railroad will pass only part of property, the value of that part only should be considered on a question of compliance with Laws 1892, p. 2093, § 91, which makes the consent of the owners of half in value of the property "bounded on * * * that portion" of a street where a street railroad is projected necessary before its construction.

Property which practically fronts on a street on which a railroad is projected should be considered in determining whether enough property owners in value to authorize the construction of the railroad have consented thereto, though the property might be strictly considered as fronting on another street which runs into the one in question.

An executor cannot consent to the construction of a railroad in front of property of his testator's estate, unless the will vests in him title to the real estate.

A property owner is entitled to an order restraining the unauthorized construction of a street railroad along the street on which his property is located, but, where such an order would impede public interest, its operation will be restricted to the block on which his property is located.—(Merriman v. Utica Belt Line St. R. Co., 41 Supp. 1049.)

WISCONSIN.—An ordinance granting a corporation the right to lay tracks and operate a street railroad in certain streets in a city, when accepted and acted on, not only constitutes a contract between the city and the railroad corporation, but operates also as the grant of a franchise by the state, acting through the city council by virtue of its statutory authority, for the failure to exercise which the state may, by proper proceedings, forfeit the corporate charter of the grantee, but which cannot be surrendered by such grantee without the consent of the state, given either expressly or presumptively.

A certain portion of the track of a street railroad was not used for a period of four years and eight months, during which time the franchise was owned by successive corporations, which were in financial difficulties. An ordinance was introduced in the city council repealing the franchise covering such portion of the road, but, on representations of the company, was not passed. The street was also paved during the time, and the track was taken up by the city, with the knowledge and consent of the railroad company, and not replaced, but the poles and wires placed for use in operating the road by electricity were left. The track removed, however, was constructed for a horse railway, and had proved insufficient for use by electric cars. *Held*, that the nonuser for such time, not being accompanied by any act clearly indicating an intention to abandon the right, and there having been no consent on the part of the public to such abandonment, did not operate to extinguish the franchise, and that an injunction would not lie to restrain the company owning it from constructing new tracks.—(Wright et al. v. Milwaukee Elec. Ry. & Lt. Co., 69 N. W. Rep. 791.)

WISCONSIN.—A city cannot sue to enjoin a street railway company from laying its tracks upon a street, on the ground that the nonuser by the company for five years of its franchise to lay tracks constituted a forfeiture of such right, as such a suit would be, in effect, for the forfeiture of a franchise, which can only be brought in the name of the state.—(Milwaukee Elec. Ry. & Lt. Co. v. City of Milwaukee, 69 N. W. Rep. 794.)

Under Laws 1895, c. 363. § 6, imposing a license fee on street railways, and providing that it shall be in lieu of all other taxes and assessments, and "all" personal property, franchises and real estate owned by such companies shall be exempt from assessment and taxation, and that all lands and lots unimproved or having buildings thereon shall be liable to taxation for state, county and school purposes—all the property of such companies, whether used for railroad purposes or not, is exempt from assessments.—(Same v. Same, 69 N. W. Rep. 796.)

MICHIGAN.—A municipality has not the authority to grant a street railway company exclusive rights in a street unless such authority is expressly granted by the legislature, or arises by implication so directly as to be equally clear.

The train railway act (section 34), providing that all street railway companies shall have the exclusive right to operate any street railways constructed by them, provided that no such companies shall be authorized to construct a railway through the streets of any town without the consent of the municipal authorities, and upon such terms and conditions as said authorities may prescribe, does not authorize municipalities to grant an exclusive privilege to operate street railways on its streets.

An ordinance granting a street railway company exclusive authority, at its option, to construct street railways on all streets within the city as may be fixed by the common council, is, in effect, an exclusive franchise.—(Detroit Citizens' St Ry. Co. v. City of Detroit et al. 68 N. W. Rep. 304.)

ILLINOIS.—The right of a street railway to lay tracks in the public streets of a city, and run its cars thereon, is given and exists solely because of the undertaking and duty of such company to serve the public.

A street railway company cannot maintain its tracks in a public street for the purpose of holding its right to such street, or for the purpose of keeping the public, either through another company, or in any other way, from using the street in a manner that shall serve the public convenience.

The right, in consideration of services rendered the public, to lay tracks in a public street and to operate cars thereon, is a property right, and held under certain conditions. It may be forfeited, but it cannot, either in whole or in part, be, by the mere will of a legislative body, taken from its owners, either for public or private use.—(Chicago General Ry. Co. v. Chicago City Ry. Co., 62 Ill. App. 502.)

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Special effort will be made to answer promptly, and without charge, any reasonable request for information which may be received from our readers and advertisers, answers being given through the columns of the JOURNAL *when of general interest, otherwise by letter.*

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OUR second "International Number" next month will in many ways reflect the general interest in improved motive powers found in all parts of the world. Several months ago we addressed to the principal tramway companies of Europe a series of questions, to which they have most kindly and generously responded with a mass of valuable drawings and descriptive matter which will be of much interest to our American readers, as well as to those in foreign countries. From this material we shall present, in an extended and valuable article, a digest of the best European practice in electric railroading, together with a critical analysis of many of the specific features of the different installations. We shall also commence next month a series of articles on "The Financial Results of Improved Motive Powers in the United States," in which will appear, in a digested form, the fruit of one of the most complete and painstaking statistical investigations ever undertaken, we believe, by any technical publication. In these articles will be shown, by a novel system of "financial graphics," the effect which the introduction of electricity and the cable has had upon the capitalization, gross receipts, operating expenses (in some detail), etc., of a large number of American street railway systems. We shall commence next month what will thenceforth be a regular feature of every monthly issue in the form of a digest, in French, German and Spanish, of all the important articles appearing in the Journal. By this means we hope to increase the usefulness of the Journal to our friends in foreign countries. Original and contributed articles of special value will also be included in the "International Number" next month.

DURING the past winter the experience with electric heaters reported by electric railway companies has been of a varied character. While all unite in their expressions on the convenience of electric heating, the verdict reached by different roads as to the cost of electric heating is not the same, even by roads in the same city. Some companies report that the amount of current consumed by the heaters is trifling, averaging not more than two or three amperes in cold weather, while others state that the amount of power required is almost, if not quite, fifty per cent of that used to operate the cars. In face of these differing testimonies some other explanation must be had than that of local conditions, different makes of heaters, or leaky cars. Our own belief, founded on experience, is that the cars upon most roads which report a high consumption of current are overheated. A passenger wears the same wraps inside of a car as he does before he enters it, and does not expect or care for a high temperature. The fault of overheating does not usually lie in the instructions given to the conductors, but with the conductors themselves. Some of them, being obliged to spend considerable time on the rear platform, like a warm car to get into, while others do not take the trouble to change the controlling switch to a lower combination when the car takes in more passengers, or the weather outside gets warmer. It would seem as if the experiment might be worth trying, on roads certainly where the routes are short and where there are a number of register inspectors, to take the control of the electric heaters entirely out of the hands of the conductors and place it in those of the inspectors. These men could set the switches at the termini, and being fewer in number could be held more accountable for any waste in current. If necessary, a few additional inspectors could be stationed at the middle points of a long route to change the switches at these points if necessary.

STREET railway salaries are too low. This is a broad statement which doubtless finds many exceptions, but in the main it is true that the unhealthy competition of half trained "engineers," "master mechanics," and other candidates for minor positions of responsibility on our street railways, to say nothing of those calling for managerial ability, has brought about a state of affairs on many systems which it is not pleasant to contemplate. How can it be thought possible to avoid costly mistakes without the best operating organization to be obtained. A thoroughly grounded and experienced master mechanic at $2000 a year ought to save ten—nay, fifty times the difference between his salary and that of a comparatively inexperienced man at $1500. A superintendent who knows his business can establish and maintain relations with his

men such that strikes may become difficult or impossible. To pay such a man a salary which will make him discontented and anxious to leave for other fields is folly. The manager who possesses tact, patience and never-failing courtesy can give a road local popularity and prevent public agitation adverse to its interests. If such a man has, in addition, the power of organization and the ability to see that his company's purchases are made with skill and care, he becomes of such value to the company that his compensation should be generous and adequate. At the present time there is little to attract a well trained and highly intelligent engineer or business man to the street railway field. There is little or none of the *esprit du corps* in street railroading that is so prominent a feature among steam railroads the world over, and which makes it possible to tolerate smaller salaries than what could elsewhere be obtained because of the permanence of the positions and the chance for rising to the higher places. Even now many good men are leaving the street railway field for others in which their talents are better appreciated.

* * * *

Better engineers and engineering methods are needed on the great majority of our street railway systems. The mistakes of equipment which have been made during the last six or seven years have cost the industry many million dollars—a hundred or two, perhaps. Many of these mistakes were doubtless unavoidable with the knowledge of the art of electric railroading possessed at the time when made, and many others are unavoidable now, even with our present knowledge, for in many respects we are still groping more or less in the dark after the best practice. But it is also true that wrong decisions and engineering blunders are daily being made on many systems which are relying on a class of men who only half know their business. A few street railway managers are inclined to do without engineers entirely, so bitter has been their experience with the so-called ones whom they have employed. Others obtain the cheapest "engineer" they can get and degrade him at once from the position of a professional adviser into a mechanic or a departmental head. A few—notably the most successful and profit earning managers—wisely employ the best professional engineers they can obtain and pay them enough to keep them in their service. It is, of course, true that there are many small companies whose total income does not warrant so expensive a luxury as a first class engineer in their regular service. We suggest to such companies that they make arrangements with the best consulting engineer of whom they have knowledge in their section of the country, to regularly, at least once a year, inspect their track, rolling stock, power station, overhead construction and all parts of their systems with the idea of showing what economies can be introduced or changes made to advantage. Such an inspection ought not to cost a large sum, and it would have the advantage of putting a company directly in touch with the progress of the world.

THE most important event which has taken place in the industrial world for many months, and perhaps for many years—if present hopes are justified—is the breaking up of the great combination of American steel manufacturers, which for years has kept the price of manufactured steel above competitive rates. The immediate effect of the failure of these companies to renew their pooling agreement means to American railroad and street railway managers prices for rails lower, we believe, than have ever been quoted in this country, or than are now quoted in any other country in the world. But to the world at large and to American manufacturers in particular, there are likely to be further consequences of the most far reaching character. It is not impossible to hope that we shall soon wrest from British manufacturers the title of "Ironmasters of the World." Instantly on the dissolution of the pool, one of the great American steel companies opened offices in London and in less than two weeks' time orders are reported to have been sent to America for more than 100,000 tons of steel rails, of which a large portion was purchased by two of the greatest railway systems of Great Britain. It is said that this transaction involves a profit (though a small one), and it is true that this particular manufacturing company has an advantage over all but one or two of its American, and probably over all its British competitors, in that it mines its own iron and coal, carries both by land and water to its furnaces and mills at practically cost of transportation, operates its own blast furnaces, converts its pig iron to steel, and manufactures its rails and structural material from the ingot, all without paying middlemen's profits to any one. It can thus sell rails at, or below the cost of rolling alone without losing profits further back in the grand productive process. The successful competition in international markets of American manufacturers in an industry so enormous and highly ramified as that of iron and steel production will undoubtedly mean an increasing export trade in many other manufacturing lines. We shall have something to say next month about the prospects for American manufacturers of street railway apparatus and supplies in the principal countries of the world, and shall be able to show from official sources of information that nothing but energy and ability to take advantage of our pre-eminence in tramway matters are needed to build up an enormous export movement in this particular line.

* * * * *

All indications favor a gradual but sure increase in business prosperity during the coming year. Many have doubtless been disappointed that the recent election has not yet produced a more decided improvement in manufacturing and business conditions. There have been periods of buoyancy and periods of depression since November, one of the most severe cases of the latter having come during the past month. But on broad lines there is encouragement in the air. The gold reserve is nearly $150,000,000; enormous credit balances are held abroad subject to our order as a result of unusually heavy exports of crops (at high prices) and to some extent of increasing sale of securities; the trade balance in our favor has been far larger during the past six months than usual, and even now appears as a credit at a time when in years past it has usually been a debit; bank balances are larger and money is plenty and not difficult to obtain at low rates; the collapse of the steel pool mentioned above has brought enormous orders for rails from American and foreign railroads; and in the general manufacturing lines there is good business in sight and doing. We believe that street railway operation in 1897 in all sections of the country will show large gains in receipts as the result of increasing prosperity of the people, and that by 1898 the companies who have been building mileage out into the suburbs in advance of

population will derive some return on their investment, so that gross and net earnings per mile of track which have in many cases, fallen off since the beginning of the period of street railway expansion eight years ago, will again increase to the old figure.

THE articles in this and our last issue upon parks as promoters of traffic will be found valuable to those who are contemplating the establishment of a pleasure resort in connection with their railway service. The fact that when judiciously managed a street railway park is usually a profitable investment is generally recognized, but the amount in increase of traffic which can be relied on and the return which may be expected from the lease of the different privileges are not so well known. It was with the object of collecting this information and presenting as well a statement of some of the attractions which had proved most popular in different cities that the series of articles upon this subject was commenced, of which the second appears in this month's issue. Undoubtedly, as one correspondent has stated, where elaborate entertainments are provided and the traffic is essentially one for a short season only, a great deal of additional travel will have to be created to show a net profit. But the weight of testimony shows conclusively that the establishment of parks is in most cases a profitable investment, increasing the traffic in some cases up to ninety per cent. Often by the sale of restaurant and other privileges the park can be made to pay its own running expenses, and in that case the gain from an increase in traffic represents a pure gain. In laying out a park of this kind there are several considerations in addition to the natural advantages of any locality, which should be borne in mind; these are the desirability of its location, if possible, upon a line of small traffic so that the exclusively pleasure travel may not interfere any more than is necessary with that of ordinary passengers; and where no admission fee is charged, its inaccessibility, so far as other means of transit are concerned, so that passengers to and from the park will be confined to the company's lines in enjoying the benefits of the park. The possession of a body of water upon which row boats and electric or steam launches can be operated, adds much to the desirability of any park and this point should be borne in mind in selecting the site of any proposed resort of this character.

The entire subject of the development of traffic by one means and another is one which should be carefully considered by the officials of every operating railway company. Much can be often accomplished in this way. Parks form an important factor in securing this possible traffic, but there are other methods of developing travel which should not be overlooked. Time may often be spent more profitably in a study of this question than in that of reducing expenses. An extra dollar earned is of more value than an extra dollar saved, because the former is a net gain, whereas, unless there was previously an absolute waste, no former expenditure can be reduced without some diminution in quality of the apparatus purchased or in efficiency of the service. Steam railroad companies have always a special official, the general passenger agent, whose sole duty it is to look after the passenger traffic and take steps to encourage it as much as possible. An officer with like title and duties exists on only one or two street railways in this country. The work is usually performed by the superintendent or general manager, but as each of these officers has also to attend to the multifarious duties which naturally fall to his office, besides often others, but a small proportion of his time can be devoted to the traffic problem. In many respects, however, the traffic possibilities of a large city street railway system are far greater than those on most steam railroads. On account of the low fares charged by street railway companies thousands can be attracted for some special occasion or to visit some new resort where less than one-tenth of that number under similar circumstances would pay a $3 or $4 fare on a steam railroad. Again the riding public can be reached more directly. Every inhabitant of a city is a possible customer of the city system, whereas the steam railroad passenger agent to reach his clientage must advertise in the papers or otherwise in every town and city through which his road passes, and to some extent in outside cities which are reached by his system only by connecting lines.

The amount of study and labor required to secure all the possible traffic upon most of the large street railway systems of the country, especially those which cater to any amount to pleasure riding, is so great that it would easily require all the time of one person, and it could undoubtedly be better carried out by one person than if the work were divided among several. It is impossible in this space to define all of the duties of such an officer, and they would also depend largely upon the local conditions under which a railway operates, but the following points may give a brief idea of some of the most important subjects which would naturally come under his supervision. In the first place, he should have general charge of all parks and suburban pleasure resorts which may be owned by the company, or if the company does not have property of this kind, he should keep thoroughly acquainted with the number and character of those resorts to which the company's lines extend. He should keep posted as to any new attractions which may be introduced at them and which might prove drawing cards to any particular class of pleasure seekers, and can often suggest to the managers of such resorts entertainments which would prove profitable there and which would stimulate traffic to them. He should also be prompt in learning about any new pleasure resorts or theatres which may be established from time to time and see that the operating department arranges its schedules so as to properly care for any possible resulting increase in traffic. The chartering of special cars for trolley parties and other purposes should also be under his charge and he should be able to advertise and promote this business in such ways as may seem most desirable. This is a more important factor in the development of traffic than many companies realize, for it has been found that traffic of this kind stimulates ordinary riding. Passengers on trolley parties often visit pleasure resorts of which they were previously unacquainted and if pleased repeat the trips afterwards many times in the ordinary cars. In other words, it presents one of the best methods of "educating" people to use the cars. Other ways of encouraging pleasure and other traffic would suggest themselves to an official of this kind. The plan has been tried with great success in Brooklyn, N. Y., by the Brooklyn Heights Railroad Company, and we look forward to the time when a general passenger agent will be considered as an important adjunct to every large street railway company.

CONSTRUCTION

The New Power Station of the Chicago City Railway.

The large number of new electric lines which have been put in operation recently by the Chicago City Railway Company has necessitated a station capacity in excess of that possessed at the old station of the company on Fifty-second Street. For this reason steps were taken by the company about a year ago, for the erection of a new station at Forty-ninth Street and Oakley Avenue. Ground for this building was broken June 27 last. At the present time one-half of the installation is nearly complete. The operation, however, is now limited to the heavy traffic in the morning and evening hours.

The power station is of the high pressure type, and while on test, would not show the economy that a compound condensing plant would, it is considered much more economical from a commercial standpoint than a compound condensing plant. This is because the "variations in load" can be approximated from a mechanical standpoint much nearer with a high pressure plant, built as this plant is, than with a compound condensing plant, as in the latter, taking the plant as a whole, it is necessary to have relatively high steam pressures to get high steam economy. To secure these high pressures it is necessary to use a great deal of steam power in feeding water to the boilers and independent steam pumps, which are always expensive, must be maintained for this purpose. In this plant, all water is fed to the boilers by means of exhaust steam injectors, using the exhaust steam from the engines. The feeding of these boilers for the entire plant costs practically nothing, as there is very little wear and tear by this method, and the first cost of the apparatus is so small that the interest account amounts to practically nothing.

The plant will be the largest electrical station in the world, when it has its full complement of station equipment, and completes a chain of plants in Chicago which shows the different phases of engineering in this particular line to very good advantage.

The station is so located that at present it is somewhat out of the center of traffic, but ultimately it is expected it will be as desirable a location from a central point of view as could be had.

The question of whether to use direct connection or rope drive between the engines and generators was very carefully studied by the officials and engineers of the line from the fact that in the company's Fifty-second Street station, as described in the STREET RAILWAY JOURNAL for August, 1893, and September, 1895, rope driving is employed. The very successful results which have been obtained in the way of economy at the Fifty-second Street station, however, carried the day for this method of transmitting power, and the plant, as now constructed, uses the same system of compound rope drive as that empolyed in the first station.

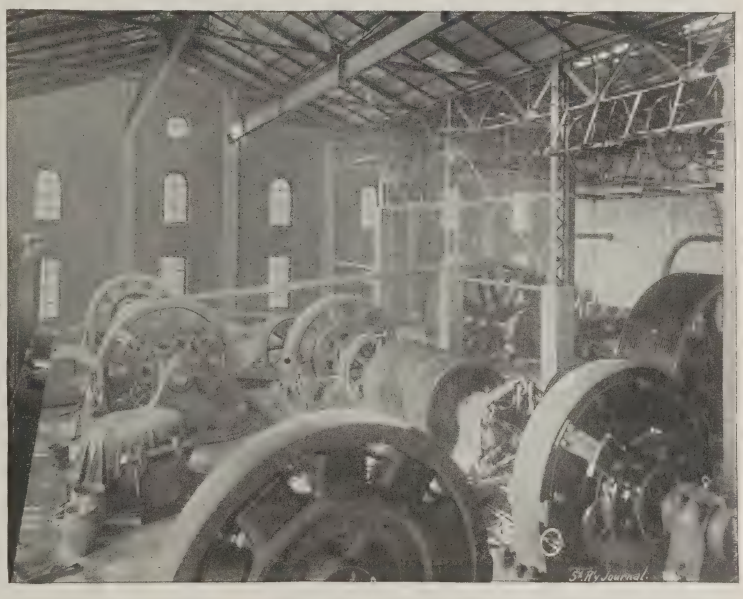


FIG. 1.—INTERIOR OF CHICAGO CITY STATION.

These advantages, as given by the officials of the Chicago City Railway Company may be concisely stated as follows:

First.—Flexibility of connections between engines and generators.

Second.—Reduction of weight on bearings from two to four per cent.

Third.—No necessity of disconnecting generators to repair engines; thus free access to all apparatus for cleaning and repairing.

Fourth.—Thorough insulation of generators, thereby lessening accidents.

Fifth.—Increase of life in apparatus from twenty-five per cent to fifty per cent.

THE BUILDING.

The building is 270 ft. in length by 214 ft. in width, or properly speaking, it is three buildings comprising two bays which are occupied by the engine and generator rooms and one bay by the boiler room. The height is 40 ft. under eaves. The boiler room has a span of 100 ft. and the engine room two spans of 59 ft. each. The building

FIG. 2.—EXTERIOR OF STATION.

is a steel structure of modern construction, there being nothing dependent upon the bricks, which simply serve as a filling. The roof is of wood with composition gravel. At present there is one stack which is located at the northwest corner of the building. It is the intention, however, to erect another stack at the northeast corner when the entire equipment is in place. The present stack is of brick with a 14 ft. flue and stands 208 ft. above the present grade, with a foundation 16 ft. deep and 50 ft. square.

The foundations of the engines and generators are of concrete, one solid mass twelve feet deep, having manholes all through to allow access to all anchor bolts. In the initial work of building these foundations a wooden frame was constructed of rough lumber. This was filled with concrete, and set in place and after the concrete had dried the forms were removed. Built in this way the foundations for the three pairs of engines and generators cost about $10,000 less than if made of brick. This was chiefly on account of the fact that skilled labor was not required in their construction. The contractor for the foundation was Clift Wise.

The floor is what is termed "mill construction"; it is composed of 6 in. × 12 in. timbers, 3 ft. apart, with 2 in. matched flooring. Above this will be laid a ⅞ in. maple floor. The floor of the boiler room is of steel plate covered with concrete.

The total capacity of the building is twelve engines, with cylinder dimensions 36 ins. × 60 ins., twelve generators, each of 880 k. w. rated capacity, and forty-eight 78 in. × 20 ft. boilers.

BOILER ROOM.

The boiler room contains twenty-four 78 in. × 20 ft. horizontal return tubular boilers manufactured by John Mohr & Sons. These boilers are guaranteed to carry a working pressure of 120 lbs. per square inch.

The shell of each boiler is ½ in. thick and heads ⅝ in. thick, all of fire box steel, of 55,000 lbs. tensile strength. The mud drums are 20 ins. in diameter and ⅜ in. thick.

Each boiler is furnished with an extension suitable for a Murphy furnace with proper opening for passage of smoke. The extension is of ¼ in. steel fitted and fastened to boiler head by six angle bars made of 2½ in. × ½ in. iron which are to be riveted to extension and set-screwed to boiler head.

All rivet, bolt, flue and other holes are drilled, and those for rivets for longitudinal and circular seams were drilled after the shell and heads were rolled and held in position by necessary tack bolts. These rivet holes were drilled through both plates in one operation so that each rivet hole was perfectly true. All longitudinal seams were triple zig-zag riveted, all other seams single riveted. All riveting was done with a hydraulic riveting machine. Each boiler was subjected to a hydrostatic test of 175 lbs. per square inch before leaving the shop. Each boiler contains eighty-eight flues, each 4 ins. outside diameter and 20 ft. long. The tubes are of lap welded charcoal iron, No. 10 wire gauge in thickness and are set in vertical and horizontal rows with spaces between them. Charcoal iron, though more expensive than steel, is used instead of steel on account of its longer life.

The boilers are equipped with Murphy smokeless furnaces and automatic stokers. The company uses three 3000 h. p. Baragwanath steam jacket feedwater heaters, 60 ins. × 22 ft. long. Each heater has 200 2 in. × 18 ft. seamless, cold drawn brass tubes of No. 13 Stubbs gauge, and 2208 sq. ft. of heating surface. Other steam appliances used are one tandem compound, duplex Weir & Craig feed pump and three Holden & Brook exhaust injectors, 14 m. m. It is also the intention before

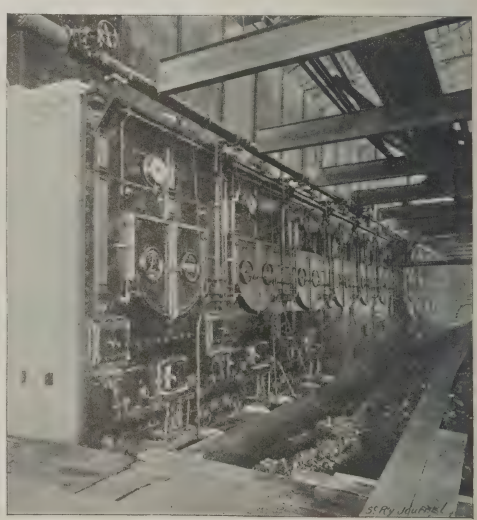


FIG. 3.—BOILER ROOM.

completing the boiler plant to put in fuel economizers, and space has been left for that purpose.

It is intended to construct, as soon as the weather will permit, a reservoir to contain 250,000 gals. of water.

Below the boiler room is an eight foot basement for the purpose of handling the ashes which slide direct from the pit into the bucket of the conveyor. In this way very

large pits, which do not necessitate cleaning more than twice a day, are secured. Above each battery of boilers, which will consist of six, is a coal tank with a capacity of 150 tons, making a total capacity of 1200 tons.

Over each battery of boilers is a header, and the headers of each two adjoining batteries are connected together by means of a copper gooseneck eighteen inches in diameter. Each header is connected with the corresponding one on the opposite side of the boiler room by means of an eighteen inch wrought iron pipe. The headers on the two batteries nearest the engines are forty inches in diameter and those on the opposite side of the building are thirty inches in diameter. The headers are connected to the boilers by eight inch copper goosenecks and the forty inch header is connected to the engines by an iron pipe and long iron bend. The goosenecks are copper and are equipped with Crane high pressure gate valves. The rest of the valves are Jenkins. The main exhaust pipe is forty-eight inches and is located below the floor behind the engines, with three forty inch risers which extend through the roof.

Coal handling apparatus is now being installed, and when this is completed all handling of coal and ashes will be by machinery. The coal for the station is received directly from the mines by railroad. The cars will run over a siding which extends into the power station. The cars are arranged to run over a hopper into which they discharge their loads. The fuel, when the coal handling machinery is in operation, will then descend into the buckets of a McCaslin overlapping gravity bucket conveyor, supplied by the John A. Mead Manufacturing Company. The arrangement of the conveyor is shown in Fig. 9, which gives one-half of the front elevation of one side of the boiler room. The chain of buckets is driven by a 15 h. p. engine located between the two batteries. The coal is carried by this conveyor and deposited into the coal tanks shown above the boilers. Here an automatic tripping device is arranged so that the buckets will discharge the fuel at any point above either coal tank, as desired. The empty buckets then descend on the other side of the boilers and return in a tunnel underneath the boilers. They are arranged so as to receive the ashes from the boiler hoppers and discharge them into the elevated ash hopper. From this they are dumped into railroad cars on the ash track.

The station is at present planned for two complete systems of coal and ash handling conveyors similar to that shown in the engraving, one for each side of the boiler room. When the new boiler equipment is added, the conveyor will be extended longitudinally along the building so as to take care of the additional batteries as they may be placed in position.

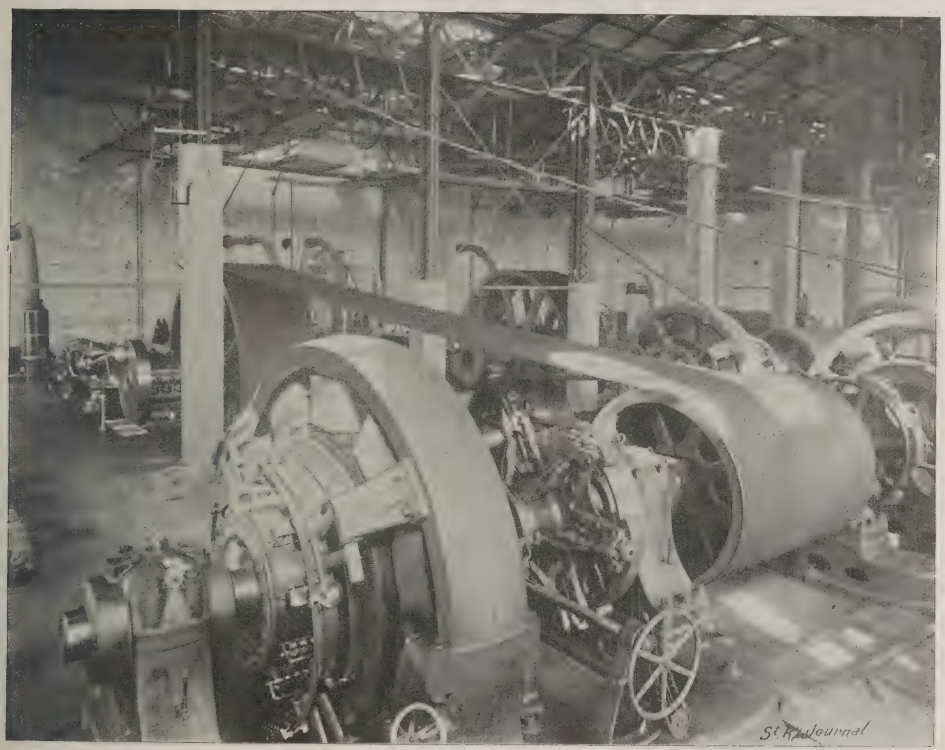


FIG. 5.—VIEW OF GENERATORS AND ENGINES.

ENGINE ROOM.

When completed, the plant will contain twelve 36 in. × 60 in. Greene-Wheelock engines, with Hill valve gear. These engines are designed to operate at 77 r. p. m., with 100 lbs. boiler pressure, each giving a maximum of 2000 h.p. These engines being in pairs, are capable of operating the generators through the rope transmission system to 4000 h. p. The frames, flywheels, crank shafts and running parts of engines are designed for 40 in. cylinders, but the chief engineer, R. J. Hill, has found it to be his experience that it is much more economical to employ the smallest size cylinder that will give the power necessary to operate the average economical load, working the engines maximum during the rush hours of the day.

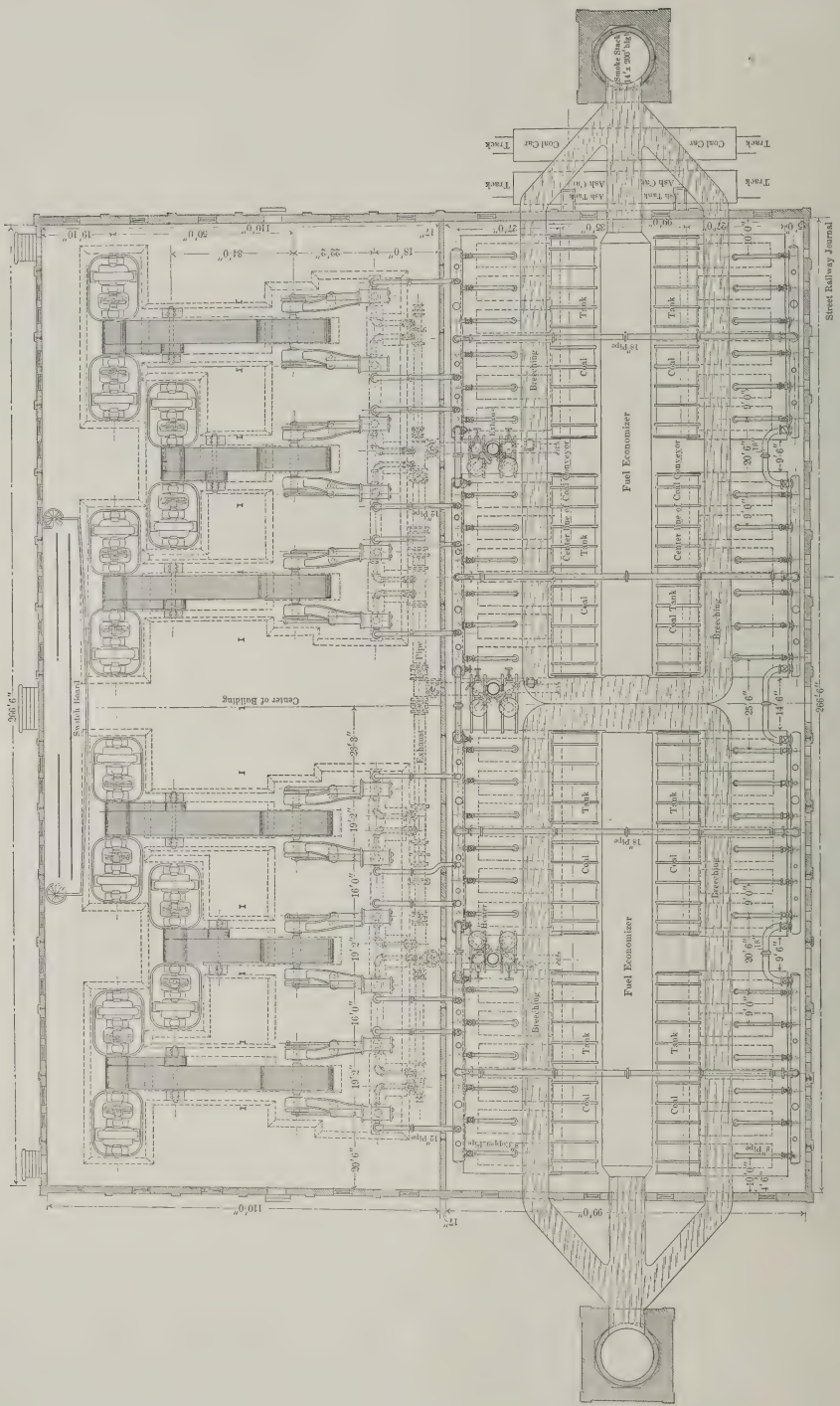


FIG. 6.—PLAN OF NEW POWER STATION—CHICAGO CITY RAILWAY.

It will be noted that the standard girder type of frame is used in this plant, with a 45 deg. angle bearing box for crank shaft. The engineers claim that this type of frame and box are much more rigid than that known as the rolling mill type of frame.

It is claimed by the builders of this station that more power can be placed to the square foot with this type of station than is possible with direct connected plants, built upon the same general lines.

The plant was furnished by the American-Wheelock Engine Company. The engines together with flywheels were built by Wm. Cramp & Sons.

The connection between the engines and the generators are made with hollow shafts of the Bethlehem Iron Company's make, 22 ins. in bearings and 26 ins. in hub, each weighing 50,000 lbs. Directly over the throttle of each engine is connected a direct separator for the purpose of separating the water from the steam on entering the engines. The fly and rope wheel is segmental with double hubs and double arms and weighs approximately 140,000 lbs. It is 20 ft. in diameter, 78 ins. face and has thirty grooves for 1¾ in. rope. In its construction all bolts are fitted in reamed holes and the arms are adjustable with side wedge keys.

The power is transmitted to the drive pulley by the Hoadley "compound wind" system. In this the rope is continuous and is carried thirty wraps around the flywheel, twelve wraps around a compound multiple winder situated between the engines and the driven pulley and forty-two wraps about the driven pulley. The compound multiple winder and driven pulley are each 8 ft. in diameter. The tension on the rope is maintained by passing it around a 104 in. pulley mounted on a horizontal carriage running on tracks overhead in the engine room and with tension weights hanging in the boiler room.

GENERATORS.

There are six 880 k. w., ten pole Walker generators 500 to 550 volts at 1600 amperes. The machines are overcompounded ten per cent and operate at a speed of 220 r. p. m. The special features of these machines are the simplicity of the brush holders and the enormous space for ventilation. When the machines were first erected, the

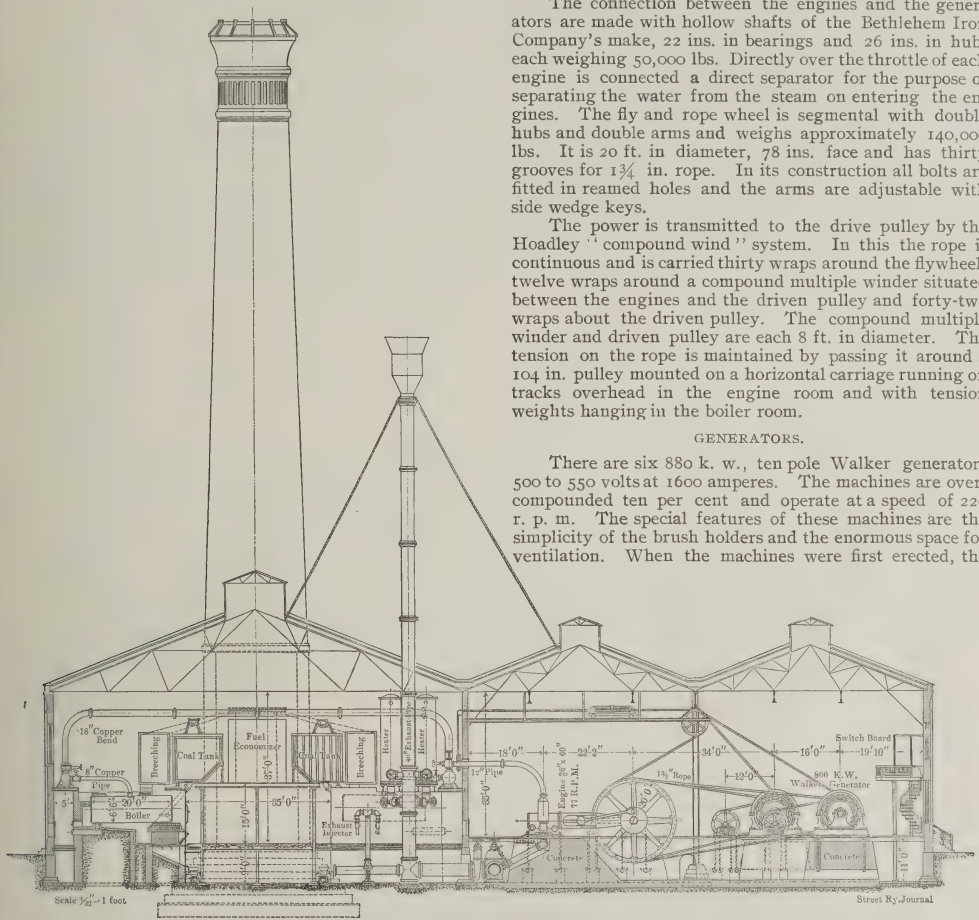


FIG. 7.—SECTION OF POWER STATION.

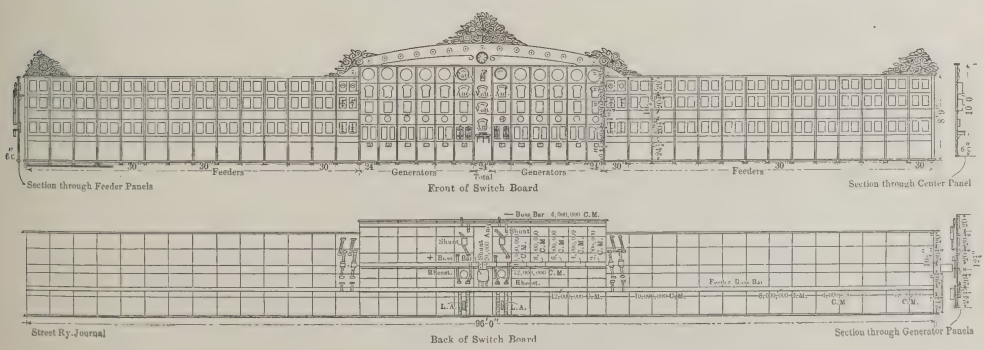


FIG. 8.—SWITCHBOARD.

weather was very frosty. This caused considerable sweating, so much in fact that it was impossible to dry out the generators with the current. In an attempt to do this they were run on short circuit for forty-eight hours with an average load of from 2000 to 2200 amperes, but developed no perceptible heat in the core or windings. In order to secure sufficient heat to dry the generators it was finally found necessary to build radiators of one inch pipe around the machines, giving 35 ft. of heating surface and to charge these pipes with steam at 100 lbs. boiler pressure. A current of 2000 amperes was then carried on short circuit, but three days' continuous running was even then required to secure a sufficient amount of heat to dry out the coils.

Up to the present the outside load on the station has not amounted to an average of more than 1300 amperes on each generator. This load is being carried every day for from three to four hours without any perceptible heating, and the commutators run so cold it is impossible to use any lubricant on the brushes.

The generators are connected in pairs by a shaft upon which are mounted the rope sheave by which they

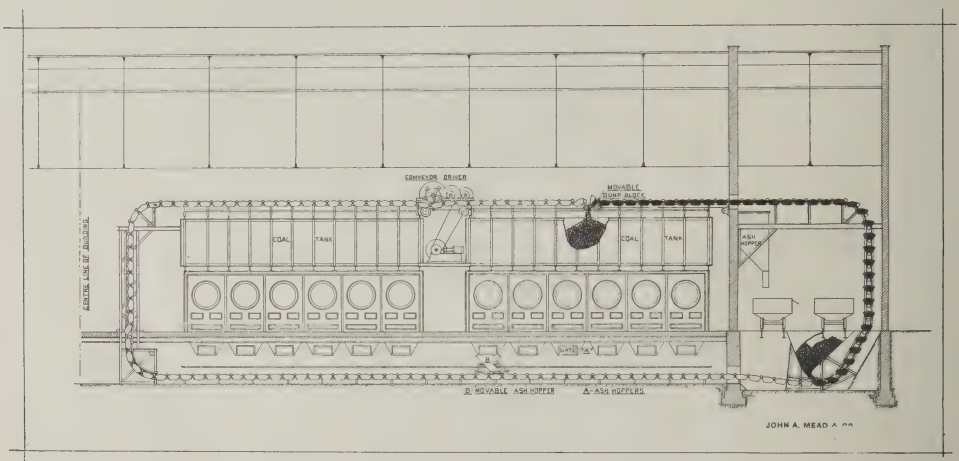


FIG. 8.—COAL HANDLING MACHINERY.

are driven from the engine. The pillow blocks of this shaft are mounted on the generator frame, and each generator is coupled to it by means of a friction clutch of 2000 h. p. which permits the running of one or both generators at any time. The weight of the shaft clutches and rope sheave is twenty-four tons and that of each generator is sixty-one tons.

SWITCHBOARD.

The switchboard is located in the south side of the engine room. It is in a balcony which is 14 ft. above the floor and has a total length of 104 ft. At each end winding stairs furnish access to the main floor. The board, which is very handsome, is of black enameled slate mounted on a steel frame. The trimmings are nickel plated and the instruments are on white marble bases. The crest of the board is a beautiful iron scroll, with a bank of lights on each side of a clock which occupies the center. The ends of the switchboard are also of ornamental scroll work. The effect of this is very ornamental and tasteful.

At the top of the main panel is mounted a bell for the automatic circuit breaker alarm, and two Weston voltmeters carried on a pivot frame so they can be turned to face any direction. One 20,000 ampere Weston shunt ammeter and a log book shelf, directly back of which is mounted the shunt for totalizing ammeter, are also carried on this board. This is the largest meter ever made for a 500 volt circuit, and reads 20,000 amperes in 100 ampere divisions. It is 4 ft. long and is made up of 14⅜ in. copper bars.

There are twelve generator panels each 24 ins. wide. Each panel carries one 2000 ampere recording wattmeter, one 2500 Weston shunt ammeter, one 2000 ampere Cutter automatic circuit breaker, two 2000 ampere, single pole, double break switches, one voltmeter plug receptacle, so connected as to ascertain leakage through generator and voltage for building up, and one Cutter-Hamler field rheostat placed back of panel, with hand wheel on the face of the board.

The feeder panels are fifty-six in number. Each is 30 ins. wide and is equipped with instruments for two feeders as follows: two Garton lightning arresters, two 1000 ampere Weston shunt ammeters, two 1000 ampere Cutter automatic circuit breakers, two 1000 ampere, single pole, double break switches. A total of 112 feeders are supplied with current in this way. There is one 1,000,000 c. m. rubber covered cable running from each feeder switch to a terminal in the basement of the building, where they connect with lead covered cables which pass into two subways which lead across the street to the pole line. The subways are of brick, and in them are the wooden and iron racks for carrrying the feeder cables. The back of the switchboard is fitted in the ordinary way, each of the laminated flat copper bus bars here is 12,000,000 c. m. in section. The wiring from the generators to the switchboard is of 1,000,000 c. m., rubber covered, concentric laid cable, manufactured for the purpose by Washburn, Moen & Company. Two of these wires run in parallel constitute a lead from each pole of each generator to the switchboard. They are fastened with a special porcelain insulator designed especially for the purpose by the electrician of the company, C. J. Reilly. Two of these wires in parallel are also used to connect the generator to the equalizer switches which are altogether on one auxiliary switchboard. This board stands on the floor between the first and third pairs of generators in plain view from the switchboard.

Over the centers of the generators and engines and running the entire length of the building, are iron girders suspended from the roof which have a carrying capacity of twenty-five tons, and on them will be mounted later a pneumatic hoisting device, thereby dispensing with traveling crane. The air service for this will be supplied by a Westinghouse air pump which will be also fitted with 50 ft. of hose for use in blowing the dust out of generators. The division of units in the station also makes it possible

to handle any piece of the entire equipment with rollers and jacks.

This station when fully completed will cost in the neighborhood of $400,000. This is very much less than any other station of approximately the same power capacity.

Heavy Track Construction in Kansas City.

The Metropolitan Street Railway Company, of Kansas City, Mo., has recently completed some unusually heavy track construction that is intended to be very durable. This new track is laid from Second Street to S. W. Boulevard on Wyandotte Street for a distance approximating 7600 lin. ft., of which 6400 ft. is trench work and 1200 ft. is tie construction.

The rails used in both tie and trench work are of the Johnson Company's section, 103 lbs., No. 312, and 90 per

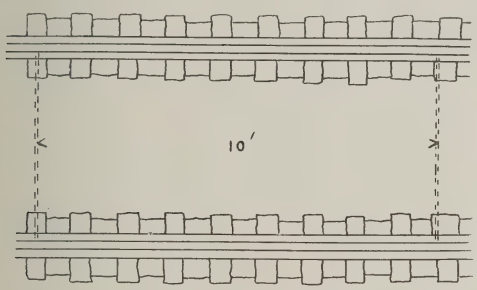


FIG. 1.—PLAN OF TRACK.

cent or over are of standard lengths of 60 ft. No rails were used of less than 40 ft. unless demanded by the nature of the construction at local points. The ties for the 1200 ft. of tie construction are No. 1 oak, standard railroad size and spaced 2112 to the mile of single track.

The joints, estimated at 500, are of the Falk cast welded type. The spikes for the tie construction and blocks are 5½ in. × $\frac{9}{16}$ in. or 5 in. × ½ in. railroad spikes. The tie rods are ¾ in., round, of suitable length and with two square nuts on each end, and are spaced every 10 ft. in trench work and 7½ ft. in tie construction. The four nuts rest tight against the rail when in place.

The trench work consists of a longitudinal trench for each rail fifteen inches deep measured from the top of the rail head, twenty inches wide at the top, and sixteen inches wide at the bottom, to receive the concrete pier upon which the rail rests. In the trench there is placed at a distance of every 10 ft., an oak block 5 ins. × 8 ins. × 16 ins. This block is set about 3 ft. from the end of each rail, and is used for gauging, surfacing and aligning the track. After the rail was placed in position, the trench was filled with concrete under and around the rail, and brought to the proper height to receive the paving.

The concrete for the pier is composed of one part cement, two parts of good, clean, sharp river sand, mixed with clean water into a mortar, and five parts of broken stone added. The cement used in concrete is one-half imported Portland and one-half domestic Louisville. After the rails had been surfaced and aligned and the concrete brought to a proper height, a granite block toothing was placed in position and grouted in with Portland cement mortar of the proportion of one of cement and two of sand in granite and asphalt paving.

In the tie construction, an excavation was first made 18 ft. wide, and of a depth sufficient to receive a concrete foundation 4 ins. thick upon which to pave. After this excavation was made the ties were laid, rails spiked to same by four spikes to each tie, the spikes on each side of the rail being on the corresponding side of the ties. All ties were thoroughly tamped with screenings to a depth of 2 ins. under the ties. After the track was laid, a concrete foundation for the paving 4 ins. thick and of proper width was put in. The concrete consisted of one part Louisville cement, two parts clean, sharp river sand and five parts broken stone. The size of the stone used, does not exceed 2½ ins. in the greatest dimension. The foundation was thoroughly tamped until the mortar was flush with the surface.

Overhead Construction for Suburban Lines.

BY J. F. MACARTNEY.

One of the first things to be considered in the proposed construction of any electric line is the probable cost of the overhead work. This varies, of course, with the quality of construction to be installed, the location of the line and the amount of feeder wire required, and may be largely increased if there should be any especial difficulties to be overcome, such as rock blasting for pole setting, the location of poles in swampy land, or should special attachments be required for bridges and trestles. It is in the item of feeder wire, however, that the great difference in cost comes in between most roads.

The conditions which enter into the calculation of the proper size of feeders are as follows: First, number, weight, speed and headway of cars. Second, grades and curves. Third, distance in feet from the source of power to a center of distribution. This is determined by the distance of the road from the power house and the number and distribution of the cars operated. Fourth, cost of power in station which determines the amount of power which may be economically lost in the feeder.

The smaller the feeder the greater the loss of power in transmission, and one can readily see that with coal, at, say, $4 per ton delivered in the power house, it would not be economy to lose so large a percentage of the power in the feeder, in order to reduce the cost of the feeder, as it would with coal at $1.50 per ton, or where water power is used. After the feeders have been figured out under the

FIG. 2.—SECTION OF STREET.

conditions of the road, accurate judgment is required to place them where they will give the best results.

Outside of the feeders the cost of straight line work depends upon the character of the construction, and the builder or owner must decide the following points: Poles—are they to be 30 ft. × 7 ins. or 28 ft. × 6 ins. shaved and straight, or scrubby and full of knots? Setting poles—are they to be set six feet in the ground, well tamped and braced against strain, or are they to be set three feet in the ground and tamped in about the same way as fence posts, without regard to whether the pole is plumb or raked for the strain, also whether the poles will be 100 ft. or 125 ft. apart? Brackets—are they to be of 1½ in. pipe 7½ ft. long, with under brace to give strength, and fitted with a span wire attached to the bracket to overcome the pounding of the trolley wheel, or are they to be of 1¼ in. pipe 6 ft. long

with no under support and no wire attachment? Placing the brackets—are they to be lined up, every one the same height from the track, or are they to be put up by eye measurement? Spans—are they to be of $\frac{6}{16}$ in. cable fastened to the poles around a fork bolt having porcelain insulator, the span pulled up tight and straight across the track, or are they to be of solid No. 4 or No. 6 wire made up around a plain eyebolt with no allowance for secondary insulation? Is the trolley to be pulled up tight, plumbed over the center of the track, with fifteen inch deep grooved hangers soldered on, anchored at every curve and every 2500 ft. on the straight line, lightning arresters cut in on the pole line, and all overhead material stormproof and of known merit; or is the wire to be hung at sight for centering over the track, with a cheap hanger without proper soldering and wire at curves a foot or so out of place? This difference in the character of construction possibly explains why some contractors have to charge more for their work than others and why it is advisable to have in charge of all new work an electrical engineer to see that all details are performed correctly. Would so many of the roads need reconstruction if the work had been done right in the first place?

The following figures of the cost of electrical overhead work for suburban service have been taken from some recent estimates, and while they will not be found to fit every case will be found approximately correct under conditions similar to those existing in most of our Eastern and Middle states. The construction is intended to be plain but durable.

Cost of one mile of span work, poles 110 ft. apart, having one curve and one turnout.

105 poles delivered, 7 ins. × 12 ins. × 30 ft. at $2	$210
1 mile of trolley wire	130
1 curve	30
1 turnout	30
Line fittings	110
Lightning arresters	10
Span wire curves and pull-off	30
Tapping in from feeder	10
Haulage of material	30
Labor	600
Incidentals	10
	$1200

Cost of one mile of bracket work, poles 100 ft. apart, one curve and one turnout.

55 shaved poles 7 in. × 30 ft. delivered at $2	$110
50 7½ ft. flexible brackets, 1½ in. pipe	125
1 mile of trolley wire	130
1 curve	30
1 turnout	30
Line fittings	100
Lightning arresters	10
Wire for curves, turnout and anchors	25
Tapping in from feeder	10
Haulage of material	20
Labor on work	500
Incidentals	10
	$1110

A Revolution in Copper Manufacture.

By Harold P. Brown.

In these days of keen business competition, makers of electrical apparatus and machinery are quick to seize upon each advance in the arts which will reduce the cost of material or increase the daily output of their shops. And the alert engineers in our large electric power houses are always ready to adopt improvements which will effect a saving of power. Both these classes will therefore be glad to learn of a discovery in metal handling which will reduce cost and save time and power. It has been considered impossible to obtain solid castings of copper without mixing with it some other metal.

And it is well known that even ½ per cent of alloy is enough to reduce the electrical conductivity of the casting to one quarter that of pure copper. Many processes of mixing or tempering this metal have been invented, but their product has not up to this time been able to show the physical properties of rolled or drop-forged copper. Some months ago in a new type of rail bond, I used strips of rolled copper with cast copper terminals. These castings were made for me by a firm which claimed extraordinary things for their product. I therefore expected very little from the metal, and in making tests was greatly surprised to find that a piece of this metal with but ⅜ sq. in. section, could transmit 1500 amperes for twenty minutes without heating. A calculation based on this performance indicated a conductivity of at least ninety per cent that of the best rolled copper. As I had never before found cast copper with more than forty per cent conductivity, and this only after compression, I decided to make a thorough and complete series of tests so as to ascertain the facts concerning this metal which is called MB copper. A chemical test suggested by Mr. Edison showed that these castings had less impurity than was contained in some sheet or rolled metal sold as pure electric copper. To exactly determine the relative conductivity, I ordered a pattern made from which I obtained castings of the best commercial copper and of the MB metal.

These castings were carefully finished so as to present for testing, a cylinder 25 ins. long and .8 ins. in diameter; a terminal was left at each end, about 2¼ ins. × 2¼ ins. × 1 in.

As a basis for comparison I had an exactly similar bar turned up from the best rolled Lake Superior copper. The completed bars were magnificent pieces of metal without an apparent flaw. The difference in shrinkage of the two castings and a slight variation in the size of the terminals made it impossible to exactly obtain the comparative weight. The terminals of the rolled bar measured 2 ins. × $2\frac{7}{16}$ ins. × 1 in., and its weight was 7 lbs. 6 oz.

The commercial cast bar was a popular process "tempered" copper, with terminals $2\frac{1}{16}$ ins. × 2⅛ ins. × 1 in.; its weight was 6 lbs. 9 oz. The MB bar's terminals measured 2 ins. × $2\frac{3}{16}$ ins. × 1 in., and its weight was 7 lbs. 1 oz. Each of the cast bars gave a clear musical tone when suspended and struck, the MB bar, though the heavier, giving the higher note. Of course, the rolled bar was without resonance. The commercial cast bar had accidentally been turned .002 in. too small, but the other two measured exactly .8 in., thus having a section of practically ½ sq. in.

I decided to test the electrical drop in 2 ft. of each bar, and its temperature at from 100 to 1500 amperes, the latter being three times the proper current for that section of copper. In order to prevent any rise of temperature from the contacts at terminals, each terminal was amalgamated by the Edison process and coated with the Edison flexible solder; there was, therefore, no appreciable drop at these contacts. In amalgamating the commercial copper bar by the Edison process, fumes were given off, with an odor of zinc, and a black precipitate was formed. This was washed off and the process repeated several times until the surfaces remained bright. Both of the other bars yielded instantly to the process, without fumes or precipitate.

Mr. Edison states that this is a keen test of the purity of copper, and so it proved, for analyses subsequently made for me by Ledoux & Company showed the commercial casting to have 99.15 per cent of copper; the rolled bar 99.83 per cent, and MB copper 99.85 per cent. In spite of the different characteristics of these bars, the variation in composition is less than seven-tenths of one per cent. From tests of similar samples, the tensile strength of the commercial cast copper was 19,000 lbs. to the square inch, while the MB was 30,000 lbs., which is practically the same as rolled copper.

The cables used for connections were 500,000 c. m., with triple braided insulation. When heavy currents were used, the bare ends of the cables near the bar connections were cooled with wet waste. The observed temperature of the bars was, therefore, not due to any outside cause. The instruments used were all made by Weston, and comprised a shunt ammeter reading to 1500 amperes; a milli-

voltmeter reading .0002 per degree up to .01 volt; another reading .002 per degree up to .1 volt, and a third reading .01 per degree up to 1.5 volts. In each case the same voltmeter terminals were used; these were clamped upon amalgamated spots on the bars, just twenty-four inches apart. A special dynamo, driven by Edison motors, was used; its field was excited from the Edison mains; by using a rheostat and a bank of lamps, the amount of current generated could be accurately adjusted.

The first readings were taken at 100 amperes after about one minute's run; the current was then increased 100 amperes and a second reading taken, and so on until 1500 amperes were reached. This amount of current was continued for ten minutes and increase of the temperature and drop noted. The bars were then disconnected and laid upon a wooden floor and their rates of cooling noted. Since the copper resistance tables are either calculated for a constant temperature or were compiled years ago from data based on impure copper, I decided to use as a basis of comparison the drop of the rolled copper bar at each 100 amperes. Since the performance of the MB copper came so close to this standard, I repeated the tests on each and found the readings accurately recorded. The tabulated results are as follows:

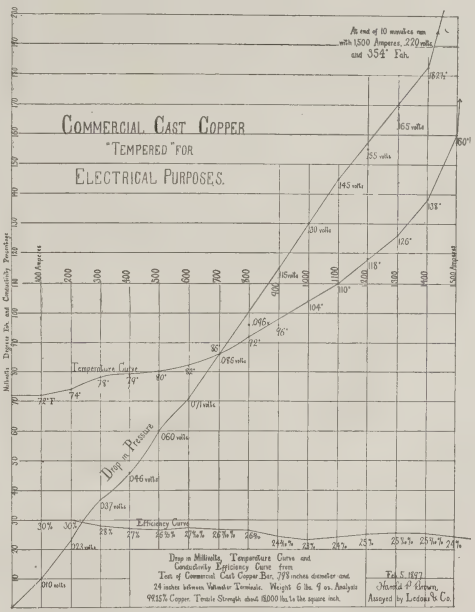
Amperes.	Rolled Copper.		MB Copper.			Commercial "Tempered" Cast Copper.		
	Degs. F.	Milli-Volt.	Degs. F.	Milli-Volt.	Per Cent.	Degs. F.	Milli-Volt.	Per Cent.
100	72	.003	72	.0032	94	72	.010	30
200	74	.0065	72	.007	93	74	.023	30
300	76	.0105	72	.011	95	78	.037	28
400	78	.0134	72	.014	96	79	.046	27
500	79	.017	72	.017	97	80	.060	26.6
600	80	.0195	72	.020	97.5	82	.071	27.4
700	81	.02225	72½	.023	96.7	86	.086	26.7
800	81½	.025	73	.027	94.4	92	.096	26.5
900	82	.028	73¼	.0295	95	96	.115	24.3
1,000	83	.03175	73½	.034	93.4	104	.130	23
1,100	83½	.035	74	.036	97	110	.145	24
1,200	84	.039	76	.040	97.5	118	.155	25
1,300	86	.042	78	.044	95	126	.165	25.4
1,400	88	.046	80	.048	96	138	.1825	25.2
1,500	90	.048	81	.052	92.3	150	.195	24.6
1,600	138	.053	136	.057	93	154	.220	24

The last set of readings was taken after a ten minutes run with 1500 amperes.

The accompanying curves will show the behavior of the three metals under exactly the same set of conditions. The commercial cast copper averaged less than twenty-eight per cent conductivity and before the end of the run, scorched the wood on which it rested and cotton covering the thermometer bulb, as it reached 354 degs. F. and .22 volt drop. Before the test the color of this piece was fine and closely resembled that of the other bars; after the test the bar was a mass of red and silver colored spots and had lost nearly all its resonance. At the end of the run it had expanded from increase of temperature, 1/8 in. in 24 ins. and .002 in. in diameter. Allowance should be made for its difference in size.

It required two hours and twenty minutes to cool to the temperature of the room. The rolled copper showed a conductivity far greater than called for by the tables ordinarily used. Its actual resistance per foot at 72 degs. F. was .000015 ohm. In the table published by the London *Electrical Review*, the resistance of a piece of copper, ninety-five per cent pure, one foot long, with a section of ½ sq. in., is said to be .00001706 at 60 degs. F. Without reducing to the same temperature, the latter resistance is $13\frac{7}{10}$ per cent greater than the resistance observed. The tables based on the Matthiessen standard conductivity also show higher resistance; it is therefore wise to use an actual measurement of modern rolled copper as a standard of resistance for cast copper. The rolled copper bar at end of the ten minutes' run with 1500 amperes, reached 138 degs. F. and .053 volts. It had then increased 1/8 in. in twenty-four inches, as did the other, but the diameter increased but .0005 instead of .002 in. It required one hour and twenty-three minutes to cool. The performance of the MB copper was a surprise and remains a puzzle. In the tests it kept 8 to 10 degs. cooler than the rolled bar up to a load of 1400 amperes. At end of the ten minutes' run with 1500 amperes it reached 136 degs. F. and .057 volts.

The varying temperature of the two bars evidently accounts for the up and down movement of the efficiency curve. If in the tests the temperature of the bars should be kept at 72 degs. by allowing time for cooling after each reading, it is my opinion that this curve would be practically a straight line at ninety-five or ninety-six per cent. I need not say that this conductivity is marvelous and opens



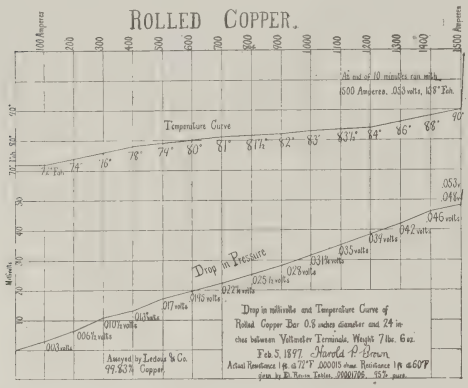
an entirely new field for dynamo and motor construction and for switchboard work, where a large saving can be effected by using it in place of rolled or drop-forged copper, both of which will warp or twist when heated, while the finished cast metal retains its shape. I know of large multipolar dynamos upon which castings of low conductivity have been used for field coil connectors, etc.; on account of the unsuspectedly high resistance of these contacts, the calculations concerning compounding have been upset and the dynamos have been failures. Another surprising quality of these MB castings lies in their elasticity. I have fastened in a vise one end of a casting one inch wide and 3/8 in. thick; the other end, twelve inches distant from point of support, was bent one inch out of its position, but sprang back when released. I have driven through a 7/16 in. hole in a hardened steel plate, a plug of MB metal $\frac{3}{64}$ in. in diameter. This required as many hammer blows on the fifth trial as it did the first.

In another experiment I drove into an opening $1\frac{9}{16}$ ins. wide between heavy steel rails, two plugs of MB copper, the sum of whose widths was $1\frac{19}{32}$ ins., thus compressing the metal $\frac{1}{32}$ in. or about two per cent. A current of 1500 amperes was then passed through the junction whose section was 3/8 sq. in., and a drop of .018 volt was indicated from rail to rail through the two copper plugs in series. The rails were then separated $\frac{1}{32}$ in. more, but the drop

remained the same. An analysis of another sample of this MB copper gave the following results:

Copper	99.870 per cent	Bismuth	None
Silver	.034 "	Lead	"
Iron	.011 "	Cobalt	Trace
Arsenic	.002 "	Sulphur	None
Zinc	.015 "	Oxygen (by difference.)	
Tin	None		.068 per cent

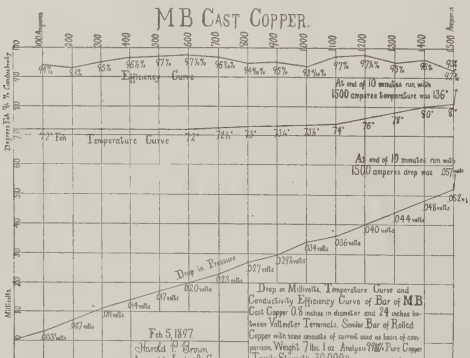
This analysis is verified by others made by such experts as Ledoux & Company, Garrett and Blair, Prof.


ROLLED COPPER.
Temperature Curve
Drop in Pressure
Millivolts
Drop in millivolts and Temperature Curve of Rolled Copper Bar 0.8 inches diameter and 24 in. thus between Voltmeter Terminals. Weight 7 lbs. 6 oz.
Feb 5, 1897. Harold P. Brown.
Actual Resistance 1/9 at 72°F .000015 ohms. Resistance 1/9 at 60°F
given by D. Nevin Tester. .000017.05 .15% pure.
Assayed by Ledoux & Co.
99.83% Copper

Frank X. Moerk and others, and show exactly the same results as the best Lake Superior copper. It is evident that no alloy has been used. And yet the process has increased the electrical conductivity and the tensile strength; has given a certain amount of elasticity and decided resonance; has increased the density and changed the structure of the metal.

On presenting this matter to Mr. Edison, he accounted for the evident change in the structure of the metal, by the theory that the shape of the crystals had been altered so that their lines were parallel, and that the molecules were thus brought closer together and into more intimate contact with each other.

The fact that MB copper can also be rolled or forged adds new interest to its development. Since its tensile


MB CAST COPPER.
Efficiency Curve
Temperature Curve
Drop in Pressure
Millivolts
Drop in Millivolts, Temperature Curve and Conductivity Efficiency Curve of Bar of MB Cast Copper 0.8 inches in diameter and 24 inches between Voltmeter Terminals. Similar Bar of Rolled Copper with same amounts of current used as basis of comparison. Weight 7 lbs. 1 oz. Analysis 99.8% Pure Copper Tensile Strength 30,000 lbs. per square inch.
Feb 5, 1897
Harold P. Brown
Assayed by Ledoux & Co.

strength exceeds that of ordinary copper wire, it is certainly worth while to make wire from it in order to determine its strength and conductivity when in this shape. If it is possible by this process to make as large an increase in the conductivity of wire as it has made in conductivity of cast copper, it would revolutionize dynamo and motor building and every electric light and railway company would save money by using it to replace its present line wire. And if the tensile strength of the wire is increased by this process, poles can be set further apart and the wire will be less likely to decrease its diameter during winter.

It is understood that Mr. Edison is interested in the development of the process and that MB copper will be manufactured under his supervision at the Menlo Park Works.

Specifications for Open and Closed Cars.

The specifications below give those used by the Syracuse (N. Y.) Rapid Transit Railway Company for ordering its last open and closed cars, and are quite complete.

OPEN CAR BODY SPECIFICATIONS.

The engineer hereinafter referred to is the electrical engineer of the Syracuse Rapid Transit Railway Company.

The Style of Car.—To be ten bench enclosed end with six reversible seats, and four stationary seats, seating fifty passengers.

Dimensions.—Length of body over dashers, 29 ft.; width at bottom, 6 ft. 4 ins.; width at posts, 7 ft. 2 ins.; height from under side of sill to top of roof, 8 ft. 8 ins.

Bottom and Body Framing.—It is the intention of these specifications to provide for a car framework of the stiffest and staunchest kind. The car builder will use for his bottom sills and joists nothing but thoroughly seasoned clear white oak. The two side sills shall be in dimensions not less than 8 ins. × 4¼ ins., and shall be faced throughout their length on the outside with a smooth steel plate ½ in. thick and properly secured to the sills with bolts and screws. The other bottom framework shall be arranged for standard truck with seven feet wheel base and a detailed plan of the same shall be submitted with his proposition by each contractor bidding on the work.

Motor Traps.—Motor trap doors to be arranged in bottom, and of suitable size and location for either Westinghouse or General Electric motors. Each pair of trap doors to have their inner edges supported upon an inverted T-iron 1¼ ins. × 2½ ins.

Flooring.—Flooring to be of kiln dried Georgia pine of good quality, dressed on both sides, to be ⅞ in. thick, tongued and grooved, put down tight and secured around traps, and at ends with screws and elsewhere with nails. Flooring, not to exceed 4 ins. in width or to be less than 3 ins.

Deck Sash.—The single deck sash in front and rear and two deck sashes on each side of car shall be of quartered oak and shall be of such a size and design as to allow the name of the division, upon which the cars are to run, being inserted in lettered glass. This glass shall be furnished by the car builder and shall consist of a colored back ground with white letters. The colors and design of this sash shall be determined by the engineer after the contract is signed, and shall be arranged for at least four divisions with four colors in the groundwork of the glass. The sashes shall be provided with pivoted fixtures for holding them in the frames, of a construction which will allow of their not only being opened for ventilating purposes, but being shifted from one car to another. The plan for these fixtures shall be furnished by the street railroad company's engineer. The deck sashes which are not in the immediate fronts and sides of the cars and which are not interchangeable shall be glazed with Florentine glass.

Roof.—Roof to be what is known as the monitor type with dome extending full length, provided with four steel carlins arranged to properly support roof, and prevent sagging. Roof boards to be whitewood ¾ in. thick, to be doubled beaded laid with tight joints, and all nail heads set and all rough places properly smoothed off before canvas is put on.

Roof Canvas.—Roof to be covered with twelve ounce duck, to be in one piece full length without seams; to be laid in thick white lead and no glue size to be used. Duck to be stretched on tight and smooth, and properly secured at edges with tacks and mouldings. Mouldings on ends of roof to be half oval iron.

Ceiling.—Ceiling to be of three-ply bird's eye maple, decorated and varnished, securely fastened in place, and to be arranged on lower decks to take 11 in. advertising cards. Ceiling to be moulded off neatly with quartered oak moulding.

Bonnets.—Bonnets or canopy hoods to have bent back curves and bent rims of elm or oak, and three bent ash ribs and to be roofed with clear white basswood double beaded to show ½ in. between beads, and to be perfectly smooth on inside and finished in varnish. Bonnet to be roofed separately from car body, put on flush with main roof, and joint covered with an iron strap put on with thick white lead. Ornamental brass corner posts will also be provided securing the bonnet to floor of car.

Car Seats.—The car seats shall be cushioned with springs and covered with fine woven rattan. The Hale & Kilburn seat is preferred, and any other which contractor may wish to furnish must first meet with the approval of the street railroad company's engineer. Great care must be taken to anchor both ends of the springs used so that it will be impossible for them to get loose, and, working through, spoil the seats. The inner lining to be of firm material, preferably light steel, and shall underline the seat covering, and serve as a protection against injury to the same.

The backs shall be reversible, constructed of quartered oak

frames and two rows of neatly turned quartered oak spindles. Th backs for the stationary or end seats shall be quartered oak panels framed into the end partitions.

Sash.—Sash both for windows and deck sash to be of quartered oak well proportioned, and securely put together.

Glass.—Glass in window sash to be first quality, double thick French.

Inside Finish and Trimmings.—The interior of the car shall be finished throughout in quartered oak, including all mouldings, seat backs, finish on end partitions, etc. The same shall be thoroughly rubbed and polished, and shall be held in place by half oval headed bronze screws.

End Partitions and Posts.—The end partitions, with windows which may be raised or lowered, will be furnished of massive design, and arranged to give the greatest stiffness possible to the car. The posts shall be of a section sufficient to give the maximum stiffness to the car, and shall be further strengthened with bronze brackets at the upper corners.

Steps.—Side steps to be of Georgia pine, extending full length, with treads 1⅛ ins. thick by 8 ins. wide, and risers about 5 ins. wide, all supported upon strong iron step brackets spaced so as to clear the running gear. Step brackets will be provided with a clevis joint, allowing of the step being raised on the left hand side of the car. Detail drawing of this joint to be submitted to the engineer for approval. Front edge of treads to be bound with half oval iron, ¾ in. wide, securely fastened in place with screws.

Dashers.—Dashers to be of No. 16 steel, smooth, cold rolled and pickled, to be 32 ins. in width, and securely fastened in place with clips and stove bolts. Standards to be extra heavy, with large butts, and to be neatly drawn and tapered. Dash to be firmly secured to the upper deck by ornamental brass rods at the corners.

Dash Rail.—Dash rail to be $\frac{5}{16}$ in. × 1¼ ins. iron, and provided with a bronze cap.

Brake Staff.—Brake staff to be extra heavy, with a 6 in. rachet wheel and dog, and to be provided with Lyons or Adams & Westlake latest pattern ratchet brake handle. Brake staff to be placed inside of the dash, and to have a supporting "stirrup" at the lower end.

Drawbar.—Drawbars to be of the long radial pattern, to be provided with a "spring cage" and a spiral spring at the rear end. They shall have a radial length of, at least, 4½ ft., and a swing of 3½ ft.

Trimmings.—All trimmings shall be of the best bronze metal, of a substantial design, highly polished and lacquered, and shall be subject to the approval of the street railroad company's engineer. Grab handles shall be provided at the end of each seat; also bronze pipe handles with sockets bolted through pillars upon every post. Seat back arms shall be of solid bronze, and shall be also subject to the approval of the street railroad company's engineer. Four signal bells of extra large size to be provided with necessary cord, rope eyes, etc., put up with cord running under outside the drip.

Curtains.—Curtains to be of the spring roller pattern, made of heavy waterproof curtain goods, provided with the Acme curtain fixture manufactured by the Adams & Westlake Company, with waterproof curtain material. Each curtain to have three or more steel bars running through the goods with the ends of said bars running in the grooves in the posts to keep curtain in place.

Guard Rail.—A removable guard rail shall be provided on each side of car finished in quartered oak which may be raised or lowered at pleasure, and which will serve as a barrier against passengers getting on or off on the left hand side of car when the car is in operation. A detail drawing of this device must be submitted to the engineer for approval.

Wiring.—Cars to be wired by the builder for trolley connections and light wires. Trolley wire to be brought down corner posts, and suitable length left under seat.

Painting.—The car to be painted with best lead paints and varnished with Murphy or Parrott varnish, or with a varnish which in the opinion of the street railroad company's engineer is just as good. There shall be at least twelve coats of paint and varnish applied in all, and a first class job of lettering shall be done according to the directions of the engineer, at least three coats of varnish being applied.

Material and Workmanship.—All material entering into construction of these cars to be first class in every respect, and the workmanship to be of the very best.

The purchaser to have full privilege to inspect the work and material at any time during construction and to keep a competent inspector on the ground at all times, if they may so wish.

Trolley Stand.—Cars to be provided with trolley boards on roof of most approved construction, raised on brackets 3 ins. above the roof, and to have slat walk on lower deck to protect canvas, also suitable grab handles attached to same, and steps secured to corner posts to assist motorman when climbing upon the roof.

End Lamps.—An end lamp to be provided for each end of car to be used with candle.

Foot Gongs.—To be two foot gongs per car, i.e., one under each platform, of pressed steel 12 ins. in diameter with proper striking fixture.

Foot Rests.—To be foot rests provided under all reversible seats.

Motorman's Box.—Each car to have under the last seat at each end a box equal in length to about half the length of seat. Said box to set upon strips of wood about three inches wide, and securely attached to the floor. Box to have a door lifting up, running two-thirds of its length with strong spring hinges at the top, the intent being to provide a suitable place in which the conductors and motormen can store overcoats and other personal property. Box must be well made and substantial in every way.

Dasher Posts.—Car builder will furnish ornamental bronze corner posts at each corner of car, which shall extend from the platform to under side of bonnet. These corner posts will be secured to the platform in a way which shall contribute most to the rigidity of the structure.

Register Rods.—Car builder will furnish in place on car, register rods and fixtures for holding and manipulating the same. These rods shall be of polished brass held in place by brass brackets of ornamental design and equipped with necessary rocker arms, handles, etc.

Bumpers.—The car bumpers shall be of massive design, steel faced and shall extend over the entire width of platform. They shall extend out at least nine inches from face of dashers.

Advertising Racks.—Car builder will provide moulding and necessary fixtures for advertising racks on each side of car. This moulding shall be equal in finish to rest of car woodwork.

Electric Headlights.—Car builder will furnish with each car an electric headlight of the type manufactured by the Changeable Electric Headlight Company, of Syracuse, N. Y., two sockets for the same, one at each end of car, and will do the necessary wiring for connecting up the headlights in the lamp circuit of the car. Such wiring to be in conformity with the light wiring both as to work and material.

Hood Irons.—Car builder will provide both hoods on car with irons to protect them from the trolley rope.

CLOSED MOTOR CAR BODY.

Dimensions.—Body not less than twenty feet in length. Platforms not less than four feet in length. Width of car at belt not less than seven feet five inches. Width of car at bottom not less than six feet two inches. Height of car body from under side of sills to top of roof not less than eight feet three inches.

Roof.—The roof shall be of the monitor deck pattern, extending full length of car and carefully trussed with steel carlins or rafters at every post. The frames shall be constructed of white ash and special large steel rafters shall be placed near the center, the better to take the strain due to the weight and motion of the trolley base and pole. A decided camber will be given the roof to aid in stiffening the framework and every precaution will be taken to prevent any possible sagging. The roofing shall be of three inch white-wood, free from knots and tongued and grooved. This shall be covered with eight ounce duck set in soft white lead, and painted with four coats of white lead paint. No glue size shall be used.

The car builder shall further provide on the upper deck of roof a ⅜ in. × 13 ins., whitewood board fastened to outer rail, car lines and monitor plate with screws; remaining roofing to be of 3 ins. × ⅜ in. white wood, beaded and nailed with clout nails as usual.

The lower deck shall be provided on each side with a white-wood or ash board, ½ in. × 13 ins., extending entire length of lower deck (not spliced or butted), to be laid in white lead and screwed to carlins and side plates, the lower edge forming the eaves of the deck.

Trolley Board.—To this roof, constructed in the manner above specified and bolted strongly to the rafters, the car builder will fasten white pine brackets made of two inch stuff for receiving the trolley board. These brackets will rise a distance of not more than two inches above the surface of the roof and to them the trolley board, in length equal to the roof itself, will be secured by screws. The whole will be painted with three coats of lead paint.

Deck Sash.—The deck sash shall be of mahogany and shall be of such a size and design as to allow the name of the division upon which the car is expected to run, being inserted on lettered glass. This glass shall be furnished by the car builder. The sashes shall be provided with pivotal fixtures for holding them in the frames of such a construction that they may not only be opened for ventilating purposes, but may be shifted to another car, thus making them interchangeable. A detail drawing of sample of the proposed fixture for securing these lights and a statement of the precautions taken to make them interchangeable will be furnished by each car builder with his bid. The remaining deck sashes, (4) not containing name of division, shall be glazed with Florentine glass.

Bonnets.—Bonnets shall be detachable with oak frames and ash carlines covered with ⅜ in. tongued and grooved poplar boards 2½ ins. wide. These shall be covered with eight ounce cotton duck and treated in the same manner as the rest of the roof.

Dasher Posts.—Car builder will furnish ornamental bronze corner posts at each corner of car, which shall extend from the platform to under side of bonnet. These corner posts will be secured to the platform in a way which shall contribute most to the rigidity of the structure.

Roof Mats.—Car builder will furnish roof mats to protect the car from the feet of repair men who may find it necessary to climb on top.

Ceiling.—The ceiling panels shall be of best three-ply veneer, in curly maple or other finish, tastily decorated, which shall be satisfactory to the engineer and shall harmonize with the inside finish of the car. The same shall be held in place by mahogany moulding, smoothly finished and polished to a degree in harmony with the rest of the car. Veneering to be well painted on back with three coats of paint before being placed in position.

Windows and Sash.—All side, end and door sashes shall be made of solid mahogany and glazed with the very best quality French crystal plate glass imbedded in rubber on all edges. They

shall be furnished with oval tops and may number either six or seven on each side. Rubber cushions shall be provided to prevent injury to the sash in lowering, and anti-rattling springs furnished of a character to absolutely prevent any noise on the roughest track.

Curtains.—Car builder will provide curtains of best quality curtain goods mounted on Hartshorn rollers and furnished with the Burrowes latest type patent curtain fixtures. Material from which curtains are made will be subjected to the approval of the engineer.

Winter Casings.—A full set of casings shall be provided by car builder; the edge of casing next to sash to be covered with felt and held in place by bronze castings.

Doors.—The car shall be equipped at each end with double doors provided with an attachment which shall allow them to open simultaneously by one movement of the hand. This attachment shall be substantial in its design and construction and shall be warranted by the car builder not to get out of order under the ordinary treatment received in service.

Seats and Backs.—The car seats and backs shall be cushioned with springs and covered with fine rattan or velvet carpet. The Hale & Kilburn seat is preferred. Great care will be taken to anchor both ends of the springs used, so that it will be impossible for them to get loose and by working through, spoil the seats. An inner lining of firm material, preferably light steel shall underlie the seat covering and serve as a protection against injury to the same.

Seat Linings.—The space under the seats shall be closed up with solid mahogany panel work, extending from floor to under side of seat rail, with a door at each end on both sides, hinged at the top and provided with a bronze spring catch. Said panel work shall be easily removed and replaced and arranged for electric heaters.

Floor and Floor Mats.—The floor shall be laid of well seasoned hard Georgia pine flooring, ⅞ in. thick and 3½ ins. wide, dressed on both sides and securely fastened to body frame with wire nails. Trap doors of suitable size and position in the car to allow for easy access to the motors shall be provided and over all tapered floor mat strips, ¾ in. at the bottom and ⅝ in. at the top, made of clear hard maple, shall be screwed into place. These strips shall run longitudinally with the car, reaching the entire length of car floor, excepting a space of two inches at each end to allow for sweeping.

Inside Finish and Trimmings.—The interior of the car shall be finished throughout in solid mahogany, including all mouldings, seat back cappings, finish over windows, etc. The same shall be thoroughly rubbed and polished and shall be held in place by half oval headed bronze screws. The bronze trimmings shall be of substantial and ornamental design and shall meet with the approval of the engineer.

Hand Rail.—A polished brass hand rail shall be furnished on each side of car, provided with embossed leather straps for passengers who are standing to hang on by.

Lamp and Candle Fixture.—Car-builder will provide an ornamental candle stand at each end of car to be used in case the electric light fail. Three light electroliers shall be distributed along the ceiling.

Electric Signal Bells.—The moulding over window posts shall be properly grooved on the inside and push buttons of ornamental design inserted in them for electric signal bells. The car builder will do the necessary wiring and provide the necessary fixtures, viz.: two batteries, two bells, one for eachend and two three-way switches, for said system. Great care will be taken with the wiring to insure a good and lasting job. Best quality annunciation wire will be used, each wire held in place by separate fastenings. Under no circumstances, will the use of double ended tacks covering more than one wire be allowed. When completed the system shall allow of either bell being rung by passengers touching the buttons.

Mirrors.—Two bevel French plate glass mirrors shall be placed in each end of car body over the end windows in mahogany frames.

End Linings.—End linings shall be made of solid mahogany with mahogany panels.

Signal Lights.—Interchangeable signal lights shall be placed in center of car body over doors.

Register Rods.—Car builder will furnish in place on car, register rods and fixtures for holding and manipulating the same. These rods shall be of polished brass held in place by brass brackets of ornamental design and equipped with necessary rocker arms, handles, etc.

Bottom and Body Framing.—It is the intention of these specifications to provide for a car framework of the stiffest and staunchest kind. The car builder will use for his bottom sills and joists nothing but thoroughly seasoned, clear white oak. The body framing shall be made of best clear white ash and the various rails, sills, ribs, and other parts making up the body framework must be continuous throughout their lengths and shall in no event be spliced. All tenons or interlocks are to be thoroughly leaded and secured with screws or pins according to the most approved practice. Posts must be mortised into sills and shoulders boxed ¼ in. into sills and fastened with strap bolts.

Panels.—The panels on car body shall be thoroughly ribbed with at least four ribs of tough ash between every two posts. These will be mortised into the sills and properly secured to rails. All panels shall be heated before being placed in position and glued to posts, ribs and rails being nailed only at the posts. Panels shall be backed with a good quality of burlap, securely glued in place and painted, and shall be made of whitewood thoroughly seasoned, and one piece for length of car.

Truss and Tie Rods.—Body framing shall be secured in place by tie rods, of ⅝ in. Norway iron. Truss rods, of ¾ in. Norway iron, shall also extend the entire length of the body under the seats.

Platforms.—The car builder will furnish with his bid a drawing showing his design and arrangement, together with dimensions of timbers for the platform and bottom sills. The platform must drop, at least, 4 ins. from the level of the car floor, and must be supported in the most substantial manner. It is desirable that the inside platform sills, after being securely anchored to the cross sills at the ends of the car, shall extend back to the trap door openings. They shall further have a bearing on all joists extending across the car back to the point. As a further means of strengthening the body framework, the car builder shall reinforce the outside with steel plates, at least, 5 ins. × ⅜ in. in sections, securely bolted to the sills and extending the length of the body.

Dashers.—The dashers shall be constructed of No. 14 steel, securely clamped to standards made of 1¼ in. iron tapering full length, and shall close the platform on the left hand side of the car. The right hand side shall be provided with Wood's patent car gate (two for each car) manufactured by the Bliss Manufacturing Company.

Bumpers.—The car bumpers shall be of massive design, steel faced, and shall extend over the entire width of the platform. They shall extend out, at least, nine inches from the face of the dashers.

Drawbars.—Cars shall be provided with Brill's patent drawbars, having a radial length of, at least, 4½ ft., and a swing of 3½ ft.

Brake Staff.—The brake staff shall be made of 1¾ in. round iron, and shall be forged tapering from the ratchet wheel to the top, and provided with 18 in. solid bronze ratchet brake handle. Brake chain to be of best quality Norway iron.

Signal Bells.—Four conductor's signal bells of approved design shall be provided, with necessary bell cords, fixtures, etc. Bell cord to be ⅝ in. round leather.

Trucks.—Car body shall be constructed to receive the Diamond truck, with 7 ft. wheel base.

Motorman's Steps.—Car body shall be provided with iron steps on two corners, enabling the motorman to ascend to the roof in case of difficulty.

Advertising Racks.—Car builder will provide moulding and necessary fixtures for advertising racks on each side of car. This moulding shall be equal in finish to rest of car woodwork.

Gongs.—A 12 in. steel alarm gong shall be hung at each end of car to be operated by the foot.

Electric Heaters.—Contractor will provide electric car heaters, six to a car, of the Consolidated or other type which may be approved by the engineer.

Hood Irons.—Car builder will provide both hoods on car with irons to protect them from the trolley rope.

Wiring.—The car shall be wired with two separate circuits for lamps and motors, the wires to be hidden and the wiring to be done during the process of building. The lamp wiring shall be arranged for five lamps at equal intervals down the center of car and two electric headlights. No. 6 best quality braided Okonite or Habirshaw wire will be furnished for motor circuits. At end, six feet of each wire shall be left on roof for trolley connections. Eight feet of motor circuit wire shall be left under the seats for motor connections.

Dash Signs.—Suitable cleats shall be provided on each dasher for the reception of the signs showing the division on which the car is running. These signs to be interchangeable.

Electric Headlights.—Car builder will furnish with each car an electric headlight of the type manufactured by the Changeable Electric Headlight Company, of Syracuse, N. Y., two sockets for the same, one at each end of car, and will do the necessaay wiring for connecting up the headlights in the lamp circuit of the car. Such wiring to be in conformity with the light wiring both as to work and material.

Material and Workmanship.—The material and workmanship on the cars are to be first class in every respect and the engineer or his authorized inspector is to be given every facility to oversee and examine the same. In the event of his disapproving of any of said material or workmanship, it is understood that such changes shall be made as he may suggest until the fault is rectified.

Painting.—The car will be painted with best lead paints and varnished with Murphy or Parrott varnishes or with a varnish which in the option of the engineer is just as good. There shall be at least twelve coats of paint and varnish applied in all and a first class job of lettering shall be done according to the direction of the engineer; to be varnished at least three coats.

The Application of the Storage Battery to Electric Traction.*

BY CHARLES HEWITT.

There are three methods or forms in which the battery has, up to the present time, been employed in electric traction.

1. The application of the battery on the car or locomotive.
2. The application of the battery to long lines.
3. The application of the battery in the power house itself.

The Application of the Battery on the Car Itself.—The history of this use of the storage battery is a chapter of most remarkable failures. But these experiments have had the effect of materially

*Abstract of paper read before the Engineers' Club of Philadelphia, Dec. 5, 1896.

assisting in the rapid development of the battery, for there is scarcely any application of the storage battery which is so severe as its application to a car or locomotive. Some of these experiments have been very extensive, including the operation of a considerable number of cars, and sometimes of only one single experimental car. But little reliable data are obtainable from all the various experiments that have been made; such information that has been given is of a very general character, and is affected by enthusiastic imagination. All trials that have been made in this country have been at the expense and under the supervision of the storage battery manufacturers, and the data which they have undoubtedly obtained seem to have been most carefully guarded.

The following are the results of a test made of a storage battery equipment by the writer about four years ago.

The total weight of a cell averaged twenty-eight pounds made up as follows:

Each lead form	10 oz.
Each rubber casing	4 "
Active material, per plate	16 "
Total	30 oz.
11 plates at 30 oz	330 oz.
Lead conductors per cell	16½ "
Acid	85.6 "
Jar	28 "
Rubber fittings	4½ "

The active material formed fifty-three per cent of the weight of each plate and thirty-nine per cent of the weight of each cell. There were 136 plugs of active material in each plate, and the total surface exposed to the electrolyte was thirty-six per cent of the total area. These figures compare very favorably with other better known makes of batteries. The total weight of a battery of 144 cells was 4032 lbs.

This test was made on the Ninth Avenue line in New York, running from Fifty-fourth Street and Ninth Avenue to 125th Street, or Manhattan Avenue, a distance of nearly four miles. The road has numerous grades of two per cent, three per cent, and four per cent, and from Manhattan Avenue to 117th Street, a distance of nearly one-half mile, is a continuous rise of about six per cent, the track being in poor condition. The regulation of the motor was accomplished by commutating the battery; or in other words, by changing the number of cells so as to vary the e. m. f. applied to the motor. As a consequence the voltage varied from seventy-two to 288, according to the load and the position of the switch. Six trips were made from Fifty-fourth Street to 125 Street and return, and the battery was charged after each trip. The first five trips were made at such speeds as we were able to make between the horse cars without making unnecessary stops. During the sixth trip, stops were made at every third or fourth block in order to imitate a car in actual service. The seventh trip up was made to 117 Street only, but in this case two runs were made without recharging; this trip did not include the six per cent grade, and was made in order to see what difference this would make upon the capacity of the battery. In all, the car made over sixty-two miles, at an average speed of only eight miles per hour. The maximum speed obtained was twelve miles per hour, which, compared with trolley cars, is very low. The e. h. p. per car mile was found to average 1.07 for the trips including the six per cent grade, and .8 for the trip not including the six per cent grade; this is about what I should expect to find with a trolley car of the same weight. The batteries were always charged immediately after a run, and after standing over night they were found to have lost so much as to make an extra charging necessary. The average e. m. f. per cell at the end of the main charge was 2.35 volts, after standing over night this had fallen off to 2.09 volts per cell.

The total watt-hours *output* divided by the watt-hours *charge*, showed an average useful efficiency of only forty-four per cent for the trips, including the six per cent grade, and forty-five per cent for the trip not including the six per cent grade. The ampere-hour efficiency generally referred to by storage battery manufacturers, has been calculated approximately and shows 64.7 per cent for the trips including the six per cent grade and sixty-four per cent for the trip not including the six per cent grade.

From these results I find also that for each hour of run, including the six per cent grade, 2⅓ hours charging are necessary, and not including the six per cent grade, 1.43 hours are necessary. This has a very practical bearing, as it means that in the first case at least an average of 3⅓, and in the latter 2.43 complete sets of batteries must be maintained for each car.

I would next call your attention to the average power required in charging, which I find to be a little over 8 e. h. p. Taking an average of 8 e. h. p. required at the battery, and two batteries per car undergoing charge, and allowing fifteen per cent loss in engine and generator leads, we find we will require an average engine output of 18.8 h. p. per car. For ordinary trolley roads 10 to 12 h. p. is the rule. For this battery the output of the station per car mile will vary from 1¾ e. h. p. hours to 2½ e. h. p. hours; whereas, for trolley cars the output seldom averages over 1 e. h. p. hour per car mile. Mr. Dawson, in an article recently published, gives the following data: power per car mile required at power house, Paris, with lead batteries, 1.5 e. h. p. hours; Berlin, with lead batteries, 1.44 e. h. p. hours; Vienna, with copper-zinc batteries, 1.71 e. h. p. hours. It will be seen, therefore, that the battery car, even on a regularly equipped road, will require at least fifty to seventy-five per cent more horse power hours than are required by a trolley car.

In order to get some idea of the capacity of the battery for doing work, I discharged it through a liquid rheostat at about the average rate of discharge while running a car. Volt and ampere readings were taken every fifteen minutes and one minute of rest was allowed. The discharge was stopped, when the open circuit e. m. f. had reached 1.7 volts per cell; beyond this point the pressure would have fallen off very rapidly. The results show an average e. m. f. of 253 volts; current 24.4 amperes; total time two hours thirteen minutes; deducting nine minutes for rest we get the actual discharges in two hours four minutes.

Taking the e. h. p. hours required to run a car as .8 and 1.07, as already shown, we find that the battery would run the car from eighteen to twenty-two miles according to the contour of the road.

There is one feature in regard to this part of the subject which I have not yet referred to; that is, the disintegration of the lead grid which holds the active material. In the ordinary well known forms of batteries it seems to be a well established fact that if the current density in a cell is kept within certain limits, the lead grid is but slightly attacked or disintegrated; but when cells are subjected to frequent heavy discharges, much beyond their normal current density, the lead grids themselves are attacked and disintegrated. As the weight of a traction battery must be kept at the minimum limit, the grids are necessarily as light as possible, and in consequence comparatively little disintegration will so affect the mechanical strength of the grid that it soon goes to pieces. From such information as I have been able to gather, six months seem to have been a good life for a positive plate; whereas, the average life has been nearer three or four months.

The Application of Storage Batteries on the Ends of Long Lines. In such applications the conditions are entirely different. The battery in this case acts essentially as a pressure regulator. The conditions do not restrict the size of the plates, so that the plates can admit of such a size that the current density on discharge per unit area of plate can be kept well within the limits of normal discharge; and in consequence of this, the battery is not subject to the great loss of efficiency, due to the fall of e. m. f. on discharge.

Only a few such installations have been made, two of which are on the Isle of Man; one has been installed by the Anaconda Mining Company, at Butte, Mont.; there is also a small plant at Merrill, Wis. The first installation, however, that has been made for any large city road for its suburban service, I find, is the one installed by the Union Traction Company, of Philadelphia, at Chestnut Hill. The history which led up to the installation of this battery may be of some interest.

The road was originally a horse car line which ran as far as the depot at Pelham. Conduits and cables were installed for operating a number of cars which were supposed to be amply sufficient. The phenomenal increase in the travel, however, necessitated a large increase in the car service. In addition, the success of the line warranted its extension to Chestnut Hill, and, the service was extended as far as Chestnut Hill Avenue, which is at the top of the long grade descending into the Wissahickon Valley. More recently the line has been extended down this grade to Hillcrest Avenue, and from Hillcrest Avenue to the Wheel Pump on the Bethlehem Pike. With the first extension of the line to Chestnut Hill, the underground cable was also extended, but the drop in pressure over this long line made it impossible to run the requisite number of cars, as the speed of a trolley car is approximately in the direct ratio to the applied e. m. f. The cables for feeding this section consisted of one cable extending to Chestnut Hill, one to Chelten Avenue and one to Wayne Junction about five miles from the station; all these cables were 1,000,000 circular mils, copper, rubber covered and leaded, laid in terra-cotta ducts. The investment in feeders for this line had reached a point considerably above $100,000, not including the ducts. To have increased the cable system so as to have supplied this section properly, would have required about seven cables of 1,000,000 circular mils, and of 48,000 ft. each at $1.05 per foot, laid, which would amount to $352,800; deducting the value of cables three and seven, which were already laid, and which are estimated at $79,000, we find that the extra cost for cables without conduits would have been $273,800; this figure was of course, prohibitive.

The question then resolved itself into the necessity of building a station, or providing some other means of keeping up the pressure. If a station had been built at that point, it would of necessity have been small and inefficient. From records taken at the main power house, we found that it would be necessary to provide a station of about 750 k.w. capacity; such a station would have cost about $85 per horse power, or a total of $85,000. A battery station, on the other hand, required but little real estate, and would be inexpensive to operate; its cost would be considerably less than a power station. In the Chestnut Hill plant the entire cost of real estate, battery and building was approximately $25,000; to this must be added the cost of a booster in the main power house. We found that this required a 200 k. w. generator, which with its engine would cost about $8000. The total cost of battery and booster would, therefore, have been $33,000. In this installation, however, we simply adapted a 500 k. w. generator at our Beach Street power house to this service, so that although we lost its service for 500 volt work, we were put to but little extra expense in the power house for adapting it to booster purposes. We find, therefore, that deducting $33,000, the cost of the battery and booster, from $85,000, the cost of a station, that the difference in first cost is $52,000 in favor of the battery. In addition to this, we were put to an expense of a little over $13,000 for changes in the cable. In the estimates that follow I do not include any cost or interest on the cable, as the investment would have been about the same whether we had built a station or installed

a battery. It is very apparent, therefore, from the facts given, that on the score of first cost, the battery was by far the cheapest installment which we could make.

There are three cables concerned in this work, which we have numbered No. 3, No, 4 and No. 7, all of 1,000,000 circular mils capacity; the lengths of these cables are as follows: No. 3, 48,012 ft.: No. 4, 50,718 ft.; No. 7, 27,233 ft. Cable No. 4 is the only one which supplies the trolley wire direct; or, in other words, all the taps from the underground cable to the trolley wire are tapped on cable No. 4; this cable runs all the way from the bus bar at the Beach and Green Street power house to the end of the line and feeds about twelve miles of trolley wire. Cable No. 3 runs direct from the Beach and Green Street power house to the bus bar at the battery house. Cable No. 7 simply augments the capacity of cable No. 3.

In ordinary operation the current on cable No. 3 passes through the booster at Beach and Green Street power house, by which the initial pressure is raised 150 volts more or less above the ordinary bus bar pressure of 530 volts. By this means the drop in the cable is overcome, so that we are able to adjust the pressure at the battery house to a point where the battery varies but little to each side of the zero point, or, in other words, it charges and discharges continually, maintaining the load on cable No. 3 nearly constant, and consequently maintaining a constant e. m. f., where the current passes out from the battery house through cable No. 4. This cable (No. 4) is therefore fed from two points, namely, from the Beach Street end at 530 volts, and from the Chestnut Hill end at a little above 500 volts. As a consequence, the distribution along the line from Wayne Junction to the end of the line at Chestnut Hill is comparatively uniform, and is now very satisfactory. When the load on the line is low, the current going over the cable No. 3 to the battery house, divides at the bus bar, one part supplying the necessities of the line, the other part charging the battery. When the demand on the line is heavy, the pressure drops a little at the battery house; all the current going over cable No. 3 will pass out over cable No. 4, and in addition, the battery will discharge sufficiently to make up for the extra demand for current. This has the effect, as I have stated above, of keeping an almost constant load on cable No. 3. After several months' experience with this equipment, we have found that at times the load on cable No. 3 has become so heavy as to reach the maximum pressure which the booster will generate. With the speed at which we are now running the booster, this maximum is about 250 volts; at such times, by an arrangement of switches at the Beach Street power house, we throw cable No. 4 on to the booster as well as cable No. 3. In doing this, we increase largely the current through the booster, but are enabled to reduce the pressure to about 125 or 130 volts, and, in addition, get better pressure at the Wayne Junction end of the section.

The following data are the result for the operation for the month of October, 1896.

First, as to the cost of operating. From volt and ampere meter readings, taken from the power house at Beach and Green Streets, we find that 136,576,919 watt hours were delivered to cable No. 3. By wattmeter records at the battery house, 1,728,000 watt hours were lost in the battery, leaving a difference of 134,848,919 watt hours delivered to the line at the battery house. These figures, I may explain, do not include the watt hours generated by the booster, since we have assumed that this entire amount is lost in transmission. As a matter of fact, this is not strictly correct, but if a station were operated at Chestnut Hill, it would be run at a bus bar pressure a little above the battery pressure; and therefore, for our present purposes, the assumption is correct. From our experience in operating power houses of various capacities, we find that a power house, operated at Chestnut Hill, under conditions which I have described, would cost about 1½ cents per kilowatt hour output. We, therefore, get the following as the cost of generating the number of kilowatt hours required by the Chestnut Hill branch during the month of October, if furnished by a station at Chestnut Hill:

134,848,919 k. w. hours, at 1½ cents	$2,022.73
Interest on $85,000, at 5 p. c. per annum	354.17
Depreciation on machinery, etc., at 5 p. c. per annum	354.17
Insurance, taxes, etc	200.00
Total cost of operation for the month by direct method.	$2,931.07

Actual cost of operating the battery and booster:

Watt hours delivered to cable No. 3 by bus bar	136,576,919
" " generated by booster	34,234,648
Total watt hours delivered to cable No. 3.	170,811,567

We find the cost of operating the Beach and Green Street power house for the month of October, exclusive of interest and depreciation, was seven mills per kilowatt hour; therefore, we obtain the following:

170,811,567 k. w. hours, at .7 cents	$1,195.68
Cost of labor and supplies at battery house	179.73
Total	$1,375.41
Depreciation of battery at 5 p. c. per annum	83.33
Interest at 5 p. c. per annum on $33,000	137.50
Taxes, insurance, etc	32.00
Total cost of operation	$1,628.24

Deducting this from the cost of operating by a station at Chestnut Hill, we find the difference in favor of the battery for the month would be $1,302.83. At this rate the saving for the year is $15,633.96.

RECAPITULATION.

Saving in cost of installing battery over a new power station for Chestnut Hill	$52,000.00
Saving in operation per annum	15,633.96

These results speak for themselves, and need no further comment. The following data may also be of interest.

Highest charge for 24 hours	456,000	watt hours.
Lowest " " " "	312,000	" "
Average " " " "	385,161	" "
Highest discharge for 24 hours	456,000	" "
Lowest " " " "	216,000	" "
Average " " " "	329,419	" "
Average efficiency for the month, 85.5 p. c.		
Average day charge in amperes	46	
" night " " "	155	
" discharge " "	50	
Ratio of the night charge to the day charge	highest, 1½ to 1; lowest, 4 to 1; average, 2.63 to 1	
Ratio of day charge to discharge	highest, 1 to 4.45; lowest, 1 to 1.86; average, 1 to 2.95	

SPECIFIC GRAVITY.

Maximum specific gravity at 6 A. M	1.210
Minimum " " " 6 "	1.2
Average " " " 6 "	1.206

These are the specific gravities at the end of full charge:

Maximum specific gravity at 6 P.M.	1,201
Minimum " " " 6 "	1,184
Average " " " 6 "	1,192
Maximum specific gravity at 12 "	1,194
Minimum " " " 12 "	1,182
Average " " " 12 "	1,188

This last specific gravity is practically that immediately preceding the night charge, and is an indication of the amount taken out of the battery during the day. At a specific gravity of 1.16 the battery would be about empty; so that we find at no time was the battery more than half discharged.

This method of power distribution cannot be considered economical *per se*, but where the conditions are such as we have described, and the question is simply whether a power house shall be constructed or a battery installed, I think there is no question as to the economy in favor of the battery.

There are many such lines in the country as the Chestnut Hill branch in this city, and it is interesting to note that railway engineers throughout the country are giving this matter much more serious consideration now than in the past.

The Application of the Battery in the Power House.—In this application the battery becomes a load regulator rather than a potential regulator, as in the previous case. The object of a battery is to even up the load on the generators, so that the engines may run at the point of maximum economy.

There is an absolute lack of data on this method of applying the battery, as very few stations have so far been equipped. There are a number of these stations in Europe, and such reports as we have received show very satisfactory results. In this country such a battery is now being installed at Easton, Pa.

CONCLUSION.

In conclusion, I have only to add that in my judgment there is a wide and growing field for the storage battery for potential regulation on long lines and for load regulators in power stations; but I do not look for any marked success for applications of the battery to moving vehicles.

DISCUSSION.

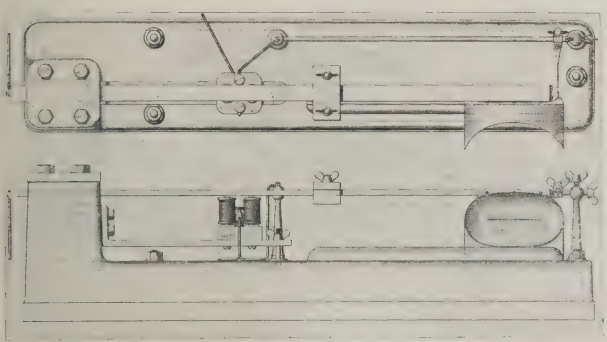
MR. W. C. L. EGLIN: Has it been decided when it would be more economical to replace the battery station with a generating station, and what would be the maximum economical output from a battery station, under the conditions at Chestnut Hill?

MR. HEWITT: It is rather difficult to give a general answer to this question. Each installation, of the character referred to, would have its own limitations. Theoretically, it would pay to put in a generating station, when the extra cost per unit, due to the booster, would equal the difference in cost per unit between the cost per unit at the larger station and the cost per unit at the smaller station. In the particular case under discussion, it would probably pay to put in a generating station at Chestnut Hill when the load on that section reaches the capacity of the present cables. In reply to the latter part of the question, I would say, that the less work the battery does, the higher will be the efficiency. In other words, the battery should be used simply as a potential regulator. The maximum permissible output, in the case under discussion, is 500 amperes, but the maximum economical output is zero output.

SCIENCE · ENGINEERING · INVENTION ·

Vibratory Tachometer.

A very ingenious device for showing small variations in the speed of steam engines has recently been placed on the market by the Ball & Wood Company. It is extremely accurate and is probably destined to work a revolution in the present methods of testing steam engines. A plan and side elevation of this instrument are shown in the accompanying illustration. It consists of a rod which is supported at one end, and is kept continuously vibrating by means of an



VIBRATORY TACHOMETER.

electromagnet in a make-and-break circuit controlled by the vibrator. Any required number of vibrations can be obtained by changing the location of a weight on the vibrating rod. Toward the free end of the rod is a narrow slit. Immediately in front of this rod is placed a screen having a narrow opening corresponding in size and shape with the opening in the rod. As the rod vibrates it brings the two openings together at regular intervals.

When an engine is to be tested the instrument is placed a few feet to one side, and in such a position that an observer looking through the openings will see nothing but a spoke of the flywheel. The vibrator is then so adjusted as to give the proper number of vibrations corresponding with the speed at which the engine should run. This is the number of revolutions of the engine multiplied by the number of spokes in the flywheel. By starting the vibrator when the two slits and one spoke are in line any variation in engine speed can be made apparent by the departure of the spokes from the line of vision.

To make the method of operation more plain, suppose, for instance, an engine running at 300 r. p. m. with a governor wheel in which there are six arms. The observer standing at the side of the wheel and in front of the instrument looks through the narrow slit and sees the arms of the wheel as they pass. In the case assumed if the rod is at rest with the two openings together, he sees what appears to him to be 1800 of these arms pass the opening every minute. Now if the vibrating rod is adjusted so as to cover and uncover the opening in the screen at 1800 equal intervals per minute, it will appear to the observer that one arm remains stationary in front of the opening, but if there is the slightest difference between the arm intervals and the times of vibration, the arm will appear to move slowly across the opening in a direction depending on which interval is the greater.

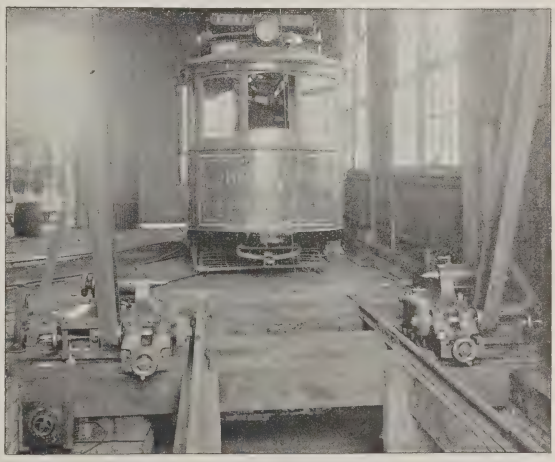
This device was designed by Bert C. Ball, one of the former employes of the Ball & Wood Company. It was developed at the works of the latter company and is secured to its use by contract. By its application the Ball & Wood Company is able to test its governors and detect the slightest variations in the speed of its engines under all conditions of load before they leave its works. Optical demonstration is also afforded of the promptness with which the engine meets the varying changes of load due to the action of the governor, and on the testing block no governor is considered satisfactory which exceeds one per cent of variation between no load and full load.

Truing Machine for Flat Car Wheels.

The advent of rapid transit in street railway travel has intensified the flat wheel evil greatly and made it an extremely burdensome expense to street railway companies. Many wheels go flat when comparatively new, either from careless braking or some other cause, and companies in too many cases simply cannot afford to stand the expense of having them taken off and trued, or replaced with new wheels. As a result the track and rolling stock of the road are hammered to pieces and the patrons disgusted with the bumping and jolting they get.

The Murphy car and locomotive wheel truing machine, made by the Murphy Manufacturing Company, is now being put on the market, having been thoroughly tested by a year of active service in the shops of the Second Avenue Traction Company, of Pittsburgh, and the report of that corporation shows that it has saved it an average of $600 a month in wheels alone, while the wear and tear on track and rolling stock has been reduced to the minimum.

This machine is a simple one and very rapid in its operation. It is not necessary to remove the wheels from the trucks to true them. The car is simply run into the shops, placed into position over the machine; the wheels to be trued, jacked up and centered on the axle, and the motor controlling them started. The emery grinding wheels are then moved into position and started in the opposite direction to the car wheels. In eleven to thirteen minutes after the car has been placed on the machine it can be on the road again with wheels that are absolutely true. There is no loss of time to the car; no expert work about the operation of



TRUING MACHINE FOR FLAT CAR WHEELS.

the machine, and 40,000 to 60,000 miles of service can be gotten out of every wheel.

The practical working of the machine can be seen at any time at the shops of the Second Avenue Company, Pittsburgh, and full information regarding it can be obtained from the Murphy Manufacturing Company, of that city.

Scroll Saw With Differential Strain.

The illustration herewith represents a scroll saw with patent differential strain, which has been built for wood working shops by the Egan Company. The absence of the friction on the strain, and the lightness of crosshead, produces no perceptible jar, even when running at the enormous speed of 1600 r. p. m. It can be run in second and third stories of any factory without shaking the building. The upper part of the strain consists of a differential traversing pulley, in connection with a leaf spring, which gives an even tension and does away with all friction and slides, and on account of the differential traveling pulley requires only a movement of ⅝ in. on the point of spring to give saw full four inch stroke. The strain can be increased or decreased at will of the operator.

The adjustable slides below the table are of the best gun metal,

SCROLL SAW.

with self-oiling globes, and the crosshead which works in same is of solid forged steel. The changing from inside to outside work is much quicker than on any other strained or unstrained saw. The operator passes the end of the saw through the table till it strikes a steel plate, where it slides into the crosshead. It is impossible for the saw to miss catching, and requires no screw to hold it.

The machine has a patent brake and shifter combined, the brake raising as if on a screw, and applying its full face to the crank wheel, instantly stopping the machine.

Forthcoming Exhibition in New South Wales.

On June 26, an important exhibition is to be opened in the Exhibition Building, Prince Alfred Park, Sydney, N. S. W. The exhibition will remain open during the months of July and August. It is intended to embrace engineering in all of its branches, and the exhibits will consist of raw materials, manufactured articles, machinery and models (in motion and otherwise), drawings and photographs of all kinds relating to scientific, mechanical and educational works, in classified sections. There will be no charge made for space allotted, but the executive committee reserves the right to limit the space of each exhibitor. The exhibition will be under the patronage of the Governor of New South Wales.

Among the various groups is Group IV. Prime Movers, comprising steam engines, gas, electric, hydraulic, hot air, etc.; water wheels, turbines, windmills, etc.; steam generators, accessories of engines or boilers.

Group V comprises machine tools, hardware, edge tools, cooking appliances.

Group VI. comprises railway, tramway and vehicular appliances, and embraces rails, switches, signaling apparatus, locomotives, goods wagons, carriages, etc., tramway cars, rails, permanent way, brakes, couplings, ticket checking apparatus, bicycles, tricycles and autocars.

Electricity, Group IX., occupies an important place and embraces generators, conductors, testing and measuring apparatus, telegraph and telephone apparatus, electric lighting apparatus, electro-metallurgy and electro-chemistry, transmission, distribution and utilization of power, lightning conductors, electro-thermic apparatus, and electro-medical apparatus.

The executive committee has appointed Edward Noyes, of Sydney, its representative in Europe and America for the purpose of obtaining exhibits. All communications on the part of intending exhibitors may be addressed to him care of The Standard Air-Brake Company, 100 Broadway, New York.

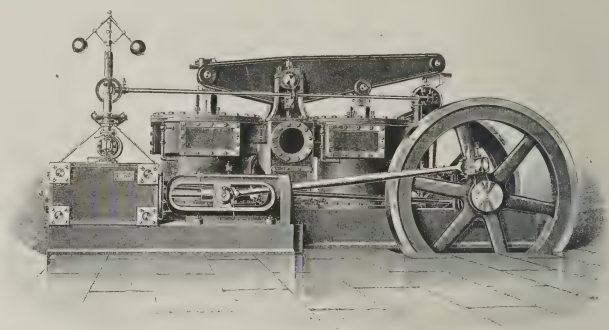
This opportunity gives American manufacturers of electrical and engineering apparatus an excellent means of displaying their wares in Australia as the exhibition will be very largely attended.

5000 H. P. Jet Condenser with Corliss Valve Gear.

The following is a description of a novel independent steam condenser which is manufactured by the C. & G. Cooper Company. The economy of this class of apparatus is receiving considerable attention from street railway managers, and the tendency is to select a machine of a high economy in steam consumption.

The accompanying cut illustrates a 5000 h. p. jet condenser recently installed for the Atlantic Avenue Railway Company, of Brooklyn, N. Y., by the C. & G. Cooper Company. The cut shows two vertical single acting air pumps, driven by a horizontal Corliss cylinder mounted on the same bed. The power is transmitted to the pumps by means of connecting rods, crank shaft and walking beam. The steam cylinder is placed on one side of the pump cylinder, and drives on the crank pin, fastening in one of the two flywheels.

The condensing chamber is located between the two pump cyl-



5,000 H. P. JET CONDENSER.

inders, the top of which also supports the bearings of the walking beam. The condensing water is taken through the opening shown in cut, and is evenly distributed in the condensing chamber by means of baffling plates. The steam opening is on the opposite side and below the opening of the circulating water. The condensing chamber extends down through the base plate, and connects with the bottom of the condenser pumps. These pumps are of the single acting bucket type provided with foot valves, with all parts in contact with the water made of brass or brass lined, as the condensing water used at this station is very acid.

The steam cylinder is 12 ins. bore × 30 ins. stroke, and runs at a speed of from twenty-five to fifty revolutions per minutes. The change in the revolution is done by changing the speed of the governor. The condenser is intended to take care of the steam from eight tandem compound Corliss engines, developing about 5300 h. p.

The C. & G. Cooper Company is also erecting two condensers of the same size as the one above described for the Lowell & Suburban Street Railway Company, Lowell, Mass.

New Insulating Material.

A new material for insulating purposes, which is claimed to be absolutely waterproof for underground work or in damp places, is being placed on the market by The Fiberite Company. The material is in the shape of vulcanized fibre, and will quickly adapt itself to many uses where a perfect insulation is required. It can be used in the construction of dynamos and motors, but is specially adapted to underground street railway work, for insulating track work, block signal purposes and anywhere where vulcanized fibre is used. This material has been thoroughly tested and seems to have stood all tests made upon it in a satisfactory manner.

The Fiberite Company manufactures a complete line of overhead insulating material for all purposes, and was one of the earliest manufacturers of overhead appliances. This company aims to manufacture all its appliances from material possessing the highest possible insulating qualities, not affected by weather changes, strong enough to bear the strain of construction and neat enough in appearance to do away, as far as possible, with the objections to overhead construction. A great number of tests have been made to determine the efficiency of the materials used, and they seem to have stood the tests well.

New Steam Separator for High Pressure Service.

The accompanying cuts illustrate a new form of the Cochrane live steam separators or horizontal pipes, which has been specially designed for high pressure service. This new form is of the baffle plate type, with a steam passageway on each side of the baffle drainage direct to well by gravity, with protection from the current of steam for the water or oil deposited in the well. In this new design the shape of the upper part of the head, where separation is effected, is similar to that of an oblate spheroid or flattened sphere, with branches projecting from each side, parallel to the minor axis for conveying the incoming and outgoing current, and with a branch from the bottom of the head for the connection to the well.

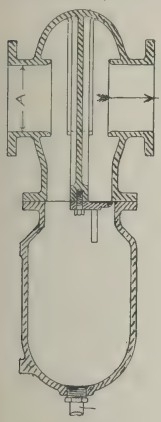


FIG. 1.

The baffle plate, which is cast as part of the head, is ribbed or corrugated on both surfaces, and has ports or passageways for the steam at each side, protected by extra deep ribs. The lower sills of these ports have been placed on a line with the bottom of the steam pipe, so that no water can be carried past the separator, should the well be allowed to fill up, until the water taken out reaches the level of the bottom of the pipe. The area of these ports is such that practically no friction is caused by the separator, except that due to the steam entering the outgoing pipe. The branches projecting from the sides of the separator head are continued beyond the inside wall, the one on the inlet side to insure the impingement of all entrained water against the baffle, and the one on the outlet side to prevent any water of condensation entering the outlet pipe.

Of the two chambers within the head formed by the baffle plate, the one on the inlet side is in direct communication with the well through an opening one-half the area of the steam pipe, the branch for this connection being of the same diameter as that of the steam pipe. The chamber on the outlet side is isolated from the well by a plate closing the other half of the opening between head and well; in this plate is inserted a small pipe for draining away any condensation that may occur in the outlet chamber when steam is standing in the separator, and for destroying the cushioning effect of steam in the well, which would tend to prevent the water stopped by the baffle from dropping into the well, while the separator is in operation. The well is provided not for the purpose of storing the water taken out by the separator, but to give time to the ordinary draining arrangement (steam trap, etc.), to carry off any sudden flushes.

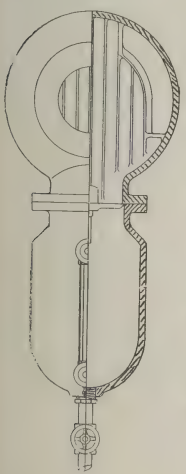


FIG. 2.

FIG. 3.

The advantages claimed for this new design are: first, efficiency, and second, strength; the form adopted for these heads giving greater strength than a cylinder of the same diameter, while giving ample room for the ports and baffle.

Where it is desired to carry a large quantity of steam close to an engine, because of small supply pipes, or sudden variations of load, or of vibration due to a quick cut-off, the manufacturers recommend the use of a large steam receiver instead of the standard well. This changes the arrangement for draining water from the head, as will be noted while comparing the illustrations presented herewith. The purpose of this receiver being to act as a storage tank of dry steam, or as a cushion to take up the rebound when the flow of steam is suddenly stopped, it is necessary that it should be freely open to the supply pipe running to engine. To accomplish this the plate closing off the chamber on the outlet side is transferred over to the inlet side, and a large drain pipe running down to the bottom of the receiver is inserted in this plate. This prevents any water from being "whip-snapped" under the baffle. The drainage of these receivers is effected by any of the methods used in connection with the standard separators, and either cast metal or wrought steel can be used in their construction, depending on the capacity desired. The separator is manufactured by the Harrison Safety Boiler Works.

Fig. 1 shows a vertical section through center of the separator. Fig. 2 shows a half section looking into pipe. The half center section shows right passage way. The exterior of the separator is shown in Fig. 3.

New Line in Pennsylvania.

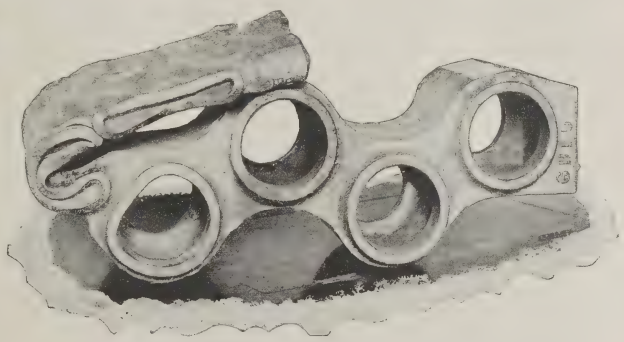
The East Penn Traction Company with headquarters at Yardley, Pa., near Trenton, expects to begin operations in the spring, and the first line to be constructed will probably be between Trenton and Philadelphia and between Trenton, Morrisville, Yardley, Newton and Doylestown. The remainder of the system will be built as fast as practicable, but the company will build in small sections between leading points, and put each division in operation as fast as completed. The company's proposed lines will connect the principal portions of Bucks County, the city of Trenton, N. J.; and portions of Montgomery, Lehigh and Northampton Counties with Philadelphia. A. S. Cadwallader, of Yardley, is president of the company and E. W. Meloney is assistant general manager. The capital stock of the company is $350,000 and will probably be increased to $1,000,000 at an early date.

"Flowed" Steel.

About a year ago the Aultman & Taylor Machinery company made a series of experiments, with a view to obtaining a mix for steel castings which would equal, if possible, in its chemical and physical properties, the best boiler plate steel. After a long series of expensive trials a mixture was discovered which gave wonderful results. Castings made by this "flowed" steel process are free from flaws, defects or blow holes, and are uniform in their texture throughout. Every piece of the metal is guaranteed to have an elongation of not less than twenty-five per cent, and a reduction in area of not less than fifty per cent with an eight inch test piece. Some of the samples have shown an elongation of thirty-one per cent, and a reduction in area of over sixty per cent. The metal can be worked cold as well or better than steel plate.

The basis of the mixture is open hearth steel of the finest quality. "Flowed" steel is used by the Aultman & Taylor Machinery Company in manufacturing crossboxes, flanges, etc., in all its Babcock & Wilcox type of boilers. Where this type of boiler is manufactured for a working pressure exceeding 225 lbs. to the square inch, the company also uses it in the "headers" or manifolds into which the boiler tubes are expanded.

The engraving herewith shows a header of this type, six tubes high. It will be noticed that the header, for a space of two tubes in length, has been flattened out and then bent back on itself. It is extremely doubtful if this experiment can be successfully performed on a steel forging of any description.



HEADER OF "FLOWED" STEEL.

A header made in this manner possesses two very material advantages over a header made of forged steel. First, there is no weld to be made, which avoids one great element of weakness in forged headers, and second, the walls of the header can be thickened at will where the strain incident to its use requires greater strength than at other points. This is especially desirable at all corners in the header, as the strains are greatest there. With the forged steel header the process of manufacture thins the metal at these very points of greatest strain, or an exact reversal of what should pertain to give best results. The same holds true in regard to crossboxes on the drums of boilers for the reception of the header nipples.

STREET · RAILWAY · NEWS ·

Executive Committee Meeting of the American Street Railway Association.

The Executive Committee of the American Street Railway Association held its first meeting in Niagara Falls on Monday, Feb. 15, to make arrangements for the next annual meeting. President Robert McCulloch, of St. Louis, and Secretary T. C. Penington, of Chicago, were present together with Charles S. Sergeant, of Boston; D. B. Dyer, of Augusta; C. F. Holmes, of Kansas City; H. P. Bradford, of Cincinnati, and George B. Hippee, of Des Moines.

Arrangements were made with the principal hotels of Niagara Falls to keep open until and during the meeting, Oct. 19 to 22. The International Hotel was made the headquarters of the Association. It was agreed with the Chamber of Commerce at Niagara Falls that a convention hall containing at least 20,000 sq. ft. of floor space should be erected and completed by the time of the meeting and that this building should contain the meeting room and the exhibition as well. It was also arranged that there should be a steam railroad siding built direct to the door of the convention hall, so as to save all expenses of drayage. The sum of $1000 was raised locally for the purposes of the Association as an additional inducement for the meeting at Niagara Falls.

The committee laid out in a general way the plan of the convention next fall, and selected the topics for papers which will be announced after the parties who will be invited to read them have signified their acceptance.

Among those who entertained the committee at Niagara Falls, were Hon. W. Caryl Ely, president of the Buffalo & Niagara Falls Railway Company, and Burt Van Horn, its general manager; Charles B. Hill, treasurer of the Niagara Falls & Suspension Bridge Railway Company; J. M. Brinker, president of the Niagara Falls & Lewiston Railway Company, and Henry M. Watson, president, and H. H. Littell, vice-president and general manager, of the Buffalo Railway Company, together with Arthur Schoellkopf, Mayor of Niagara Falls, and Messrs. W. S. Humbert, E. T. Williams, W. H. Beardsley and A. J. Thibadeau, of the Chamber of Commerce.

The party rode over the "Gorge" road to Lewiston, and visited the power house of the Niagara Falls Hydraulic Power Company and the Niagara Falls Power Company. On Tuesday morning a trip was made to Buffalo, over the Buffalo & Niagara Falls Railway, and the party was entertained at dinner by Messrs. Watson and Littell, after which the power house of the Buffalo Railway was visited.

Meeting of Street Railway Accountants.

As announced last month the meeting of street railway accountants will be held in Cleveland, March 23 and 24. All street railway companies are invited to send representatives, and already more than fifty companies have agreed to do so. The general feeling among street railway companies is that the plan is a most excellent one and much good can be accomplished. The headquarters of the meeting of the convention will be at Hollenden Hotel. The subjects announced for discussion are: "From Horse Car to Electric Traction"; "Statistical Reports in a Nut Shell"; "Useful and Useless Classifications"; "Monthly Closing of Accounts"; "Earning, Handling and Accounting"; "Standardizing Accounts"; "Naming and Standardizing Apparatus"; "Transfer Tickets"; "Interurban Accounting."

Meeting of the Texas Street Railway Association.

The next meeting of the Texas Street Railway Association will be held at Austin, Tex., on Mar. 17. On account of the death of Col. Sinclair, Carl F. Drake of Austin, succeeds to the presidency. A full meeting can be counted upon, and it will be to the interest of supply men to have representatives present.

Extensive Power Transmission Plant at Minneapolis.

The contract for the electrical utilization of the Falls of St. Anthony at Minneapolis has been awarded to the General Electric Company.

It will be remembered that the St. Anthony Water Power Company, and the Pillsbury flour mills and elevator lines were merged into the Pillsbury-Washburn Flour Mills Company, which controlled not only most of the developed water power of the Falls, but also the undeveloped water power below the Falls. A dam to utilize this power was constructed and the total available is calculated at 10,000 h. p.

The water will pass through turbines of Stilwell-Bierce & Smith-Vaile manufacture, seven of which, each of 1000 h. p. capacity, will form the initial hydraulic equipment. The electrical equipment will consist of a plant comprising both direct current railway apparatus for the needs of Minneapolis, and three-phase apparatus for transmission of part of the power to St. Paul, ten miles distant.

The direct current portion consists of two 700 k. w. General Electric multipolar generators, with a speed of 130 r. p. m. furnishing current at 600 volts, and two 100 k. w. exciters for the three-phase alternators.

The three-phase generating plant consists of five 700 k. w. alternators with a frequency of 35 cycles, and an initial voltage of 3450 volts. This pressure will be raised to 12,000 volts in six step-up transformers of the well known air blast type, and at this voltage the current will go to St. Paul either by overhead or underground wires. This has not yet been settled. At St. Paul the pressure will be reduced in fifteen step-down transformers, when the current will be led into the rotary converters of special type. Of these there will be five. They will resemble in appearance those which the General Electric Company has installed in the power house of the Buffalo Street Railway Company, to take care of the power transmitted from Niagara Falls. They are eight pole machines, each of 600 k. w. capacity, running at 520 revolutions and turning out direct current at 580 volts. They are designed to operate in parallel with each other, or with the generators now driven by steam in the existing station.

The water power development and the electric plant completed by the Pillsbury-Washburn Company will be operated by the Twin City Rapid Transit Company, a lease having been made between the two companies to that effect. The street railway company will send to St. Paul about 3000 h. p., leaving 4000 h. p. to be used at Minneapolis.

When the new power is set to work running the street cars, the street railway company will dismantle the Thirty-first Street power station, using the room for other purposes. It will continue the main power station at Third Avenue North and Second Street, and also the power station in St. Paul. These will be kept ready for emergencies, such as a breakdown, a sudden call for extra power and similar occasions. In case there is water enough and conditions are favorable there are still three more units to be installed at the dam. There was a close competition between the companies engaged in electrical development and manufacture in this country. The General Electric Company's apparatus, however, was preferred on account of that company's long experience in power transmission work.

Large Car and Truck Order in Boston.

The West End Street Railway Company, of Boston, placed an order last month for 185 open cars. The order was divided as follows: to the J. G. Brill Company, seventy-five cars; to the St. Louis Car Company, seventy-five cars; to the Newburyport Car Manufacturing Company, thirty-five cars.

The cars are all to be mounted on single trucks of the Brill type and will be equipped with Westinghouse motors.

Electricity on the Manhattan Elevated Road.

The Manhattan Elevated Railway Company, of New York, has decided to put in operation several electric locomotives to test the economy of electricity for this work. The division selected for the

test is the Second Avenue elevated road. This decision was reached after receiving the report of W. J. Fransioli, general manager of the road, upon the operation of eleetric locomotives on the Chicago elevated railways.

Maine Railroad Commissioners' Report.

The report of the Railroad Commissioners of Maine, recently issued, gives the following statistics in reference to street railways in Maine:

The total number of miles of track operated in the state is 131, being an increase of thirty-seven miles over last year. The gross receipts for all roads for the year ending June 30, 1896, were $669,998, as against $502,478 for the same period in 1895. The total number of passengers carried for 1896 is given as 12,302,326, and for 1895 as 9,143,377. The commissioners devote considerable space in their report to the experiments with the third rail system on the Nantasket branch of the New York, New Haven & Hartford Railroad.

Foreign Notes.

Barmen, Germany.—The gross receipts of the electric street railway of Barmen, Elberfeld, amounted for the year 1896 to 837,770 marks. The receipts of the same line for the year 1895, before the introduction of electric traction, were only 571,348 marks, showing an increase of 266,422 marks in favor of electricity.

Berlin, Germany.—By decree of Dec. 23, 1896, the branch of the Berlin-Charlottenburger Strassenbahn from Kupfergraben in Berlin to Westend, is to be equipped with electric power.

Birmingham, England.—The City of Birmingham Tramways Company has asked for power to extend its line in several directions.

Blois, France.—By decree of Dec. 17, 1896, the Department of Loir-et-Cher is empowered to issue a loan of $1,672,800 francs, redeemable in forty years, at a yearly interest of 3.85 per cent, for the construction of street railways from Montrichard to Blois and from Oucques to Vendôme.

Bozen, Austria.—An electric street railway from Bozen to Gries is to be opened during the fall of 1898.

Braila, Roumania.—By decision of the Municipal Council, the concession for the construction and operation of a line of electric tramways of about 31 km. will be awarded on Mar. 15.

Cannes, France.—It has been decided by the municipal authorities of Cannes to construct a tramway system in that city, to be operated by cable or overhead trolley traction. The resolution condemns the animal traction as obsolete, and the steam traction on account of the deleterious gases resulting from the combustion of fuel.

Chalons-sur-Marne, France.—By decree of Jan. 26, the construction of a net of electric street railways in Châlons-sur-Marne has been authorized.

Coventry, England.—The Coventry Electric Tramways, Limited, has asked for permission to extend its lines for a distance of about six miles.

Copenhagen, Denmark.—The Kongens Nytoro-Nörrebro Street Railway is to be changed to electric traction, and was partially opened last January.

Dundalk, Ireland.—The Dundalk & Blackrock Electric Tramways Company, has been granted permission to build an electric line from Dundalk to Blackrock. The Development Syndicate, Ltd., of which J. H. Ryan is the attorney, is backing the scheme.

Edinburgh, Scotland.—The Town Council has decided to purchase the Edinburgh Northern Tramways which are worked by cable traction, at a price of £115,000. These tramways are six miles in length.

Genoa, Italy.—A number of new lines are being constructed by the Allgemeine Electricitäts Gesellschaft of Berlin, who have bought out the local horse railways, and have secured concessions from the municipality for considerable new mileage.

Goerlitz, Austria.—The Allgemeine Elektricitäts-Gesellschaft contemplates, after the purchase of the line of horse railways, the change of the motive power to overhead electric traction, and also the construction of two new lines, one from Goerlitz to the city of Prague, and the other from the Post Office to Landeskrone.

Gothenburg, Sweden.—It is stated that the Gothenburg Tramways Company has decided to equip all its lines with electricity and to make several extensions to its road. New motor cars will be purchased, and the old horse cars will be used as trail cars. The power station will be erected at the site of the present depot, where the necessary land has already been acquired. The annual car mileage of the Gothenburg tramways is about 500,000, and the number of passengers 2,750,000 per annum. F. W. Stoddard is managing director of the company.

Halle, Germany.—The following figures are given by the *Frankfurter Zeitung* of the operation of the electric tramway company of Halle: gross receipts for 1896, 354,332 marks, as against 335,380 marks for 1895. The receipts of the horse car company of the same town were for 1896, 170,204 marks as against 169,367 marks for 1895. No dividend has been paid on the latter line for the past two years.

Hastings, England.—Application will be made to Parliament for a bill to provide for the construction of tramways in Hastings and St. Leonards. These tramways will probably be operated by electricity, although the bill provides for animal power, electricity, compressed air, oil, or other mechanical power.

Johannesburg, Transvaal.—The concession for the new electric tramways in Johannesburg has been definitely granted. In exchange for the franchise the company is to pay the sum of $10,000 to the Government. The new roads will be operated in opposition to the horse car lines, several of the rival lines running through the same streets.

Kingston, Jamaica.—The Privy Council invites applications for a license for the establishment and working of a system of rapid transit in Kingston. Copies of the local rules and maps of Kingston are kept at the offices of the Crown Agents for the Colonies, London, England.

Leeds, England.—The City Council has resolved to extend the line of the Leeds Corporation Tramways in York Road.

Le Treport, France.—It is proposed to build an electric tramway connecting the towns of Eu, Tréport and Mers.

Lodz, Austria.—The contract for the construction of an electric street railway in Lodz has been secured by the Allgemeine Elektricitäts Gesellschaft.

London, England.—The City & South London Railway Company reports total receipts for six months ending Dec. 31, 1896, as £25,075, compared with £23,459 for the same period of the preceding year.

Lyons, France.—By decree of Dec. 17, 1896, the building of a street railway from Lyons, Place Saint Paul, to Fourviere and Loyasse has been authorized.

THE important system of railways extending from Lyons through the extensive mountain region northwest of that city, is in process of conversion to electric traction. One line has been operating for two years, the construction of the second has been completed and it will soon be in operation, and for three other lines public franchises are expected during the present year.

Magdeburg, Germany.—The Union Electricitäts Gesellschaft of Berlin has purchased the Magdeburger Trambahn, which will be amalgamated with the Magdeburger Strasseneisenbahn, and equipped for electric traction. An extension of the existing line is also contemplated.

Mayence, Germany.—The Local & Street Railway Company, of Mayence, Germany, which is now operating its lines partly by steam and partly by animal traction, writes us that it will, in the near future, commence conversion to electric traction, and is now studying the various problems connected with electric railway operation.

Messina, Italy.—The Street Railway Company of Messina is considering the question of changing its motive power from steam to the overhead electric system, its present service being unprofitable. The company is controlled by Belgian capitalists, and all the apparatus has been furnished from that company.

Milan, Italy.—The contract between the municipality of Milan and the Società Anonima degli Omnibus (horse tramways) having expired on Jan. 1 of this year, the whole system of street railways, of about sixty kilometres in length, is to be equipped with electric traction. The Edison Company has secured a concession for twenty years.

Nottingham, England.—The corporation of Nottingham has decided to acquire the tramway lines now owned by the Nottingham Tramway Company, Ltd., but the basis of purchase has not yet been determined upon. When the tramways have been acquired by the municipality electric traction will probably be introduced.

Paris, France.—The Société des Tramways et Voitures Automobiles has been organized.

THE establishment of the following lines of street railways by mechanical traction is under consideration: from the Porte d'Orléans to Sceaux and Chatenau, from the Porte d'Allemagne to the City Hall of Pantin, from Charenton to Alfortville, from Saint Ouen to the Champ-de-Mars, and from the Luxembourg to Arcueil-Cachan.

THE opening of the Rue Reaumur, from the Place de la République to the Bourse, in Paris, which has just been completed, has, it seems, established the practicability of anunderground railway, by removing most of the objections that might be presented on the part of the public against that kind of system. It is

also definitely settled that electricity will be the motive power adopted on all the new lines of tramways.

Perth, Scotland.—The Perth & District Tramways Company, Ltd., is seeking a provisional order for the extension of its lines. The capital stock of the company will be increased in order to make these extensions.

Poitiers, France.—The Compagnie des Tramways de Poitiers has been organized under the direction of M. Marcel Delmas, to build and operate a service of tramways in and around Poitiers. The capital stock is fixed at 1,000,000 francs, all subscribed.

Prague, Austria.—Felix Singer & Company of Berlin, have secured a concession for an electric street railway from Smichau to Kosir near Prague.

Rouen, France.—By decree of Dec. 28, 1896, the construction of an electric street railway from Rouen to Blosseville-Bon Secours and Mesnil-Esnard has been authorized.

Rowley, England.—The Birmingham, Wolverhampton & District Tramways Company has asked for permission to build an electric railway from Newtown to Cradley Heath.

St. Helens, England.—Negotiations are in progress for the acquisition by the Corporation of the St. Helens & District Tramways.

Santander, Spain.—The tramways of Santander, Spain (which has a population of about 42,000), are considering the question of changing to the overhead or the underground system.

Saragossa, Spain.—The tramways of Saragossa, Spain, which are now in operation by mules are planning to change their motive power to electricity by the overhead system, as soon as authority can be obtained from the Spanish Government.

Scheidegg, Switzerland.—It is proposed to build an electric rack railway to the top of the Jungfrau, in Switzerland, which will be 7½ miles long, starting at Scheidegg. A number of grades, from fifteen per cent to twenty-five per cent, will be necessary, on which the maximum speed will be about five miles per hour. At the foot of the main peak of the Jungfrau an electric elevator will be built, which will be about 330 ft. in height.

Sheffield, England.—The Sheffield City Council has approved the promotion of a bill in Parliament to provide for the extension of the tramway system at an estimated cost of £80,000. The Sheffield tramways at present consist of nine miles of double track, and the company owns forty-four cars and 311 horses. The lines will probably be equipped with electricity in a short time.

Smichow, Bohemia.—Felix Singer & Company, of Berlin, have secured the contract for the construction of an electric street railway between Smichow and Kosir, in the vicinity of Prague, as a result of the general satisfaction given by the street railways of the latter city.

South Staffordshire, England.—The South Staffordshire Tramways Company reports total receipts for the last fiscal year as £29,667 being a decrease as compared with the previous year, of £572, but the total receipts per car mile were 12.45*d* as against 11.61*d*. The expenditures for the year showed a decrease of £373.

Starnberg, Bavaria.—The first cable road built in Bavaria has been in operation for a short time between the Leoni Hotel and the Rottmannshöhe Hotel, on the shore of the Starnberg Lake, and is about 1 mile long. The steepest grade is 21 per cent and the distance is covered in 15 minutes.

Swansea, England.—Bids have been received for the construction and equipment of the Constitution Hill tramway, for which J. Croydon Marks, of 18 Southampton Buildings, Chancery Lane, London, is consulting engineer.

Trieste, Austria.—Messrs. Gairinger & Company, of Trieste, are trying to secure a concession for an electric tramway in Trieste, about eight to twelve miles long.

Turin, Italy.—The two tramway companies of Turin are on the eve of equipping by electricity. One of them, the Società Torinese di Tramways e Ferrovie Economiche, is owned and operated by Turinese citizens, and will be obliged to introduce electricity before Apr. 1, 1898, the time when the National Exposition opens in Turin. The other company, the Società Anonima dei Tramways di Torino, is owned and managed by Belgian capitalists, and operates several suburban lines by steam power. It also will soon introduce electricity gradually on all these lines. The tramway properties in Turin are said to be very profitable, and are monopolies.

Versailles, France.—Electric traction has been in operation on about 9 miles of track owned by the Société Versaillaise de Tramways Electriques, in Versailles, France, for the last three months, and within that short period the traffic has increased threefold. The line was built by the Thomson-Houston Company, of Paris.

Vienna, Austria.—The contract for the electrical equipment of the tramway running between Vienna and the suburb of Baden has been placed with Schuckert & Company, of Nuremberg, Germany.

The first line of electric street cars in Vienna was opened to the public on Jan. 28 last in presence of the Premier, Count Badeni, of the Minister of Railroads, and other officials. The road, which forms a section of the "transverse" line, runs on a length of 9½ km. and was equipped by the Union Elektricitäts-Gesellschaft in Berlin after the General Electric system.

Zug, Switzerland.—Several applications have been made to the cantonal authorities for concessions for electric street railways from Zug to different neighboring places.

News Notes.

Akron, O.—Reports state that the Akron, Bedford & Cleveland Railroad Company has about concluded terms for the purchase and amalgamation of the Akron & Cuyahoga Falls Rapid Transit Company's lines.

Albany, N. Y.—Oscar F. Hilt, of Greenbush; W. E. Slingerland, of Albany; James K. Averill, of Averill Park, and M. E. Dunn, of New York City, are the promoters of an electric railway from Greenbush to Bath, DeFreestville, Averill Park, Sand Lake, Glass House Lake and Crooked Lake, a distance of thirteen miles.

Amherst, Mass.—The Amherst & Sunderland Railway Company will begin work on its lines in the spring. Franchises have been obtained, the capital subscribed and some of the material is already on the ground. Walter Cirobs is president of the company.

Atlanta, Ga.—It is reported that the Chattahoochee River Street Railway Company will extend its lines from Bolton to Marietta, a distance of 11½ miles.

Auburn, N. Y.—The Auburn & Western Railway Company has applied to the State Railroad Commissioners for a franchise to build its lines.

Augusta, Ga.—The North Augusta Land Company, it is stated has decided to construct an electric railway from North Augusta to Augusta. Walter M. Jackson is general manager of the company.

Ayler, Mass.—An electric railway from Lowell to Clinton and Fitchburg, passing through Ayler and other towns, is projected by citizens of those places.

Bell's Corners, Ont.—John Moodie, of Bell's Corners, promoter of an electric way from Richmond to Bell's Corners, there to connect with the proposed extension of the Ottawa Electric Railway, has applied to the County Council for a bonus of $10,000. Branch lines will be built to different towns. Franchises and rights of way have been secured and power for the line will be obtained from the plant at Deschenes.

Braddock, Pa.—The Braddock & Duquesne Street Railway Company has been incorporated by L. G. Woods (president), F. M. Ross and John F. Baxten, of Pittsburgh, to build an electric railway from Braddock across the Monongahela River to Duquesne, a distance of 2½ miles. Capital stock, $15,000.

Braintree, Mass.—The Braintree Street Railway Company has applied for authority to lease or purchase the Randolph Street Railway and to increase its capital stock to such an amount as may be necessary to carry out the purchase.

Brattleboro, Vt.—A bill has been introduced in the New Hampshire Legislature for the incorporation of the Hinsdale & Brattleboro Railroad, Light & Power Company, the object of which is to allow the Brattleboro Street Railroad Company to extend its lines to Northfield, Mass., by way of Hinsdale, N. H. If the bill is defeated, the company will probably extend its lines to Greenfield by way of Guilford, Vt., franchises for which route have been secured.

Brentwood, L. I., N. Y.—The advisability of building an electric railway across the island from Northport to Bay Shore by way of Comac and Brentwood with a branch to Central Islip is being considered. A franchise has been granted for a part of the way.

Bridgeburg, Ont.—J. Kearney Rogers, of New York, and T. O. Rusling, recently general manager of the Rochester Railway Company, are interested in an electric railway to be built from Bridgeburg, the Canadian terminus of the International Bridge to the new Fort Erie Jockey Club Grounds, and thence to Crystal Beach. Work will be begun as soon as possible. The cost is estimated at $250,000.

Brockton, Mass.—The contracts for building the lines of the Brockton, Bridgewater & Taunton Street Railway Company have been awarded and construction work will be begun this spring.

Buffalo, N. Y.—The Buffalo Traction Company has elected Herbert P. Bissell as president and Joseph B. Mayer secretary and treasurer of the company. Mr. Bissell has succeeded in placing a bond issue with Tallman & Company, of New York, sufficient to enable the company to construct sixty-six miles of road at $30,000 per mile. Charles W. Ricker has been engaged as electrical engineer for the company.

Canton, O.—Reports state that W. A. Lynch, president of the Canton & Massillon Electric Railway Company, is promoting the interests of an electric railway from Canton to Akron.

Carlisle, Pa.—The Cumberland Valley Traction Company will extend its lines from Boiling Springs to Mt. Holly, a distance of five miles. Contracts have been let.

Chambersburg, Pa.—Mr. Hughes, of New York, and his attorney, John R. Miller, of Carlisle, Pa., have been in Chambersburg lately, looking over the city with a view to building an electric railway there.

Charleston, S. C.—The Charleston Street Railway Company has purchased the system of the Charleston City Railway Company, and will equip it with electricity.

Chelmsford, Ont.—The Mineral & Timber Electric Railway Company has applied for incorporation to construct an electric railway northerly from Chelmsford to Sturgeon Falls and Wahnapitae Lake, southerly to Killarney, on Lake Huron, and a line to James Bay.

Chicago, Ill.—The Chicago General Railway Company is negotiating with the Union Loop Company for downtown terminal privileges.

Cleveland, O.—The Cleveland & Eastern Electric Railway Company has been incorporated by D. H. Tilden, Roger M. Lee, Charles E. Fish, George H. Hopper and Charles H. Taylor to build an electric railway from Cleveland to Orwell in Ashtabula County.

Columbus, O.—The Columbus Central Street Railway Company announces that it will establish a freight service between this city and Westerville, twelve miles north.

Corsicana, Tex.—Woodford Brooks, secretary and treasurer of the Glenwood & Polytechnic Street Railway Company, Ft. Worth, is considering the advisability of building an electric railway in Corsicana.

Dayton, O.—Two rival companies have applied to the County Commissioners for franchises to build an electric railway from Dayton to Eaton. One is the Dayton & Eaton Traction Company, in which A. G. Feight and Henry B. Pruden, of Dayton, are interested, and the other company, which is not incorporated yet, is composed of R. M. Nevin, J. E. Feight and J. E. Lowes, of Dayton; C. L. Kurtz, of Columbus, and others.

Delavan, Wis.—A franchise has been applied for and will undoubtedly be granted to the Delavan Light & Fuel Company to construct an electric railway connecting the city and the several parks around the lake, making about fifteen miles of road. Work will begin as soon as the preliminaries can be arranged.

Doylestown, Pa.—The Doylestown & Easton Electric Railway Company, incorporated recently, has filed extensions of routes to be built this spring and elected the following officers: president, Harry J. Shoemaker; secretary, Mahlon H. Stout; treasurer, Samuel A. Hellyer, all of Doylestown.

Eau Claire, Wis.—H. N. Bates and Curtin E. Applegard, of Boston, are considering the advisability of buying and operating the Eau Claire Street Railway.

Exeter, N. H.—Capitalists are negotiating for the charter of the Exeter & Hampton Electric Railway, granted in 1889. It is reported that the company expects to have the road in operation by Sept. 1.

Fitchburg, Mass.—The Gardner, Westminster & Fitchburg Street Railway Company will begin work on its lines about May 15. Among those interested are F. S. Coolidge, of Fitchburg; J. A. Stiles, of Gardner, and Herbert Carter, of Springfield.

Fort Wayne, Ind.—A press despatch from Fort Wayne states that preliminary papers for the combination of the Fort Wayne Electric Corporation with the Siemens & Halske Electric Company, of Chicago, were signed in Fort Wayne five weeks ago, and the work of taking the stock inventory of the two concerns has been completed.

Goshen, Ind.—J. J. Burns, of Chicago, who is interested in a proposed electric railway between Goshen and Elkhart, states that construction work will probably be begun in April.

Hamilton, O.—The Cincinnati & Hamilton Electric Railway Company has filed a $10,000 bond with the Hamilton Pike Company as a guarantee that it will begin construction work on its lines by May 1. The line will run from Price Hill, a suburb of Cincinnati, through Mt. Healthy, Pleasant Run and Symmes Corner to Hamilton a distance of twelve miles. C. T. McCrea is president and J. C. Hoovens and G. A. Rentschler, of Hamilton, are interested in the company.

Hamilton, Ont.—A company of St. Catharines men is being organized to build an electric railway from St. Catharines to Beamsville. The Hamilton, Grimsby and Beamsville Electric Railway Company is also interested.

Hampden, Me.—H. L. Mitchell, president of the Hampden & Winterport Railway Company, has applied to the State Legislature for a franchise to build a line from Stockton Springs to Searsport.

Harrisburg, Pa.—The Harrisburg & Mechanicsburg Electric Railway Company will probably extend its lines from Mechanicsburg to Riverton this spring.

Holland, Mich.—Capitalists contemplate building a passenger and freight electric railway between Douglass, Saugatuck and Holland, taking in summer resorts and a fruit shipping dock.

Jacksonville, Fla.—The City Council has granted a franchise to the Benjamin Park Railway Company to build its lines from Benjamin Park to Riverside. L. R. Benjamin is president of the company.

Kansas City, Mo.—A meeting of the stockholders of the West Side Street Railway Company will be held on Mar. 15, at the office of the Missouri, Kansas & Texas Trust Company, Kansas City, for the purpose of voting on the propositions to increase the capital stock of the company from $2000 to $100,000, and to authorize an issue of $100,000 first mortgage bonds on the property and franchises of the company.

Keokuk, Ia.—The lines of the Keokuk Electric Street Railway & Power Company have been abandoned because of lack of patronage.

Kokomo, Ind.—Frank E. Snow, 905 Hammond Building, Detroit, is interested in the electric railway to be built from Kokomo to Greentown, for which franchises were granted some time ago.

Los Angeles, Cal.—The Los Angeles Terminal Railway, according to local reports, will apply to the City Council of Los Angeles for a franchise to build an electric railway in Los Angeles with the object in view of extending it to Pasadena.

Louisville, Ky.—The Metropolitan Railway Company has been organized by George H. Harries, president of the Metropolitan Railroad Company, of Washington, D. C.; J. W. Woolfolk, of New York; Robert M. Kilgore, P. Gault Miller, John H. DeWitt, James F. Grinstead and Thomas P. Hargis, of Louisville, to build and operate a conduit electric or compressed air railway in Louisville, on the streets now occupied by the Louisville Railway Company, which cover about 150 miles. Capital stock, $4,000,000.

Machias, Me.—An electric railway from Machiasport to East Machias may be built.

Marion, Ind.—William E. Avery, of Detroit, Mich., is attempting to secure a franchise for an electric railway in Grant County through the towns of Roseberg, Sims and Swayzee, and crossing into Howard County to Sycamore and Greentown.

Minneapolis, Minn.—The North Side Street Railway Company will equip its steam motor line, running between Minneapolis and Robbinsdale, with electricity.

Monroe, Mich.—C. T. Geddes, of Toledo, is largely interested in an electric railway which is projected from Monroe to Tecumseh, via Petersburg. The road will be used principally for transporting the white glass sand found in beds near Tecumseh to Monroe and Toledo.

Montville, Conn.—The Connecticut Supreme Court has dismissed the appeal in the case of the Montville Street Railway Company, which prevents the company from building a line from Norwich to New London.

Newburyport, Mass.—The Selectmen of Salisbury have granted the Haverhill & Amesbury Street Railway Company permission to equip with electricity a branch of its present system now operated by horses from Salisbury Square to the New Hampshire line.

New Castle, Pa.—The New Castle Traction Company has completed thirteen miles of its road and put it in operation on Jan. 30.

Niagara Falls, Ont.—George Hanan and Edward Davis, of Niagara Falls, Ont., have secured control of the Niagara Falls, Clifton & Drummondville Street Railway, and will equip it with electricity in the spring.

Pittsburgh, Pa.—The West Side Belt Railroad Company has let the contract for the construction of its lines from Woodville Avenue, Sawmill Run, to Virginia Avenue, Mt. Washington, to J. J. Houghton, of Allegheny.

Portsmouth, N. H.—The directors of the Portsmouth, Kittery & York Beach Electric Railway Company have elected the following officers: president, A. F. Gerald; treasurer, I. C. Libbey; clerk, Samuel W. Emery. They state that work on the road will be begun as soon as the weather will permit.

Quincy, Mass.—A company, capitalized at $100,000, has recently been organized for the construction of an electric railway from Forest Hills to Neponset, to a connection with the Quincy & Boston Street Railway. John Graham is at the head of the enterprise.

Rockaway, N. J.—It is reported that the Central Railroad of New Jersey is contemplating the equipment of its Highbridge line between Hopatcong Junction and Rockaway, a distance of ten miles, with electricity.

San Bernardino, Cal.—C. R. Lloyd, of the San Bernardino Electric Light Company is making advances toward establishing an electric railway in San Bernardino.

Wilmington, Del.—The Wilmington & New Castle Electric Railway Company is applying for amendments to its charter, permitting it to run its line through Wilmington to some point on the state line, and also to extend its lines south from New Castle, through the towns and villages of the state to Smyrna.

Woodbury, Conn.—The Railroad Committee gave a hearing recently on an amendment to the charter of the Woodbury & Southbury Electric Railway Company. The petition called for an electric line touching Woodbury, Watertown, Waterbury and terminating at the western end of Waterbury.

Proposed Extensions.

It is stated that the officials of the Consolidated Traction Company of New Jersey have mapped out a very comprehensive plan for the extension of the company's lines in Jersey City, Newark and the Oranges. It is proposed to elevate the tracks in the cities named wherever the crowded condition of the streets renders it necessary, and finally to create an entirely new line to Jersey City, with cars from the Oranges to New York every half hour. The new line will afford direct communication with the Central Railroad Ferry at Communipaw, and will also place the company in a position to run a branch line to what is known as "South Cove," where, it is reported, the Lehigh Valley Railroad contemplates establishing a terminal station and operating a ferry between that point and New York.

Personals.

Mr. A. H. Ford has been elected secretary and treasurer of the New Orleans Traction Company.

Mr. G. F. Collins, formerly with the Valentine Varnish Company is now connected with the Beckwith Chandler Company.

Mr. Edwin R. Gilbert has been appointed general manager of the Holmesburg, Tacony & Frankford Electric Railway Company.

Mr. John Balch, receiver of the Dubuque Light & Traction Company, has resigned, and Mr. H. G. Torbert will probably succeed him.

Mr. Samuel J. Fenner, superintendent of the Camden & Suburban Railway Company, has resigned, and will be succeeded by Mr. Frank A. Hewitt.

Mr. Louis H. Wright has been made general manager of the Schuylkill Electric Railway Company to succeed Mr. M. H. Hubbell, resigned.

Mr. Edward W. Ash, general manager of the Schuylkill Traction Company, has also been appointed general manager of the Lakeside Electric Railway, of Mahanoy City.

Mr. A. L. Wilkinson, special representative of the Ohio Brass Company, has recently suffered a severe affliction in the loss of his wife, who died at their home after a brief illness.

Mr. C. A. Denman, formerly general manager of the Toledo & Maumee Valley Railway Company, has been appointed general manager of the Toledo, Bowling Green & Fremont Railway Company.

Mr. Frank R. Greene, secretary of the Chicago City Railway Company, has assumed control of the operating department of the Chicago General Railway Company, with the title of vice-president and general manager.

Dr. John MacFayden, superintendent of the Chester (Pa.) Traction Company, recently delivered a very interesting lecture on "Electric Railroad Construction" before the Senior Class of the Pennsylvania Military College.

Mr. Albert Vickers, has been appointed general manager of the Buffalo, North Main Street & Tonawanda Electric Railway Company. Under his supervision a number of important extensions and improvements will be made.

Mr. J. C. Chamberlain, treasurer and manager of The Electric Launch Company, has recently returned from a three months' trip through Europe, where he has been investigating the storage battery works of that continent, chiefly as applied to electric launches.

Mr. Chester G. Cutter, an American consulting engineer now living in Paris, is visiting this country in behalf of certain clients for the purpose of making careful and thorough investigation into street railway methods and apparatus. He will be in New York for several weeks.

Mr. A. P. Emmons, who was until recently connected with the New York Car Wheel Company, of Boston, Mass., has severed his connection with that company and has opened a Boston office for Wendell & MacDuffie, of New York. He will handle all the specialties of Wendell & MacDuffie for New England, including the Rochester car wheels and the street railway appliances of the Taunton Locomotive Manufacturing Company.

Mr. C. F. Uebelacker has resigned as electrical engineer of the Consolidated Traction Company, of New Jersey, and has accepted the position of chief engineer of the Peckham Motor Truck & Wheel Company, of Kingston, N. Y., *vice* W. E. Cooke, resigned. Mr. Uebelacker is one of the best known electric railway engineers in the country and is also a well known writer on electric railway subjects. He carries with him the wishes of his friends for success in his new position.

Mr. T. H. Nicoll, has been appointed general manager of the Rochester Railway Company. Mr. Nicoll goes to Rochester from Chattanooga where he was president of the Railway Terminal Company. Mr. Nicoll has also held a position as general manager on two of the other railways in Chattanooga and has had an extensive steam railway experience, serving as division engineer on the Illinois Central Railroad and superintendent of construction on the Chicago Northwestern Railroad.

Mr. W. A. Dutton, well known in the street railway field has recently taken charge of the railway department of the Van Dorn Iron Works, of Cleveland, O. Mr. Dutton sold his interest in the Dorner & Dutton Manufacturing Company, about two years ago, and has since that time been connected with the company only as general sales agent, and was in no way responsible for the recent failure of the company. The Van Dorn Iron Works is an old established house in the iron trade, and its street railway business will be well cared for in the hands of Mr. Dutton.

Mr. P. Moar, who has been chief splicer for a number of years of the Capital Traction Company, of Washington, formerly the Washington & Georgetown Railway Company, and who previous to that time had charge of the cables of the Melborne Tramway & Omnibus Company, has connected himself with the house of Thomas & William Smith, Newcastle-upon-Tyne, England. Mr. Moar sailed for England last month and will take charge of the cable department of this large firm which has supplied cables to a number of the principal cable lines in Great Britain, including the newly opened Glasgow Subway. Mr. Moar has given a great deal of attention to the splicing and care of cables, and is very well informed upon this subject.

Mr. C. F. Holmes, general manager of the Metropolitan Street Railway Company, of Kansas City, Mo., Mr. A. S. Littlefield, vice-president of the Lake Street Elevated Railroad Company, of Chicago, Mr. L. E. Myers, general manager of the Electric Installation Company, of Chicago, and Mr. D. B. Dean, of the Terre Haute Car Company, have recently made an extended Eastern trip. These gentlemen visited Detroit, where they were handsomely entertained by the officials of the Detroit street railway companies. They then went to Niagara Falls where they attended a meeting of the Executive Committee of the American Street Railway Association. They were entertained at Buffalo by Mr. Henry M. Watson and Mr. H. H. Littell, of the Buffalo Railway Company. The party then visited New York, where they investigated the experiments with the compressed air motors on the lines of the Third Avenue Railroad Company and the Metropolitan Traction Company. The gentlemen then started for Chicago, stopping at Philadelphia, Baltimore, Pittsburgh and Cleveland while en route.

Mr. J. A. Rutherford, formerly of the Westinghouse Company, has recently resigned and accepted a position as manager of the sales department of the Steel Motor Company. Mr. Rutherford was born at Hamilton, Ont. He was for some time engaged in the steam railroad business, but in 1883 he entered the street railway field, taking a position at Hamilton with the Edison Company which was then forming for the manufacture of apparatus under Edison patents for Canada. In 1886, Mr. Rutherford was transferred to the New York office of the Edison Company. In 1888 he accepted a position in the office of the Westinghouse Electric Company and soon afterward was transferred to the street railway department where he was made assistant to the manager. Mr. Rutherford, in addition to office work, began his experience as salesman while in this position. In 1892 he gave up office work altogether, and since that time has acted in the capacity of salesman only. Mr. Rutherford is a first class salesman and his many friends will be glad to hear of his advancement.

J. A. RUTHERFORD.

Mr. Charles LeBlanc, chief engineer of the Compagnie Générale de Traction et d'Electricité of, Paris, who has been spending several weeks in this country, returned to Europe last month. Mr. Le Blanc is a well known engineer on both sides of the water, and was educated in this country. He was associated for a number of years with the Sprague Electric Railway & Motor Company, in building electric railways in America, and later was employed by the Edison and General Electric companies. In 1893 he moved to Paris and was one of the principal organizers of the Parisian Company of which he is now chief engineer. This company has been organized to build and equip electric railways in France and owns over thirty concessions in that country. Other companies closely allied to this have been organized by Mr. LeBlanc in other European countries for similar purposes. Mr. Le Blanc stated when in the office of the Street Railway Journal last month that one principal reason for his present trip to America was to study the workings of the three-wire system. A recent French law compels the electric railway companies in that country to keep the maximum drop on the earth return to within five volts. Mr. Le Blanc believes that this may be best accomplished by the use of a three-wire system and expected to visit Bangor, Me., to study the operation of it there. Mr. Le Blanc placed a number of orders when in this country for railway supplies, part of which will be used in the

equipment of a short electric line which his company will install for an electric railway in Brussels extending to the Exposition grounds.

Mr. F. O. Rusling, until recently general manager of the Rochester Railway Company, has resigned that position in order to devote his time to certain personal business affairs. Mr. Rusling has achieved a high reputation as an organizer and street railway manager, and is well posted on all subjects relating to street railway operation. He is a native of New Brunswick, N. J., where he was born in 1863. He entered the electric lighting business in 1881, working for the Swift Electric Light Company, of Saginaw, Mich. He started as inspector of lights and dynamos, but was soon promoted to the position of general superintendent of the company, which controlled the entire lighting interest of both Saginaw and Bay City. He was afterwards employed as expert electrician for the Brush Electric Company, with headquarters at Chicago. In this position he was able to gather considerable useful knowledge in reference to constructing electrical plants, as he had charge of the construction of several large stations. He followed this line of business for several years. After leaving the Brush Company he accepted a position with the Schuyler Electric Company, of Hartford, Conn., where he was made general constructing agent and electrician. He afterwards spent three years as general manager of the Citizens' Light Company, of Wichita, Kan., this company being owned by the Schuyler Electric Company. After leaving this position he began his first street railway experience, having accepted a position with the St. Joseph Electric Light, Railway & Power Company, of St. Joseph, Mo. After resigning this position he was appointed general manager of the Calumet Electric Railway Company, of Chicago, Ill., which position he held for two years. At the end of that time he was appointed superintendent of the Buffalo Railway Company, at Buffalo, N. Y. His success while employed on this road was so gratifying that the gentlemen who control the Rochester Railway Company offered him the position of general manager of that company. This position he has held for sixteen months, during which time the service has been greatly improved and developed.

Obituary.

A. M. BILLINGS, of Chicago, president of the street railway system of Memphis, Tenn., died Feb. 7, of heart disease. He was very wealthy and was the largest stockholder and practical owner of the Memphis street railway system.

AMONG THE MANUFACTURERS.

Niels Joergensen, of West Hoboken, N. J., has recently received a request for prices and description of his patent auxiliary car seat from a number of prominent car companies, and expects to do a large business during the coming year.

The National Underground Cable Company, of New York City, has consolidated with the National Conduit Company. The company has just completed a factory at Hastings on the Hudson. It is 100 ft. × 400 ft., and capable of turning out 40,000 ft. of complete cable per day.

Henry R. Worthington, of New York, has recently issued a very neat catalogue giving a full description of the Worthington cooling tower. This cooling tower is a very valuable adjunct to ice manufacturing and cold storage plants, and to street railway plants, taking the place of a condenser.

W. H. P. Fisher, so long and favorably known as one of the pioneers on the traveling force of the Hoppes Manufacturing Company, Springfield, O., has been placed in charge of the Eastern office of the company which has recently been opened at room No. 604 Girard Building, Philadelphia.

The American Electrical Works, of Providence, sent to a number of their customers last month a handsome portrait of George Washington, also a circular which was appropriate to the anniversary of Washington's Birthday, and incidentally called attention to their own insulated and bare wires and cables.

The General Electric Company, of Schenectady, N. Y., has recently issued its catalogue and price list of street railway apparatus and supplies. The catalogue is very complete, giving descriptions of all the different types of generators and motors manufactured by this company, together with all the different parts of same.

The McGuire Manufacturing Company, of Chicago, Ill., has recently published a large catalogue of the motor trucks and other appliances which it manufactures. The catalogue is well illustrated with a number of fine half tones. A number of interesting testimonies are given, and also the results of a number of recent tests.

Kinsman & Knudson, of New York, is the title of a firm recently established for the purpose of carrying on the work of consulting and supervising engineers. This new firm will pay special attention to expert examinations of new inventions and enterprises. It has opened offices in the Manhattan Life Building, New York.

The Standard Air-Brake Company, of New York, has secured the services of Herbert B. Taylor, at present with the Consolidated Traction Company, as chief assistant in the electrical department to C. F. Uebelacker. Mr. Taylor has handed in his resignation and will enter the service of the Standard Air-Brake Company on Mar. 1.

"**Dirigo**" is the title of a new device, appliance, or something which the "Yellow Kid" commenced to describe in our advertising columns this month just before the paper went to press. He did not get very far, but during the coming month he will undoubtedly have an opportunity to complete the work of describing the merits of this improvement.

The Bergische Stahl-Industrie, of Berlin, has recently been appointed general representative in Europe for the Standard Air-Brake Company. This firm is one of the best known manufacturers of motor car trucks in Germany, and has sent the Standard Air-Brake Company an order for Standard air brake equipments for thirty double truck motor cars.

The Phosphor-Bronze Smelting Company, Ltd., of Philadelphia, Pa., has recently issued a small pamphlet, giving the nature and uses of Delta metal. This metal is highly recommended for marine and hydraulic work, in pump bodies, plunger arms, valves, cocks, worms, cog wheels, etc., and wherever a metal of great durability and strength is required.

The Hunt Air Brake Company, of Pittsburgh, Pa., has equipped one of the cars of the North Side Traction Company with a trial apparatus, and this car is now making regular trips. The officers of the North Side Traction Company are said to be very much pleased with this equipment and contemplate equipping their entire road with the Hunt air brake.

The Electric Launch Company, of New York City, has recently issued an illustrated catalogue, in which much information is given about electric passenger boats as auxiliary to electric railway systems, when operated at terminal parks and pleasure resorts. Details of various sizes of boats are given, and a list showing a large number in use in this particular service.

The Hoppes Manufacturing Company, of Springfield, O., has issued a new catalogue, giving the details of construction and directions for using the live steam feedwater purifiers and exhaust steam feedwater heaters which it manufacturers. The catalogue contains a number of fine engravings of these purifiers and heaters and also gives a long list of firms using these appliances.

The Fiberite Company, of Mechanicville, N. Y., is making a vigorous defense against the five suits brought by the General Electric Company against it for alleged infringements of patents on overhead material. These suits are practically test suits and the results will be of considerable importance to all manufacturers of overhead material, generators and motors and to electric railway companies generally.

S. C. Strock, of New York, has recently received an order from the American Telegraph & Telephone Company for 8000 yellow pine poles, ranging in length from twenty-five to fifty-five feet. This order is said to be the largest order ever placed for poles of this kind. Mr. Strock is well known to the electrical profession on account of his former connection with the Thomson-Houston and General Electric companies.

The Edward P. Allis Company, of Milwaukee, Wis., has recently received a number of large foreign orders. Among these orders is one from Trieste, Austria, for two large compound vertical engines. The company is also negotiating to supply the engines for a large flour-mill now being constructed in Braila, Roumania, and has also shipped considerable heavy machinery to different points in South America and South Africa.

The Hunter Illuminated Sign Company, of Cincinnati, O., reports that its business is progressing rapidly, and that it has put out a large number of its new signs on various roads throughout the country. The company is getting some splendid reports from the signs already in operation, and is preparing for a very large business this season. This sign will be remembered as one of the attractive features at the St. Louis convention.

The Westinghouse Machine Company, of Pittsburgh, Pa., has been doing a good foreign business recently. The company's Paris agency recently sold four Westinghouse compound engines, aggregating 1100 h. p., for electric railway service in Russia. The company reports the sale of three Westinghouse compound engines, 300 h. p. each, and one 100 h. p., to the International Company, Liege, Belgium. This is a repeated order.

The Falk Cast Welded Joint, is to be used on the extensive electric tramway system which radiates from Lyons to the mountainous districts northwest of Lyons centering at Ecully. This is quite a victory for a distinctively American device and the Falk Manufacturing Company is to be congratulated on the enterprise and energy which it has shown in taking up the foreign work which is opening up in such a promising way.

The Standard Air-Brake Company, of New York, in addition to sales already announced, during the first week of February, closed a contract with one road for twenty outfits and with another road near by for fifty outfits. This company is building some heavy types of air brakes for equipping electrified steam roads and is negotiating for furnishing its motor-compressor type air brake for some heavy electric locomotives to haul passenger trains of four cars as well as freight.

The Electric Installation Company, of Chicago, has recently secured the contract for the construction of the Southwest Boulevard line of the Metropolitan Street Railway Company, of Kansas City, Mo. This company has also secured the contract for building

the Wyandotte line of the West Side Street Railway Company of Kansas City. The officers of the company report a good business for 1896 and state that the outlook for 1897 is very promising. This company has recently completed the lines of the Glen Oak & Prospect Heights Railway Company, at Peoria, Ill.

The International Register Company, of Chicago, Ill., announces the removal of its office and factory from 197 South Canal Street, Chicago, to to 133 to 139 South Clinton Street. The business has increased so much lately that more room was absolutely necessary. The new shops have more than double the space of the old ones, and will be more conveniently arranged for the larger force necessary. The company has spared no expense to make its machines the best in every detail of material, workmanship and appearance, and this is largely responsible for the growing business with the largest railways of the country.

The Consolidated Car Fender Company, of Providence, R. I., whose fenders are well known and whose originality and enterprise in publishing attractive advertisements of its fenders have equally wide recognition, sent last month to a number of railway companies circulars appropriate to the month. These were a handsome steel plate portrait of George Washington, and also a leaflet giving an authentic portrait of the "Father of our Country" just after he had hewn down the cherry tree. The circular incidentally calls attention to the value of the Consolidated fenders and states that the fenders do "work that no others can do."

S. C. Munoz, for many years special agent for the Heine Boiler Company, and for the past year general sales agent for the Edgemoor boiler, has associated with himself in business, E. C. Darley, late of the Rankin & Fritsch Engine Company, of St. Louis, and previous to that associated with J. P. Witherow, the celebrated steel works builder. These two have formed a new firm under the name of Munoz & Darley, with offices in the Rookery, Chicago Ill. They will act as the General Western representatives of the Cahall vertical and Cahall-Babcock & Wilcox boilers, manufactured by the Aultman & Taylor Machinery Company, of Mansfield, O.

George Cradock & Company, of Wakefield, England, report an excellent record for one of their ropes which has recently been taken out of the Collins Street line of the Melbourne Tramway & Omnibus Company, Melbourne. This rope was put to work on Dec. 8, 1895, and taken out Dec. 10, 1896, amounting to fifty-two weeks and four days' service, the speed being ten miles per hour. The average of the last three previous ropes used upon this road, all by other makers, was sixteen weeks and one-third of a day. All the ropes worked on the same line and under the same conditions. The length of the rope is between 17,000 ft. and 18,000 ft. and the size 3⅝ ins. circumference.

The Composite Brake-Shoe Company, of Boston, Mass., has appointed the Barbour Stockwell Company, of Cambridgeport, Mass., its New England agents for the sale, as well as the manufacture of its "Compo" brake shoe for street railway service. The use of this brake shoe has become general on street railways in New England, having been adopted by many of the larger systems, as well as the smaller roads. The Barbour Stockwell Company, which manufactures other specialties for street railway service, has facilities for manufacturing this brake shoe on a large scale, and it will carry a supply of the various styles or patterns in stock, to insure prompt delivery.

The Conover-Goe Company, of Chicago, is the name of a new firm organized for the purpose of carrying on a general business in electrical and hardware specialties. The gentlemen who are principally interested in this new enterprise are Geo. W. Conover and David E. Goe. These gentlemen are both very well and favorably known throughout the electrical field of the United States. The Conover-Goe Company will control the entire output of electrical and hardware specialties manufactured by the C. H. Dickey Tool Company and will handle the products of the Paragon Arc Lamp Company, C. S. Knowles, the Gibbs Electric & Manufacturing Company and a number of others.

The Standard Underground Cable Company, of Pittsburgh, Pa., held its annual meeting of stockholders at the company's office on Jan. 26. The old board of directors was re-elected for the ensuing year. The report of the board of directors showed a business of nearly three-quarters of a million dollars for the year 1896; four dividends of two per cent each, were paid out of the earnings of the year and the surplus was added to the surplus account. The company's factories are reported to be in first class condition for the economic and rapid manufacture of wires and cables of all kinds, all departments are running, the rubber department being specially crowded with orders.

The Ohio Brass Company, of Mansfield, O., is more than pleased with the volume of business which it has done for the first two months of this year, its business being considerably in excess of that for the corresponding period of a year ago. Every department has been operating at its fullest capacity for some time past, and the pattern shop is at present running overtime to fill numerous orders which call for special designs of goods. In addition to several large orders received recently for material to be used in the installation of roads in this country, the company reports a number of orders for foreign shipments, secured through its European agents, who are rapidly opening up an extensive field for its products.

The Siemens & Halske Electric Company of America, of Chicago, Ill., reports than it is prepared to furnish complete trolley stands and trolley contacts, and to install complete electric conduits and electric railway systems under the patents which this company owns and controls, and it will also license prospective customers under these patents. This company manufactures a trolley or contact bar, which it claims does not infringe any patent that has ever been granted for an underrunning trolley. This trolley makes a sliding contact with the trolley wire, making overhead construction very simple, and doing away with the necessity of switches and frogs, besides making it impossible for the connection to be broken. This company also claims to own all the United States patents covering the main features of the Buda-Pesth conduit system.

Henry R. Worthington, of New York, has just been awarded a contract by the city of Chicago for six vertical, triple expansion, direct acting high duty pumping engines, each of 20,000,000 gals. daily capacity. This contract amounts to $437,600 and is said to be the largest contract for water works pumping machinery ever placed in this country. The above six engines each have a daily pumping capacity of 20,000,000 gals. against a head of 150 ft., and will be supplied with steam at a pressure of 140 lbs. to the square inch. The engines will each be of 530 h. p. This firm is also building three vertical, triple expansion, direct acting, high duty pumping engines for the city of Brooklyn, N. Y., under a contract amounting to $385,000. These engines each have a daily capacity of 20,000,000 gals. to be delivered against a head of 168 ft., and the steam will be supplied at a pressure of 135 lbs., to the square inch, each engine being of 600 h. p.

The Berlin Iron Bridge Company, of East Berlin, Conn., has recently received the contract for building the new power station to be erected for the New York, New Haven & Hartford Railroad Company, at Berlin, Conn. This building will be 110 ft. wide and nearly 200 ft. long. It will be divided into two equal portions, one side to be used for a boiler room, and the other for an engine and dynamo room. The whole frame is to be of steel, the side columns being enclosed by brick walls, and when finished it will be one of the most complete, extensive and best central stations in the world. The Berlin Iron Bridge Company has also secured the contract for the steel work in the new building for the Catholic Protectory, at Van Nest, N. Y. This building is to be two stories high, and the floors will be supported by steel posts and girders. The roof construction is to be of steel trusses supporting slate roofing. The building will be 60 ft. wide and 160 ft. long, having projections 60 ft. long and about 30 ft. wide on either side at the center. In addition to these orders this company has received the contract for furnishing and erecting the steel works in the Odd Fellows Building at Attleboro, Mass.

The Partridge Carbon Company, of Sandusky, O., is preparing for a greatly increased business, as it believes that the outlook for the coming year indicates that there will be more business in its line than ever before. With the greater confidence in the future which is widely felt, and the better tone of business in general, the opening of the spring season bids fair to usher in an increase of trade far beyond present expectations. The outlook for foreign business is also extremely gratifying, owing to the rapidly increasing adoption of electric traction, and the Partridge Company reports having recently received some very nice orders for its generator and motor brushes from abroad. These brushes have now a world-wide reputation, on account of their smooth running qualities, with entire absence of squeaking and sparking; and the company is still making improvements in their manufacture, with the object of producing the most perfect brush in every respect which it is possible to obtain. The Partridge brushes are made in three grades---hard, soft, and medium---in order to suit all requirements, and the company carries a large stock of all sizes on hand, so that it can furnish anything in this line that may be desired at short notice. The Partridge "self lubricating motor brush," has made a reputation for itself by its superior quality and unusually long life. The company is still improving it, and in its present form it is giving excellent satisfaction for electric railway work.

The Mossberg & Granville Manufacturing Company, of Providence, R. I., has received a number of letters testifying to the good qualities of the roller bearings which it manufactures. One of these letters was written by the Brown & Sharpe Manufacturing Company and in substance is as follows: "Our experience with roller bearings manufactured by the Mossberg & Granville Manufacturing Company, has been as follows: we had been running for a number of years a rolling mill for cold rolling steel, the rolls being 5 ins. × 8 ins. When run continually the rolls would heat up so as to make it necessary to stop them for two or three hours per day in order to let them cool down, owing to the friction being so excessive. About two years ago last June, Mr. Mossberg, of the Mossberg Manufacturing Company, now the Mossberg & Granville Manufacturing Company, stated that he had a way of curing this trouble and he fitted up the mill two years ago last August, with roller bearings. This mill has been run about fifteen revolutions per minute and was driven with a six inch belt and a four inch rider over that. The belts were stuffed, besides being run very tightly. When the mill was started up with the new bearings, we ran them with a one inch belt and produced as much work per hour as we did with our two belts under the previous conditions. Besides they could be run ten hours per day without any perceptible heating. We concluded afterward, however, to put on a two inch belt, and also to speed our mill up to forty-five revolutions per minute (instead of fifteen revolutions per minute) where it is now running. This mill has done excellent service, and so far as we can see, is as good as the day it was put in."

New Publications.

MOTIVE POWER AND GEARING FOR ELECTRICAL MACHINERY. By E. Tremlett Carter, C. E., M. Inst, E. E., M. Physical Society of London; Fellow Royal Astronomical Society; The Electrician Publishing Company, London; the D. Van Nostrand Company, New York City. 8vo; 620 pages; 201 diagrams and illustrations. Price $5.

This book opens with the statement that electrical engineering forms a branch of mechanical engineering, a fact that seems to have been lost sight of in this country if one were to judge by the curriculums of the electrical engineering departments of many of our American colleges; a fact which results detrimentally to graduates from these schools. Mechanical engineering is undoubtedly, as stated, the foundation on which a knowledge of electrical engineering must be based. The book is intended for those who have charge of the mechanical equipment and working of power stations for public supply or electric railways. There are six divisions, with headings as follows: Introduction; The Steam Engine; Gas and Oil Engines; Water Power Plant; Gearing, and Types of Power Stations. The opening pages have an old-time text book flavor, and contain definitions of velocity, power, work, energy, etc., that cannot be said to be excellent; for example, a half page definition of energy states, among other things, that "Energy is that condition of matter which enables the matter to exert force against any resisting force, and is that which enables a body to push backwards against a force through a distance along its line of action." It is hard to say whether this is or is not a definition of energy, at any rate it does not compare favorably with Professor Rankine's terse one which says that "Energy is the capacity for doing work."

Taking up the subjects of steam, furnaces and boilers, engines, etc., the book becomes more comprehensive and is written in a style that is quite readable, in marked contrast to the opening pages. A number of representative engines and boilers are described and methods for making tests are detailed. In the chapter on engine testing, attention is called to the common error of comparing engines by quoting their relative steam consumption in pounds of steam per hour without reference to whether the steam is wet or dry, at high or low pressure, or whether it is or is not superheated. Considerable space is devoted to gas engines, gas engine testing and oil engines; the author states that gas engines are used to a considerable extent on the Continent for operating electric generators. The discussion on water power plants deals with turbines and the theory of their design, the flow of water in pipes and the testing of water power plants. There are four chapters on the transmission of power, under the general head of gearing mentioned above. Here as throughout the other parts of the work, English practice is discussed almost exclusively, references are to English installations, English machinery is described and reports of tests, etc., are those from conditions existing in England or on the Continent. The last two chapters are taken up with short descriptions of steam, gas and water power stations, the only American one being that at Niagara Falls. The index is full and complete, three pages refer alone to the numerous tables of engineering data throughout the work; many of these tables may, however, be found in any engineer's pocketbook.

THEORY AND CALCULATION OF ALTERNATING CURRENT PHENOMENA. by Charles Proteus Steinmetz, M. Am. Inst. E. E., with the assistance of Ernst J. Berg. The W. J. Johnston Company, New York City. 8vo.; pp. 449; 184 diagrams. $2.50.

The author states in the beginning that this work is not intended for beginners, but presupposes some knowledge of electrical engineering. It has, however, been made as elementary as possible; calculus has been almost entirely excluded and only algebra and trigonometry used. While the book is by a practical engineer, and for practical men, it must not be understood to have removed the difficulties connected with a study of this branch of electrical engineering. Alternating currents at the best are extremely abstruse; so much so that in many of our technical schools the design of alternating current machinery is postponed until the post-graduate year.

Since the author is not a college professor, but the designing electrician of the General Electric Company, it may be presumed that the methods advanced are not a mere display of mathematical gymnastics, so common in works of this class, but are practical every-day problems to be met in the factory of any electrical company. He states that a considerable part of the book has been devoted to the application of complex imaginary quantities as the method found most useful in dealing with alternating current phenomena and in this regard may be considered as an expansion of the author's paper before the International Electrical Congress at Chicago in 1893. An appendix with full explanations of complex quantities is added for the benefit of those without previous knowledge of this subject. This method of solution seems less difficult than that usually employed, but does not succeed in eliminating the endless equations so painfully familiar to every student of alternating currents.

The introduction proceeds at once to the subject in hand without any lengthy history of antiquated machinery and deals with fundamental laws, Joule's law, the power equation of the alternating circuit, etc. The remaining chapters in order are: Instantaneous Values and Integral Values; Law of Electro-Magnetic Induction; Graphic Representation; Symbolic Method; Topographic Method; Admittance, Conductance, Susceptance; Circuits Containing Resistance, Inductance and Capacity; Resistance and Reactance of Transmission Lines; Effective Resistance and Reactance; Foucault or Eddy Currents; Distributed Capacity, Inductance, Resistance and Leakage; the Alternating Current Transformer; General Alternating Current Transformer; Induction Motor; Alternate Current Generator; Synchronizing Alternators; Synchronous motor; Reaction Machines; Distortion of Wave-Shape and its Causes; Effects of Higher Harmonics; The Various Polyphase Systems; Copper Efficiency of Systems; Three-Phase System; Quarter-Phase System; Algebra of Complex Imaginary Quantities and Oscillating Currents.

Trade Catalogues.

CATALOGUE. Sixty pages. Illustrated. Published by Frick Company, of Waynesboro, Pa.

SETTING ENGINE VALVES. Nine pages. Illustrated. Published by Russell & Company, of Massillon, O.

FOUR VALVE AUTOMATIC ENGINES. Twenty-six pages. Illustrated. Published by Russell & Company, of Massillon, O.

SINGLE VALVE AUTOMATIC ENGINES. Twenty-eight pages. Illustrated. Published by Russell & Company, of Massillon, O.

PURIFIERS AND HEATERS. Fifty-six pages. Illustrated. Published by the Hoppes Manufacturing Company, of Springfield, O.

THE WORTHINGTON COOLING TOWER. Twenty-six pages. Illustrated. Published by Henry R. Worthington, of New York.

RAILWAY APPARATUS AND SUPPLIES. 226 pages. Illustrated. Published by the General Electric Company, Schenectady, N. Y.

DELTA METAL. Thirteen pages. Illustrated. Published by the Phosphor-Bronze Smelting Company, Ltd., of Philadelphia, Pa.

ELECTRIC LAUNCHES. Fifty-six pages. Illustrated. Published by the Electric Launch Company, of Morris Heights, New York City.

MCGUIRE ELECTRIC STREET CAR TRUCKS. Fifty pages. Illustrated. Published by the McGuire Manufacturing Company, of Chicago, Ill.

TUBULAR AND LOCOMOTIVE STEAM BOILERS. Thirty-three pages. Illustrated. Published by the Atlas Engide Works, of Indianapolis, Ind.

SELF-CONTAINED STEAM ENGINES AND BOILERS. Fifty-three pages. Illustrated. Published by the Atlas Engine Works, of Indianapolis, Ind.

IDEAL HIGH ART ENGINES. Thirty-one pages. Illustrated. Published by A. L. Ide & Son, of Springfield, Ill.

CATALOGUE. Thirty-eight pages. Illustrated. Published by the Fischer Foundry & Machine Company, of Pittsburgh, Pa.

PARTIAL LIST OF PLANTS USING SIEMENS & HALSKE APPLIANCES. Nineteen pages. Published by the Siemens & Halske Electric Company of America, Chicago, Ill.

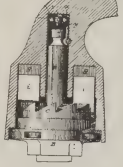
List of Street Railway Patents.

U. S. PATENTS ISSUED JAN. 26, TO FEB. 16, 1897, INCLUSIVE.

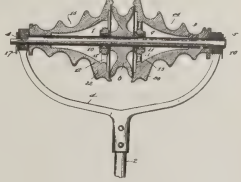
Jan. 26.

TROLLEY TRACK FROG.—Wm. J. Sumner, Holyoke, Mass. No. 575,770.

A trolley track frog made in a single casting, and having four box-shaped or hollowed arms extending therefrom, each one having a slot made through its bottom, and a wheel runway upon both sides of the slot, a central chamber, runways forming the bottom of the chamber, and a protecting flange which forms the cover for all the arms or extensions.



PAT. NO 576,043.



PAT. NO. 576,405.

CLOSED CONDUIT ELECTRIC RAILWAY.—Edwin W. Rice, Jr., Schenectady, N. Y. No. 575,785.

In a surface contact or closed conduit electric railway system, an independent ground connection adjacent to the pick-up magnet contacts and adapted to protect the coils on the pick-up magnets from extraneous or leakage currents.

BRAKE SHOE.—Frank E. Case, Schenectady, N. Y. No, 575,789.

A disk electromagnet brake shoe, having a disk mounted on a car axle and provided on its face with sets of lugs and a retaining plate intermediate of said lugs; in combination with a locking bar located in said lugs and held in position by said plate, the bar being secured to prevent rotation of the shoe.

BRAKE HANDLE.—P. G. Emery, Chicago, Ill. No. 576,043.

As an improvement in a brake handle, a handle portion, a hub portion and a mechanism adapting the brake handle, when rotated in one direction, to be operative upon the brake staff or rod, but to revolve loosely in the opposite direction, or around upon the brake staff without effecting movement of the latter, combined with friction reducing devices interposed between the brake handle and its pivotal supports.

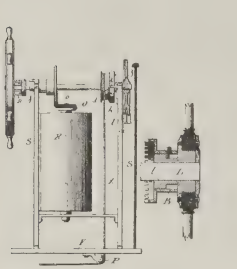
FEB. 2.

CAR FENDER.—Frank P. Maize and others, Philadelphia, Pa. No. 576,210.

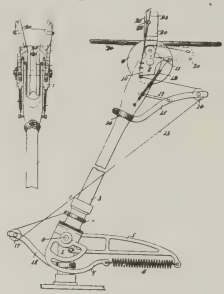
CAR FENDER.—Ira O. Stephens, Oakland, Cal. No. 576,283.

BRAKE MECHANISM AND CONTROLLER FOR ELECTRIC CARS.—Walter D. Thomas and Leigh R. Gignilliat, Savannah, Ga. No. 576,384.

In a controlling device for electric cars, the combination with the regulator or controller, and brake operating devices, of an actuating shaft rotably mounted in suitable bearings and held against longitudinal movement therein, and clutch mechanism located between said actuating shaft and brake operating devices, with means for automatically causing the clutch mechanism to connect and release the actuating shaft and brake operating devices at predetermined points in the rotation of the shaft, the said means being operated solely through the rotation of the actuating shaft.



PAT. NO. 576,384.



PAT. NO. 576,394.

TROLLEY FOR ELECTRIC CARS.—Geo. L. Campbell, Shunk, Pa. No. 576,394.

The combination of a post, a trolley pole pivotally mounted thereon, a trolley wheel carried by the pole, an arm pivotally mounted on the pole, a spring in connection with the arm and pole, a flexible connection actuating said arm, the connection being attached to the pole, and an idler pulley carried by the post and over which the connection passes.

SPIRAL TROLLEY WHEEL.—Chas. A. Langford, St. Louis, Mo. No. 576,405.

A trolley wheel, comprising a wheel having an annular groove in its periphery, a stationary shaft supporting said wheel, a yoke supporting the ends of said shaft, wheels, having spiral grooves, mounted upon said shaft, one upon each end of said first mentioned grooved wheel, said spiral grooves being designed to throw the trolley wire toward said first mentioned grooved wheel by the frictional contact of said trolley wire with said grooves, said spirally grooved wheels being overbalanced so that the inner ends of their spirals will normally be at the top of said wheels.

CAR FENDER.—Edmund West, San Francisco, Cal. No. 576,491.

CAR FENDER.—C. E. Fletcher, Waltham, Mass. No. 576,496.

FEB. 9, 1897.

TROLLEY SYSTEM.—Willis G. Caffrey, Reno, Nev. No. 576,721.

CAR FENDER.—John P. Kane, Dawson, Pa. No. 576,853.

CAR FENDER.—Harry S. Brickell, Pittsburgh, Pa. No. 576,946.

A car fender consisting of a front and rear fender, rods secured to the front fender and to a locking brace of the rear fender, the two rods being connected by an inverted V-shaped hanger secured to the car body, said rods being provided with springs on each side of the hanger arms.

FEB. 16.

CHARGING DEVICE FOR AIR STORAGE MOTOR CARS.—Robert Hardie, Rome, N. Y. No. 577,024.

A device, for charging supply reservoirs from a compressor or other primary source and for charging a storage car or other receiver from said supply reservoirs, comprising a valve and valve seat with the ports therein arranged to permit the several supply reservoirs to be connected with the storage car, in succession, under a step-by-step movement of the valve, while always keeping open the compressor or source connection, and delivering therefrom first to the untapped reservoirs in advance of the valve and then to the storage car on reaching the last of the reservoirs.

COMBINED CAR FENDER AND BRAKE.—Edwin S. Leaycraft, Jersey City, N. J. No. 577,044.

The combination, with a car, of a fender, a brake shoe and a link pivoted to the brake shoe and provided with an elongated slot embracing a pin extending from the fender.

STREET CAR MOTOR.—P. P. Mast, Springfield, O. No. 577,050.

In a street car motor, the combination with a driving shaft adapted to rotate continuously in one direction, a countershaft rotated thereby in the opposite direction, the car axles, operating wheels of larger and smaller diameters on each axle, means to connect and disconnect said wheels rotatably with said axles, and connecting mechanism between the driving shaft and said wheels on one axle, and other connected mechanism between the countershaft and said wheels on the other axle, whereby the car may be run in either direction and whereby it may be run with variable speed and power without substantially changing the speed and power of the driving shaft.

ELECTRIC RAILWAY MOTOR.—Albert Schmid, Pittsburgh, Pa. No 577,071.

The combination with a car axle and a motor supported at one side by said axle, of a plurality of springs circumferentially arranged around said axle, and bearing against the same, a bearing for said motor interposed between the same and the outer ends of said springs, and gearing between the motor armature, the bearing and the axle, whereby all of said parts rotate together.

ELECTRIC BRAKE.—Elmer A. Sperry, Cleveland, O. No. 577,119.

In an electric brake system, the combination of a dynamo-electric machine having a series and shunt field coil and adapted for propelling and braking the vehicle, with means for maintaining a field magnetization at the time the dynamo electric machine is not affecting the motion of the vehicle.

CAR FENDER.—N. T. MacFerron, Allegheny, Pa. No. 577,140.

TRACK SANDING DEVICE.—A. J. Freeman, Springfield, Mass. No. 577,245.

CAR BRAKE.—A. S. Goetz, Detroit, Mich. No. 577,294.

In a car brake, the combination with the truck frame of the vertically movable cross beam, the ways in the inner face of the rails of the frame, which receive the ends of said beam, the brake shoes connected with said beam and depending adjacent to the rails of the track, and the rotary movable wedge for actuating said beam.

CAR FENDER.—Carl Sherwood, Honesdale, Pa. No. 577,326.

We will send copies of specifications and drawings complete of any of the above patents to any address upon receipt of fifteen cents. Give date and number of patent desired. THE STREET RAILWAY PUBLISHING COMPANY, HAVEMEYER BUILDING, NEW YORK.

Power Transmission for Electric Roads.

The book with the above title, which has just been published by the Street Railway Publishing Company, has met with a very cordial reception from engineers and the technical press both at home and abroad. The following are a few of the favorable comments upon the book made by some contemporaries:

This is undoubtedly the most complete book ever published on electric railway power distribution, and the ability of Dr. Bell to handle the subject no one will question.—*Street Railway Review.*

Dr. Bell's book contains interesting information of value to electricians and above all furnishes data of great importance at this moment when mechanical traction is being talked about everywhere.—*La Nature.*

This book fills a long felt want in this branch of engineering; there have been many demands for such a work, and the well known name of Dr. Bell is alone a guarantee of the excellence of its contents.—*Engineering News.*

The impression gained from a cursory survey of the contents is that the treatise is the work of an alert, bright and experienced engineer well up to date in his facts and observations. The illustrations are profuse, a large proportion of them being half-tones.—*Engineering Magazine.*

Dr. Bell is recognized as one of the ablest writers on electrical topics. His statements are clear. He combines technical and practical knowledge in a highly interesting and instructive way in his latest publication named above. It is a valuable, modern and comprehensive book, and should be in the library of every up-to-date electric railway man.—*Electrical Review.*

Foreign Testimonial.

The following testimonial as to the high standing of the STREET RAILWAY JOURNAL in Europe is taken from a letter to one of the leading American manufacturers of street railway material from its European representatives, a well known German house:

"We would request you to have inserted in the next number of the STREET RAILWAY JOURNAL, information to the effect that we have been appointed your general representatives in Europe As the Journal is read by all street railway people of standing in Germany, a notice of this kind will be of great importance to us."

Financial Notes.

Baltimore, Md.—The directors of the Baltimore City Passenger Railway Company have agreed to recommend to the stockholders the issuance of certificates of indebtedness to the amount of $500,000 to provide funds for paying off the floating debt incurred in making various improvements and supply money needed for proposed betterments.

Braintree, Mass.—The stockholders of the Braintree & Weymouth Street Railway Company have voted to bond the road for $100,000

Brigantine Beach, N. J.—C. V. D. Joline, receiver of the Brigantine Transit Company, sold the property and effects of the company on Feb. 4 to J. Jayne, of the American Surety & Trust Company, Philadelphia, representing the bondholders, for $50,000. A thorough reorganization of the company will take place soon.

Brockton, Mass.—The Brockton Street Railway Company has applied for permission to increase its capital stock, in order to pay for the extension of its lines from Raynham to Taunton.

Buffalo, N. Y.—The Buffalo *Commercial* states that the Buffalo Traction Company has let a contract to the Erie Construction Company for the construction of fifteen miles of road this spring, forming a belt line in the east side of Buffalo. The Erie Construction Company, which is composed of George S. Gatchell, R. R. Hefford, E. G. S. Miller, and Joseph B. Mayer, will soon open offices in the Ellicott Square Building, Buffalo.

Burlington, Ia.—The reorganization committee of the Burlington Electric Railway Company has arranged a reorganization based on a consolidation of the railway, when foreclosed under the first mortgage, with the Burlington Gas & Fuel Company and the Burlington Electric Light Company, to be known as the Burlington Railway & Light Company. It is proposed to relay the road with sixty pound rails and build about 5½ miles of new track to West Burlington and Crapo Park.

Charleston, S. C.—On Feb. 13, the Charleston Street Railway Company took possession of the Charleston City Railway Company having paid $150,000 in cash for its entire stock and bond issues consisting of $100,000 in stock and $100,000 of first mortgage six per cent bonds. The new owners will immediately commence tearing up the old track and putting in new rails for an electric system. Mr. Parks, of Catlin & Company, of New York, and F. B. Jennings are the outside capitalists interested in the transaction, and their local representatives are F. D. McCeown and J. S. Lawrence. The White-Crosby Company has entire charge of the construction of the lines.

Chicago, Ill.—The Western Elevated Electric Railway Company will apply to the trustees of Cicero for a franchise to operate twenty-two miles of road. The Cook electric railway system, a model of which was exhibited at the World's Fair, will be used. The structure will consist of a single row of pillars, from twenty feet to fifty feet apart, set along the curb, spanned with trusses. The cars will be hung from the side of the structure, on top of which is a steel trough, sloping upward and outward from the center, in which travel the truck and anti-friction wheels, from which suspend the cars. On the lower portion of the truss is a similar rail, sloping down, on which travels the driving wheel of the car. The cars themselves will not be over three feet wide, constructed with a steel frame, and will not weigh more than the load they are designed to carry. Among those interested are H. D. Beam, M. Rosenthal and H. W. Cooley.

Columbus, O.—The Columbus Street Railway Company reports earnings as follows:

Year ending Dec. 31,	1895.	1896.
Gross receipts	$629,995	$631,324
Operating expenses	311,594	308,446
Earnings from operation	$318,401	$322,878
Fixed charges	183,506	196,500
Net income	$134,895	$126,378
Dividends paid	120,000	120,000
To surplus account	$ 14,895	$ 6,378
Total surplus account	192,141	198,519

Dayton, O.—The Dayton & Western Traction Company has been incorporated by Charles L. Kurtz, of Columbus; J. E. Lowes, Robert M. Nevin and J. T. Feight, of Dayton, and Oscar G. Sheppard to build and operate an electric railway between Dayton and Eaton, which is near the western state line of Ohio. Capital stock, $400,000.

Detroit, Mich.—Reports state that J. G. Tucker, receiver of the Detroit & River St. Clair Railroad Company, has been authorized to issue receiver's certificates to the amount of $500,000 to be spent in the construction and equipment of the company's lines, which will run from Mt. Clemens to New Baltimore, Fair Haven and Algonac, a distance of twenty-eight miles, passing through several summer resorts on the lake shore. The first ten miles between New Baltimore and Mt. Clemens are to be completed by May, 1. Among those interested in the company are Wm. H. Ashwell, Home Bank Building, Detroit, and Lester E. French, 12 Whitney Building, Detroit.

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Railway Mileage

of the following countries, comprising practically all the railways of the world, offers an interesting subject of study, namely: Europe, 144,380 miles; Great Britain (England, Scotland, Ireland and Wales), 20,325 miles; United States, 179,784 miles, exceeding the combined lines of Europe and Great Britain; Canada, 15,113 miles; Mexico, 6,625 miles; South and Central America, 21,302 miles. Total, excepting the United States, 207,745 miles. Grand total, 387,529 miles. It should make any manufacturer of Railway Supplies proud to be able to say that he is selling one-half the railways (in mileage) of the United States. It should make him feel quite comfortable to be able to say that, leaving out the United States and Europe, he is selling more mileage than the rest of the earth contains.

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Dover, N. H.—The Union Street Railway, which was purchased by New York parties some time ago, has been reorganized under the name of the Union Electric Railroad with the following officers: president, Sumner Wallace, of Rochester, N. Y.; secretary, Leslie P. Snow, of Rochester; treasurer, Harry Hough, of Dover.

Doylestown, Pa.—The Doylestown & Easton Electric Railway Company has been incorporated to construct an electric railway between Easton, Danborough, Point Pleasant and Doylestown. Capital stock, $100,000. Harry J. Shoemaker is president of the company.

East Liverpool, O.—It is reported that the East Liverpool & Wellsville Street Railroad will be sold at auction to satisfy the claims of the Cleveland Savings & Trust Company and other creditors.

Eureka Springs, Ark.—Judge McDaniels has appointed B. F. Putman receiver for the Eureka Springs Electric Light & Street Railway Company.

Fairhaven, Wash.—Judge Hanford has issued a decree of sale of the property and franchises of the Fairhaven & New Whatcom Railway Company at the request of the Atlantic Trust Company. The upset price is $75,000.

Fitchburg, Mass.—The Railroad Commissioners have granted the Fitchburg & Leominster Street Railway Company permission to issue $150,000 five per cent twenty year bonds, of which $120,000 will be used for funding debt incurred in extending the road, and $30,000 for refunding other bonds due Oct. 1, 1909.

Flint, Mich.—John E. Nolan, of Saginaw, has organized the Flint & Fenton Transportation Company to build and operate an electric railway from Flint to Long Lake and Fenton, a distance of twenty-one miles. Work will be begun about Apr. 1. Capital stock, $250,000.

Lancaster, Pa.—William B. Given, receiver of the Pennsylvania Traction Company, has paid a semi-annual dividend of fifteen per cent on the stock of the Lancaster & Columbia Traction Company.

Lincoln, Ill.—Judge Herdman has appointed William H. Traner receiver of the Lincoln Electric Street Railway Company.

Mansfield, O.—Reid Carpenter, of Mansfield, is the promoter of an electric railway from Mansfield to Shelby, and has applied for franchises in the latter city.

Niagara Falls, N. Y.—The Niagara Falls & Lewiston Railway Company has filed a mortgage for $1,000,000 to the Knickerbocker Trust Company, of New York, to clear up the present indebtedness and make improvements.

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Paterson, N. J.—The Paterson Railway Company reports earnings as follows:

Year ending Dec. 31,	1895.	1896.
Gross receipts	$298,689	$319,085
Operating expenses	172,901	189,488
Earnings from operation	$125,788	$129,597

Philadelphia, Pa.—The Philadelphia Traction Company has declared a dividend of $2 per share, payable Apr. 1.

Pittsburgh, Pa.—The Homestead & Highlands Street Railway Company has filed notice in the State Department of an increase of its capital stock from $200,000 to $400,000. The Braddock & Homestead Street Railway Company has made an increase from $7500 to $25,000.

Reading, Mass.—The Reading & Lowell Street Railway Company has applied to the Legislature for permission to purchase or lease the property and rights of the Wakefield & Stoneham, the Woburn & Reading and the Mystic Valley Street Railway Companies.

St. John, N. B.—The directors of the Consolidated Electric Company will apply to the Legislature for an act to empower them to issue $700,000 bonds, $500.000 of which are to be used for the purpose of exchanging or redeeming the bonds now issued, and $200,000 towards necessary improvements or extensions.

St. Louis, Mo.—Proceedings have been begun in the United States Circuit Court by Edward F. Leonard, of Illinois, to foreclose the mortgage for $300,000 on the St. Louis & Kirkwood Railroad, and for the appointment of a receiver.

THE National Railway Company, of Chicago, reports earnings as follows:

Year ending Dec. 31,	1895.	1896.
Gross receipts	$1,403,957	$1,522,273
Operating expenses	821,315	893,518
Earnings from operation	$ 582,642	$ 628,755
Interest, taxes, insurance	366,587	377,413
Net income	$ 216,055	$ 251,342
Dividends paid	175,000	175,000

Stillwater, Minn.—Sealed bids were received by the district court recently for the property and franchises of the Stillwater Electric Railway Company. The highest bid was $4500 from August Jesse, of Stillwater.

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Toronto, Ont.—At a recent meeting of the directors of the Huron & Ontario Electric Railway Company, several bids for the construction of the company's lines were received from New York companies and considered. The company has secured rights of way and may build some of its lines this year. Stock is to be issued to the extent of $2,000,000 and bonds for $5,000,000, the contractors to be secured by the bonds. The main line is projected to run from Port Perry on Lake Scugog to Kincardine on Lake Huron, a distance of 191 miles, passing through forty of the principal towns and cities of Ontario. Two branches will act as feeders to the main line, one from Flesherton to Meaford, twenty-eight miles, and the other from Walkerton to Goderich, fifty-five miles, making a total of 274 miles. M. McNamara, of Walkertown, Ont., is president, and Alfred Brunel, C. E., engineer of the company.

West Newton, Pa.—The West Newton Northern Street Railway Company has been incorporated by W. M. Patterson (president), of Homestead, and others to build an electric railway from West Newton to Herwine. Capital stock, $30,000.

A Royal Blue Flyer.

Engine No. 1313, which draws Royal Blue Line train No. 511 from New York to Washington, on Jan. 24 made a run from Camden Station to Washington in 37 mins. The distance is 41 miles. The train left Camden Station at 4:02 and was in Washington depot at 4:39. The run from Branchville to Trinidad, Washington's city limits, a distance of 8½ miles, was made in 5 mins.

Engineer Schultz was in charge. The fast time was made because the train was several minutes behind time. Engine No. 1313 is one of those recently built for the Baltimore & Ohio. It is a Baldwin ten-wheel driver. ***

A Unique Calendar.

The Lake Shore & Michigan Southern Railway has issued a very pretty and unique calendar for 1897. The face of this calendar is made to represent a United States mail pouch, and the calendars for each month are attached to the bottom. This calendar is quite elaborate, reminding one of the high standard that the Lake Shore & Michigan Southern Railway Company always maintains throughout its entire equipment. Its day coaches are still among the finest in the world. They are fitted with the Gould platform and automatic coupler, Westinghouse air brakes and signals, and heated with steam taken from the locomotive, and at night are brilliantly lighted with Pintsch gas. The interior of the coaches is finished in mahogany, highly polished and paneled. The seats are richly upholstered in crimson plush and the large plate glass windows give abundance of light. All dining cars of the company are dainty and inviting throughout and the cuisine and appointments are all that can be desired. Long ago the United States Government recognized and selected the Lake Shore as the best road over which to run the famous White Mail trains, the fastest service of this nature in the world. A vigilant management, a perfect roadbed, double tracks and absence of grades and curves have made possible the operation of this high class of service ***

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ELECTRICAL ENGINEERING DEPARTMENT
University of Illinois.

Street Railway Journal.

Vol. XIII. *NEW YORK AND CHICAGO, APRIL, 1897.* *No. 4.*

ELECTRIC RAILWAY PRACTICE IN EUROPE.

There are eleven cities in Europe with a population of over 500,000, 110 cities with from 100,000 to 500,000 and 149 cities with from 50,000 to 100,000. In all this immense wealth of street railway territory there are to-day less than 1,000 miles of track operated by electricity. In the United States there are but four cities with a population of over 500,000, twenty-four cities with from 100,000 to 500,000 and thirty cities with from 50,000 to 100,000. In these fifty-eight American cities there are not less than 7,500 miles of electric railway track.

The reasons why the Old World has not until recently taken kindly to electric traction are well known on both sides of the water. To the natural and not unreasonable inclination on the part of long established peoples to move slowly and to adopt new things only after experience elsewhere has determined their practical advantages, has been joined a resolute, and, in many cases, a violent opposition on the part of the public to the introduction of anything seeming to be a disfigurement to the beautiful old towns around which so many historical and personal associations have been for centuries clustering. Officialism has generally stood in the way of radical or hastily considered action and "vested rights" have been, as everywhere, a block in the path of progress. More than all things else, however, preventing the earlier adoption of electricity, in Europe particularly, has been the policy, common in nearly all its countries, of limiting the terms of corporate franchises to so short a term of years that capital itself has been timid about undertaking the necessary investment, especially where the right to purchase tramway systems at the end of the franchise period has been reserved to the municipality.

THE KAISERPLATZ IN AIX-LA-CHAPELLE.

All these waiting influences have, it is true, postponed the expansion of city areas and that happier time when the working classes of Europe shall be permitted to leave the tenement house districts to enjoy the benefits of suburban life; but the evil has been not unmixed with good, for the street railway companies, the municipalities,

and even the people themselves are profiting by the magnificent practical experiments in electric traction which have been carried out in America, and it ought to be possible for them to avoid many of the mistakes which have cost American companies so dearly.

From the following table may be seen the relative importance of the different countries of Europe from a street railway point of view. As countries of the first class, we have the British Isles with their seventy-two important cities, Germany with forty-seven cities, Russia with thirty-five cities and France with thirty-four cities; as countries of the second class we have Spain with sixteen cities, Austria-Hungary with fifteen cities, and Italy with fourteen; while in the third class, judged from this point of view, are found Turkey with nine cities, Holland with seven, Belgium with six, Switzerland and Roumania with three each, Sweden and Portugal with two each, Servia, Norway, Greece and Denmark with one city each, and Bosnia and Bulgaria with no city of 50,000 inhabitants or more.

Cities of	500,000 and over.	100,000 to 500,000	50,000 to 100,000
Austria-Hungary.	2	4	9
Belgium.	. .	4	2
Bosnia	. .	. .	. .
British Isles	4	26	42
Bulgaria.	. .	. .	. .
Denmark.	. .	1	. .
France.	1	11	22
Germany.	1	25	21
Greece.	. .	1	. .
Holland	. .	3	4
Italy.	. .	9	5
Norway	. .	1	1
Portugal	.	2	. .
Roumania	. .	1	2
Russia.	3	10	22
Servia.	. .	. .	1
Spain	. .	5	11
Sweden	. .	2	. .
Switzerland.	. .	. .	3
Turkey.	. .	5	4
Total.	11	110	149

AT THE ZOOLOGICAL GARDENS IN AIX-LA-CHAPELLE.

The greatest activity in electric railway building is found to-day in Germany, with France closely following, Great Britain probably third, and Belgium nearly at the top, if the proportion of electric railway mileage to the total in the country is considered. Italy, the art capital of the world, was, strangely enough, one of the first countries of Europe to try the new and "disfiguring" motive power; Switzerland, a country of hills, valleys and everlasting snow, utilizes its waterfalls in operating not a few electric railways; Servia's one important city has its electric railway; but Russia needs another Peter the Great to sally forth into the world and learn of Western nations how to give comforts to its people. Broadly speaking, Europe is to-day, as never before, awake to the meaning of electric traction in improving the condition of its people, and the next ten years will see as rapid changes in municipal transportation in European capitals as the last ten have seen in America.

In the following pages the principal street railway systems of several European cities are described with special reference to the engineering methods adopted in the construction of their roadbed, their overhead construction, their power stations and their rolling stock, and to the financial results which have so far come from the introduction of electricity. There is much to learn from the practice of these cities as so far developed—much that is worthy of imitation and not a little, alas, that should be learned only to be avoided.

AIX-LA-CHAPELLE, GERMANY.

This beautiful European city and watering place—the favorite residence and northern capital of Charlemagne, formerly the crowning place of the German emperors, and a city noted in the world's history for the numerous diets and diplomatic councils which have there been held—is also an important commercial, manufacturing and railway center and has a population of about 105,000. Its extensive street railway or "little railway" system is owned and operated by the Aachener Kleinbahn Gesellschaft, which possesses forty-five and fifty year concessions from the municipality. This system was in operation by horses for about fifteen years; but the conditions for animal traction in the city and vicinity are exceedingly trying, and a change of motive power became an absolute necessity for the development of municipal interests. The grades are severe, and the traffic offered to the cars such that horses would be quickly used up if changes were not made so frequently on the longer lines as to cause great trouble and dissatisfaction to the passengers. Horse traction therefore is practically a thing of the past, nearly all the existing lines having been already converted to electricity, and new lines are building to be operated by the same motive power. This has proven highly satisfactory to the company and to the people so that no difficulty has been experienced in securing new rights.

The entire system now in operation comprises about 40 kilometers (25 miles) of track, and is operated in five lines, the locations of which are seen on the accompanying map (page 191). Three other lines, also indicated on the map, are extensions shortly to be made, and the entire system on its completion will comprise about 100 kilometers (62 miles) of track.

Roadbed.—The track gage of the old road is 1.435 meters (4 ft. 8½ ins.) but the gage is to be changed over everywhere to 1 meter (3 ft. 3.4 ins.).

The sections of rails used on this system are shown in Figs. 1 to 5. Fig. 2 is the type used in paved streets, is 179 mm. (7 ins.) in height, and weighs 41 kgms. per meter (83 lbs. per yard). The ties are metal and are spaced about 5 ft. apart on an average, and tie rods are used at average distances of about 2 meters (6 ft. 7 ins.)

In macadamized roads and in places where the right of way is owned by the company, the Vignole rail, 1 cm. (3.94 ins.) in height is used, this section weighing 20 kg. per meter (40 lb. per yard). (See Fig. 3.) The construction of the company's track at crossings with the tracks of the state railway system is shown in Fig. 6. Gravel ballast is used with the Vignole rails. Some of the rail used is of the Phœnix type and some is made in Aix-la-Chapelle. These forms of track construction have proved sufficiently strong for electric traction during the two years in which electricity has been used. The company

estimates that the roadbed has to stand an average service of about 50,000 cars per annum on each kilometer of track, and it expects a life of forty-five years for its rail head alone, exclusive of joint difficulties. If its track work were to be done again the joints would be strengthened by the use of more material in the fishplates, and a deeper groove in the girder rails would be specified.

The steepest gradient inside the city is 5 per cent, and outside the city grades of 6 per cent and of 9 per cent are found as well as others somewhat lighter. The radius of the shortest curve is 15 meters (about 50 ft.).

The trolley wire is of hard drawn copper wire, 53 sq. mm. in sectional area and the span wires are of galvanized steel 5 mm. in diameter. For anchorage and at switches, curves and termini, galvanized steel wire, 6 mm. in diameter, is used. Within the city the feeders are laid underground and are insulated with double lead covering and double wire armoring. On the suburban line overhead feeders carried on porcelain insulators are used, and in some places they are run double so as to minimize interruption of the current in case of accident.

A bracket construction is generally used throughout

MAP
SHOWING THE LINES
OF THE
AACHENER KLEINBAHN GESELLSCHAFT
AIX-LA-CHAPELLE, GERMANY.

Overhead Electric Construction.—Well designed iron centre poles, and span wire construction with ornamental rosettes fastened to the houses are used within the city limits, and wooden poles with iron brackets in the suburbs. There was originally considerable opposition to the adoption of the overhead wire in Aix-la-Chapelle, but this has entirely disappeared in view of the neat and elegant structure which has been put up by the company and there is now no opposition to the extension of the system. If the work were to be done again the municipal authorities would permit, and in fact insist upon a larger proportion of span wire work than has been installed.

the city and suburbs, and at present the wires are fastened quite rigidly to the brackets. This will be changed to a more flexible support similar to that common in America, and at the same time the trolley wire clamps, which are now 125 mm. long, will be replaced by clamps 400 mm. (about 16 ins.) long.

Power Station.—The company does not own its power station, but buys its current from the Municipal Electrical Works, paying for this 12 pfennigs ($.029) per kilowatt hour, measured at the feeder points along the line. The power station equipment for the traction service consists of two 150 k. w., 12 pole generators, direct coupled to two

compound, condensing, 180 h. p. engines running at 230 revolutions, and a 150 k. w. rotary transformer, which is used as a reserve and gives a 220 volt current for the electric light plant and a 550 volt current for traction. The power company is about to put in a storage battery plant to equalize the fluctuations in the railway current and to reinforce the present plant.

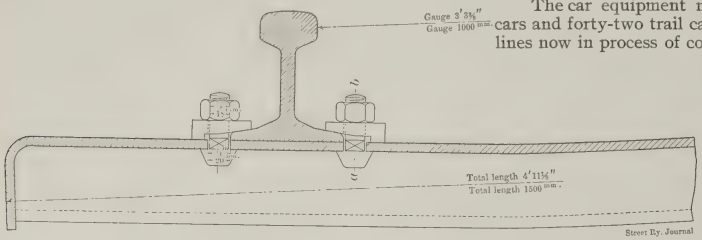


FIG. 1.—STEEL TIES—AIX-LA-CHAPELLE.

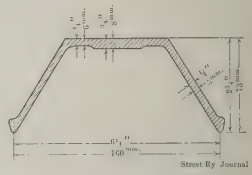


FIG. 4.

Car Equipment.—The cars used in Aix-la-Chapelle are shown in the accompanying illustrations, pages 189 and 190, and are popular in the city. The weight of the motor cars is 5500 kg. (12,000 lbs.) unloaded, and of the trail cars about 2000 kg. (4400 lbs.).

Each car seats fourteen people inside and provides standing room for six on each platform. All the cars are provided with two independent sets of brakes, which can be operated from each platform, so as to add greatly to the normal braking effect. Track brakes are also used on the lines having steep grades, and on a few of the cars electric brakes have been introduced with much success. The many grades on the line make such a step as this necessary.

The cars are equipped with 10, 15 and 25 h. p. motors intended to be watertight. The speed is limited to 12 kilometers (about 7.5 miles) per hour within the city limits, and to 16 kilometers (about 10 miles) per hour on suburban roads. On the steepest grades (10 per cent) and in certain narrow roads the speed is limited to 5 kilometers (3 miles) per hour by special ordinance, but the company states that speeds in general on its system will have to be increased, as the public demands this step, having become more accustomed to the rapidly moving cars.

The car equipment now consists of forty-two motor cars and forty-two trail cars. After the completion of the lines now in process of construction thirty-two motor cars and fifty freight cars will be added to the equipment. It is intended to give a freight service in the suburbs of the city.

As improvements on the existing system in use, the company would recommend the general introduction of electric brakes, which are now used on a part only of its cars; the better arrangement of the motors with respect to repairs; a better construction of the rheostat resistances; a somewhat more flexible trolley; and the lowering of the steps to the car platforms so as to prevent the difficulty of entrance. It would also apply a friction brake, operated from the motor car to the axles of the trail cars so as to do away with the necessity for a special brakeman on the trail cars.

The gross receipts per kilometer have not shown a material increase, but an increase is expected after the

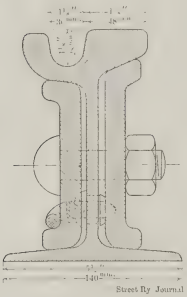


FIG. 2.—RAIL FOR PAVED STREETS.—AIX-LA-CHAPELLE.

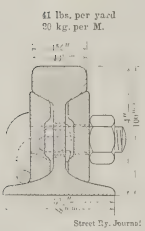


FIG 3.—RAIL FOR MACADAMIZED STREETS.—AIX-LA-CHAPELLE.

FIG. 5.—CONSTRUCTION OF ROADBED—AIX-LA-CHAPELLE.

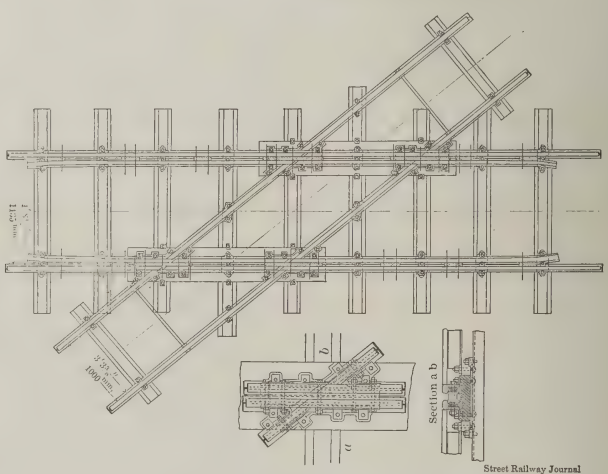


FIG. 6.—CROSSING CONSTRUCTION—AIX-LA-CHAPELLE.

new lines have been put in operation. The extensions already made have increased the receipts from about 329,000 marks ($78,960) to 451,000 marks ($108,240). The operating expenses per car kilometer have decreased from 27 pfennigs in 1895 to 23 pfennigs in 1896, these amounts being equivalent to $.104 and $.0883 per car mile respectively. A further decrease is expected by the company.

The net income for 1896, after paying operating expenses and interest on debt, amounted to 120,000 marks ($28,800) which is equivalent to a return of to 6 per cent in dividends on the capital stock. Some increase in this net return is expected, but it is not thought likely to be large.

At the end of the concession from the municipality, the entire road and equipment is to revert to the municipality without cost to the latter. In order to amortize the cost of plant and equipment, as well as to provide for depreciation and renewal of its apparatus during the life of the concession, the company passes to a reserve fund the following sums:

1.—One per cent of the net annual profits derived from operation.

2.—Fifteen per cent of the original cost of the rolling stock and other equipment. [This is apparently deducted at the time of purchase from the cost as it appears in the assets.—Eds.]

3.—One per cent per annum of the cost of the roadbed construction and 2 per cent per annum of the cost of the rolling stock, these sums to provide for depreciation.

4.—The proceeds of the sales of old material are also passed to this fund.

VERSAILLES, FRANCE.

One of the most beautiful cities in Europe is this French town of 50,000 inhabitants, and some of the finest public buildings, churches and palaces to be found in any country are conspicuous in its streets. Nevertheless, the overhead trolley system, that *bête noir* in many of the cruder cities of Europe, finds a secure lodgment in Versailles, and gives a service which in speed, cleanliness and convenience is the marvel of the city.

IN THE STREETS OF VERSAILLES.

The Société Versaillaise de Tramways Electrique et de Distribution d'Energie owns not only this street railway line, but a station furnishing electric light and power throughout the city. Its street railway system is divided into four lines, one running from Glatigny through Grandchamps; another from Glatigny to the Gate of the Orangery; another from the Square of Chesnay to the Chantiers Station, and a fourth from the Square Duplessis to the Avenue Picardie. The entire road is 8 meters (5 miles) in length and the gradients are few and unimportant, the maximum being 3 per cent. The sharpest curve has a radius of about 100 meters (62 ft.)

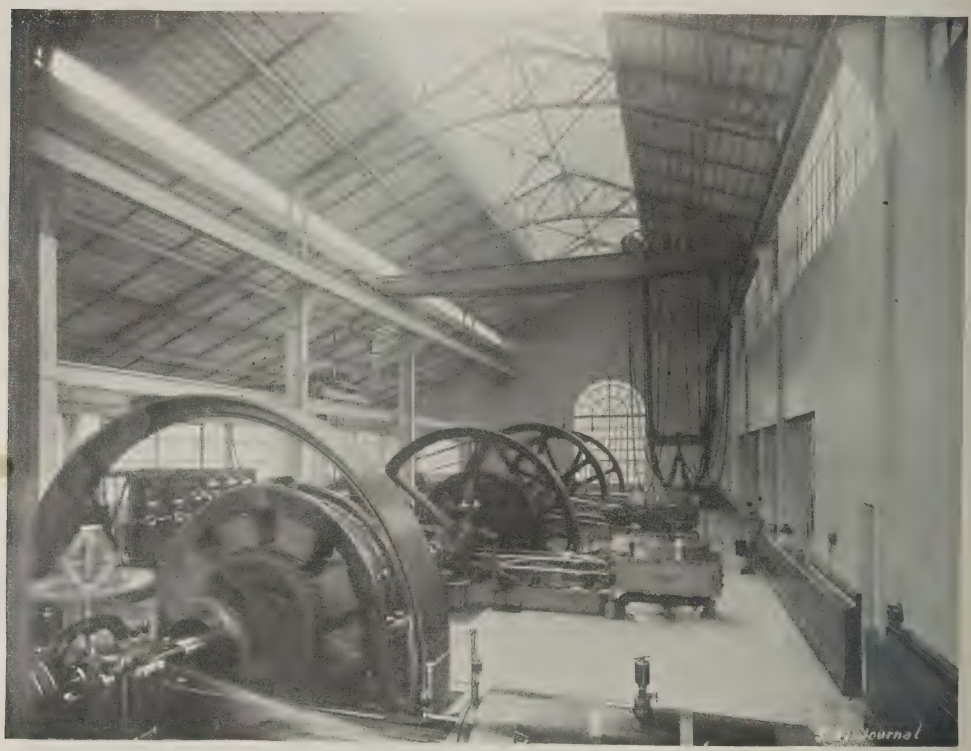
Roadbed.—The track is laid with Broca rails, weighing 36 kg. to the meter (72 lbs. per yard). The gage is 4 ft. 8½ ins. (1.44 meters), and the distances between the centers of the double tracks are 11½ ft. (3.45 meters).

Overhead Electric Construction.—On certain streets special double bracket poles are used to carry the electric lights as well as the trolley wires, and at the bases of these poles "refuges" are established for pedestrians crossing the streets.

In other streets the poles carry single or double brackets, from which are hung groups of incandescent lamps beneath reflectors, and rosettes are used wherever the lighting service does not require the use of poles.

steam piping is carried out in duplicate, and water for the boilers and for condensation is taken ordinarily from a well sunk in the company's property; but a supply is also obtained from the city mains. Injectors are used, and two steam pumps, each capable of supplying the entire boiler outfit, can also be used when necessary. The condensers are of the jet type, and the condensing water is cooled by the spray method. The pumps are driven, one by a 500 volt motor, the other by an alternating current motor.

The engines are four in number, two direct connected to the railway generators, and two belt connected to monocyclic alternators for the light and power circuits. The



POWER STATION IN VERSAILLES.

The feeder cable is carried some distance into the city, as far as the Place des Tribunaux. Two other cables are laid in the same trench as the feeder, and constitute the return circuit. All the overhead material, as well as the entire electrical car and station equipment, was furnished by the Cie. Française Thomson-Houston.

Power Station.—The power station is located outside the city customs limit at Porchefontaine. It is illustrated herewith, and is divided into two parts, the engine and dynamo room, 106½ ft. × 65½ ft. and the boiler room 65½ ft. × 39½ ft. The engine room is lighted by side windows and has a glass monitor roof. This room is practically divided into two sections, the main portion containing the railway engines and generators, and the smaller part the alternators, exciters and switchboard. A large traveling crane spans the railway section, and a smaller the alternator section. The boiler room contains four one semi-tubular boilers with 1722 sq. ft. of heating surface, furnishing steam at a working pressure of 130 lbs. The railway generators are of the horizontal, single cylinder type each of 240 h. p. capacity and run at 300 r. p. m. The speed variation between no load and full load does not exceed 2 per cent. The combined power of the two machines is above 600 i. h. p. as a maximum.

The railway generators are eight pole, 200 k. w. machines of the standard General Electric type. Both railway generators and alternators are connected to a marble panel switchboard which is equipped with indicating, measuring, controlling and emergency apparatus of the latest American type.

Rolling Stock.—The character of the rolling stock may be seen in the illustrations on page 193. They closely resemble American cars, but have certain French characteristics. They are 20 ft. long, with seating capacity of twenty, and room for ten passengers on each of the two platforms. Each car is equipped with two G. E. 800 motors, with K2 controllers, and with General Electric trolleys. No fenders are used, but aprons of wire

netting are hung around each end of the car. The gates are of ornamental metal work.

ZURICH, SWITZERLAND.

Zürich, the most flourishing city in Switzerland and the manufacturing center of the country, has a population of about 120,000, including that of its nine suburbs. Its street railway system is operated partly by horses and partly by electricity and has been in existence since 1883, although the conversion of the horse lines to electric lines was not commenced until 1894. The horse railway section is 9 kilometers (5.6 miles) in length, and on this section are operated twenty-seven cars in ordinary service, with nine as a reserve. The electric section is 4.55 kilometers (2.8 miles) in length, and on this are operated nine cars with seven held in reserve.

is to be with iron poles. Trolley wires are placed at a height of 6 meters (nearly 20 ft) above the rails. The trolley wire so far used has been of hard drawn copper 7 mm. in diameter, a size somewhat less than No. 1 B. & S. gage. In future an 8 mm. wire corresponding to No. 0 B. & S. gage will be used. For span wires a cable 7 mm. in diameter consisting of fifty-six wires has been used, but in future a steel wire 5 mm. to 6 mm. in diameter will be adopted instead. Porcelain and gutta percha are used for insulating material in the overhead structure of Zürich.

The only objection made by the people to the extension of the overhead system is confined to its use in some of the principal streets of the town.

Power Station.—The power station equipment consists of two 66 k. w. Oerlikon generators and one 3 k. w. generator used as an exciter; two Galloway boilers; and two

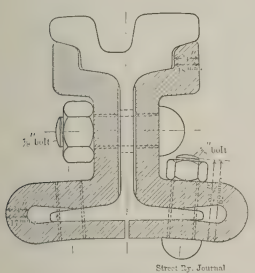


FIG. 7.—PROPOSED JOINT CONSTRUCTION—HANOVER.

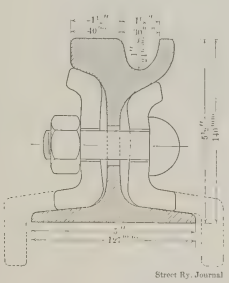


FIG. 8.—FORMER STANDARD RAIL SECTION—ZURICH.

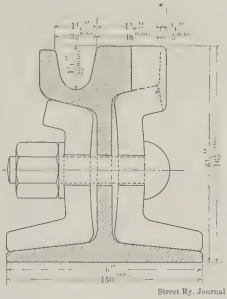


FIG. 9.—PROPOSED STANDARD RAIL SECTION—ZURICH.

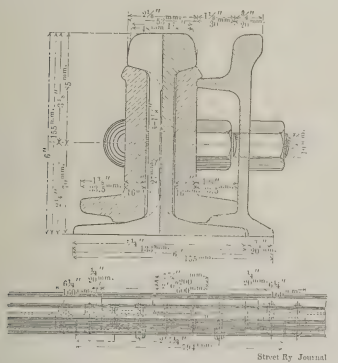


FIG. 10.—HAARMANN RAIL SECTION—ZURICH—HANOVER—BASEL.

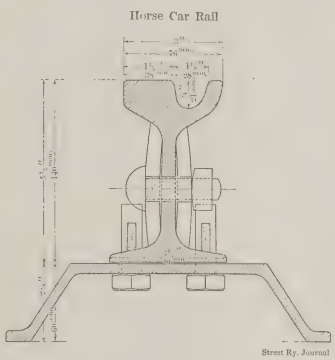


FIG. 11.—HORSE RAILWAY SECTION—ZURICH—BASEL.

Roadbed.—The different types of rail sections used on the Zürich system are shown in Figs. 8 to 11. Fig. 8 shows the Phœnix 7 A rail, which was originally used on the electric lines; Fig. 10 the Haarmann rail No. 47 F., experiments with which are now being made; Fig. 9 a new profile devised by P. Schenker, the engineer of the Zürich system, and Fig. 11 the section used on the horse railway lines.

Fig. 11 has been used on the horse railway lines since 1882, and even if it were not to be removed on account of the change to electric traction it would have to be taken up and replaced by other rail within the next four or five years, as its usefulness is nearly over. On the electric line there has been noticed a loosening up of the rail joints in a few cases, but this has not been serious. On both electric and horse railway sections from 220 to 300 cars pass over the rails each day. Ties are not used in any of the new construction.

Overhead Electric Construction.—Wood and iron poles have been used until the present time, but all new work

compound engines running at 240 r. p. m., belted to the generators. Within the next two or three years the fast running engines will be replaced by slow speed units direct connected to the generators.

The cost of motive power per kilowatt hour is 13.5 centimes ($.027). The cost per car kilometer is 7.8 centimes, equivalent to $.025 per car mile, these figures covering fuel, water, labor and ordinary repairs on power station apparatus, but excluding depreciation.

Cars and Equipment.—The electric cars in use measure 5.5 meters (18 ft.) in length over all and have a wheel base of 1.5 meters (5 ft). There are seats for twelve inside and standing room for seven or eight on each platform. The horse cars are somewhat smaller. Each electric car is equipped with a 17½ h. p. motor.

The maximum speed of the cars is limited by the state authorities to 15 kilometers (9.3 miles) per hour, but in certain places this speed is sometimes exceeded. The average schedule speed is 10.2 kilometers (6.3 miles). Cars somewhat larger than these will be used in the future

on the new electric lines and will seat from fourteen to sixteen, with standing room for eight to ten on each platform. The new cars will also have sand boxes, and the motors will be more thoroughly protected from water than the present ones.

Financial Results.—The electric system has become very popular on account of its greater speed and cleanliness. Nevertheless, certain local peculiarities of the tramway situation in Zürich, including competition and the short length of lines so far equipped by electricity, have made it impossible to show as yet a very large increase in gross

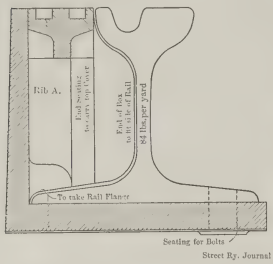


FIG 12.—RAIL SECTION AND JOINT BOX—COVENTRY.

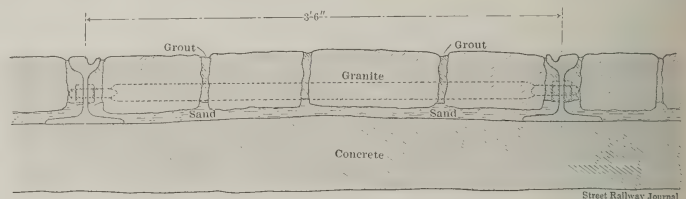


FIG. 13.—ROADBED CONSTRUCTION—COVENTRY.

or net receipts, nor has there been much saving in operating expenses over horses. The gross receipts of the electric line were increased 1 centime per car kilometer in 1896 over 1895, but the net earnings are sufficient for the return of only about 1 per cent on the capital invested. The horse railway lines cost, not including depreciation, from 38 to 40 centimes per car kilometer ($.128 per car mile) to operate and the electric system has so far cost 32.4 centimes per car kilometer ($.104). The gross receipts of the horse railway lines in 1896 were 659,540 fr. ($131,908) and of the electric lines 185,269 fr. ($37,054). Much better results are anticipated when the complete system is equipped for electric operation.

manufacturing center. The city proper has a population of 164,000 and the city and suburbs have nearly 200,000 inhabitants. It is said that its street railway mileage is larger for the population served than that of any other city of Europe. Previous to 1891 the service was not up to the requirements of the city, and this fact made it possible for a system of omnibus lines to become established and strongly entrenched in public favor, with the consequence that in spite of a large gross movement of population the street railway receipts were comparatively small, the percentage of operating expenses large and a return on the investment of 2 per cent only was earned.

The substitution of electricity over nearly all the system (the remainder being now in process of conversion) practically killed the competition of the omnibus lines, the latter were purchased by the street railway company and are now run in conjunction with the cars of the street railway system so as to serve suburbs which the cars do not yet reach, as well as to furnish transportation facilities in certain manufacturing districts where the omnibus service is, by some, preferred to the cars.

The entire system of street railways in Hanover is controlled by the Strassenbahn Hanover Actien Gesellschaft, and comprises 99.5 kilometers (61.7 miles) of track laid on 78.7 kilometers (48.8 miles) of street. On these lines are operated twenty-nine motor cars, equipped for

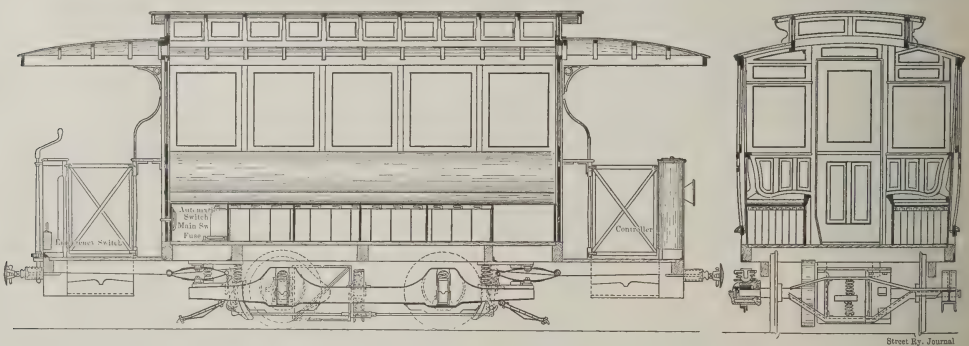


FIG. 14.—STANDARD CAR—HANOVER.

The company has established a depreciation fund on a basis established by statute, to which the following amounts are passed annually:

For the road construction 8 fr. for each 1000 car kilometers run, equivalent to $2.56 per 1000 car miles.

For each crossing 50 fr. ($10).

For the overhead structure 1.50 fr. for each 1000 car kilometers run, equivalent to $.48 for each 1000 car miles.

For the power station installation 2 per cent per annum of the original cost.

For the cars and equipment 3 per cent per annum of the original cost.

HANOVER, GERMANY.

This ancient member of the famous Hanseatic League has become in modern times an important railway and

the overhead system only; sixty-three motor cars equipped with storage batteries for use on the "mixed system," the overhead wire being employed in the suburbs and the accumulators within the city limits; 108 trail cars; 19 summer cars; and various auxiliary vehicles for watering the streets, removing snow and ice, etc. Thirty-nine omnibuses are also in use.

Roadbed.—The company's standard rail is shown in Fig. 10. The company also uses the Phœnix rail profile 14 A. The company is trying to cure the joint difficulty by the use of the Schmidt joint illustrated in Fig. 7, the length of the new joint being .55 meter (21.7 ins.) in length. The tracks have been thoroughly reconstructed during the past five years with these two sections of rail, and a roadbed is now laid down from which the company expects a life of from fifteen to thirty years. A service of

about 4,500,000 car kilometers (2,800,000 car miles) is given annually over this track and on one or two sections a car runs every two minutes on an average throughout a fifteen hour day. The weakest spot in the road construction is, and will be found, in the company's opinion, in the switches and special work.

Overhead Electric Construction.—In the best streets of the city iron poles are used, while on the suburban lines wooden poles are allowed. The trolley wire is 6 mm in diameter, corresponding to No. 3 B. & S. gage, and the overhead appliances are of the Siemens-Halske manufacture. There has been a great deal of opposition on the part of the people and the municipal authorities to the operation of the line inside the city limits by the overhead conductor, and for this reason the "mixed system" was made necessary. The accumulators for the operation of cars on the two lines are of the "large surface" type, so-called, made in Hagen and are charged in service from the trolley wire as well as at the station.

Power Stations.—The company is now operating one power station with a normal capacity of 530 k. w., has nearly completed another of 300 k. w. capacity and is building four others of a total capacity of 1325 k. w., all for operating different portions of the system. The engines in these stations are all but two of the horizontal compound type, the two exceptions being vertical engines, and are, as may be inferred, of small individual sizes. Three of the generators in use were made by Koerting Brothers and the remainder by the Siemens & Halske Company. The generators are direct coupled to the engines in all cases, but as it is intended to give a lighting and power service to small places located on the lines in course of construction, the flywheels of the engines will be used for operating 3000 volt generators by belts.

The cost of motive power in the station already in operation has been 5.50 pfennigs ($.0131) per kilowatt hour. Larger power units are advised by the company, than what are now in use.

Cars.—After many trials the type of cars represented in Fig. 14 has been adopted and gives thorough satisfaction to the company and to the public. One and sometimes two trail cars are used in summer and it is believed that all the traffic possible to be secured is obtained. The electrical equipment is made by the Siemens-Halske Company and the motors are its type B 30.

STREET SCENE IN COVENTRY.

The cars running inside the city are equipped with one motor and the suburban cars with two motors. The speed is regulated by municipal ordinance to 12 kilometers (7.4 miles) per hour in the business section of the city, 15 kilometers (9.3 miles) per hour in the less crowded parts of the city and from 20 to 25 kilometers per hour in the suburbs.

STREET SCENE IN COVENTRY.

Financial Results.—The gross receipts of the tramway system in 1891 were 755,730 marks ($181,375). In 1896 the gross receipts, with a large portion of the system operated by electricity, were 1,654,129 marks ($396,991). During this period the capital stock of the company increased from 3,000,000 marks ($720,000) to 6,000,000 marks ($1,440,000) and preferred stock and mortgage bonds were issued to the extent of 3,000,000 marks in addition.

The operating expenses have decreased to such an extent that instead of net earnings in 1891, equivalent to 2 per cent on the then capitalization, a return of 6 per cent in 1896 on the present capitalization has been made possible. Extensive additions to the plant are contemplated for the immediate future.

The company intends to build about 100 kilometers (62 miles) of track within the near future, of which 60 kilometers will be built in 1897. All of these extensions will be operated by the overhead system, but the cars will also be equipped with accumulators, as the company believes that such an equipment adds much to the safety of the traffic. Freight traffic will also be permitted by the authorities on the system and freight cars are now building. One hundred and ten accumulator cars are in process of construction, to be ready by August next.

COVENTRY, ENGLAND.

According to tradition the Lady Godiva secured from her husband, Earl Leofric, municipal rights for the town of Coventry in 1044, by a somewhat famous ride through the town. It is now a busy manufacturing city of 53,000 inhabitants and has a successful electric railway system owned and operated by the Coventry Electric Tramways, Limited. This was originally a steam road which gave a spasmodic and irregular service and was purchased by the present company from a receiver in charge of the property. The present electrical equipment has been in operation for but fourteen months. The line is single track with 3 ft. 6 in. gage, and cars run every twelve minutes in each direction for eighteen hours a day.

Roadbed.—The roadbed is substantially the same as that formerly used with the steam motors, and common to English tramways. A bed of concrete 6 ins. thick and 36 ins. wider than the track gage is first laid down, and upon this bed the rails are laid and held in place by tie rods and the paving blocks. The latter are 5 ins. × 3 ins. × 5 ins. and rest on a bed of sand 1 in. thick over the concrete, the grouting being of fine cement concrete and granite chips. The rail weighs 84 lbs. per yard, is 6 ins. in height and has a 7 in. base. A light base plate is laid under each joint, but is not bolted to the rail in any way. The joint is of the ordinary four bolt fishplate type. It is almost impossible to make a good joint with this section of rail as the fishing angles are extremely poor. The section is also defective in having a very shallow groove. The result is that there is more or less play at the joints and this leads to powdering of the concrete underneath. During the wet weather, which is frequent in Warwick, this concrete powder washes out from under the joint and leaves the latter a greater and greater chance to work loose and give trouble. To overcome this objection the company is putting in a cast iron joint box consisting of a heavy angle plate secured to the rail base by lugs on one side and bolts on the other. The vertical web supports the cover, and in theory this box makes it possible to tighten up the bolts without disturbing the pavement. (See Fig. 12.)

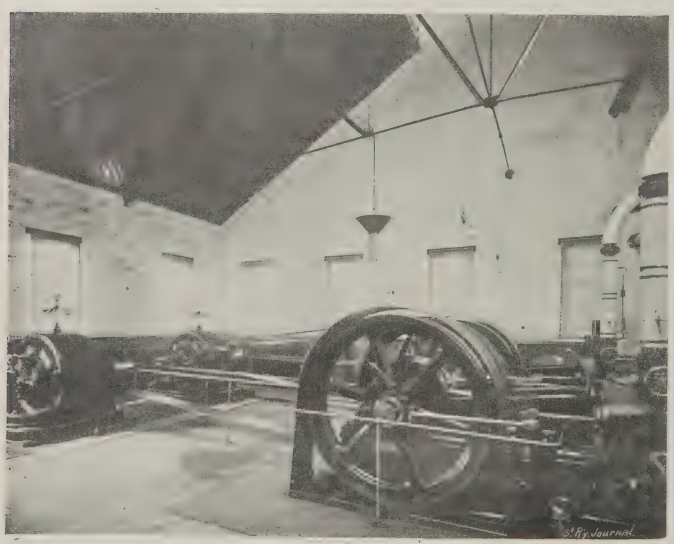
Joint boxes similar to these in general construction were made some years ago in America, but proved quite unsatisfactory, partly because of the chance offered for water and mud to accumulate.

The track has been built about twelve years. If the company were relaying it would use a section having a deeper and a wider groove, and a head such that the weight of the car could be brought more nearly over the web, together with better fishing angles and eight or twelve bolt joints of a more substantial form.

Overhead Construction.—Tubular steel poles made by the Morris-Tasker Company are used, and the general character of the line construction may be seen in the accompanying illustrations. Rosettes attached to the buildings are frequently used for the span wires in order to dispense with poles. The road is single track throughout, but in the outlying portions there are two trolley wires instead of one in order to avoid overhead frogs and to make special attention to the trolley by the conductor unnecessary. No. 0 trolley wires made in America are used.

TRAIN OF CARS IN BRUSSELS.

The feeders are partly overhead and partly underground. There are two miles of overhead feeders of Washburn & Moen braided weatherproof insulation. These are carried on Aetna insulators. There are also about 1000 yds. of underground feeders, of which the insulation is braiding saturated with bitumen, in lead sheathing covered and armored with two wrappings of steel tape, which is again protected by braided covering. The whole cable is laid directly in the ground without conduit of any description. The entire line is divided into one-half mile sections, in compliance with government regulations, and each switch is so arranged that the sections can be cut out at will. The conductors on the cars are each supplied with keys to the switch boxes.



POWER STATION IN COVENTRY.

There was originally a great deal of opposition to the overhead wire system in Coventry, but this has almost entirely disappeared and there is now no objection to the extension of the system which is in progress. The public and the municipal authorities prefer, however, a bracket construction, even with very long brackets to span wires.

Power Station.—The power station is situated in the geographical center, but not in the load center of the line. It is equipped with two 100 k. w. Westinghouse generators and switchboard apparatus; with Babcock & Wilcox boilers; and with horizontal, high speed, single cylinder, non-condensing engines belted to the generators. The cost of motive power has been about 1½d or $.03 per car mile, and the cost per car mile is nearly equal to that per kilowatt hour under the conditions found on this road.

In the new power station which the company intends

to erect, direct coupled generators and compound condensing engines will be used together with economizers, instead of the exhaust feedwater heaters now employed.

Cars.—The type of cars used in Coventry may be seen in the illustrations. There are two sizes, one a 14 ft. body seating twenty passengers inside and twenty on top, and the other a 19 ft. body seating twenty-six passengers inside and twenty-six on top. Westinghouse No. 12 motors mounted on Peckham trucks are used. The schedule speed is 6 miles per hour, the maximum speed being limited by the Government to 8 miles per hour. In the new car equipment, cross seats will be used on the roof instead of the longitudinal ones shown in the illustrations. The company would prefer to have wider cars, but cannot secure necessary permits. The present width is 5 ft. 6 ins. over all.

Financial Results.—The electric cars are exceedingly popular and are loaded to their full capacity. "The results of electric operation have been highly satisfactory to the shareholders, the citizens of the town at large and the corporation officers." The gross receipts for the first year's operation have been nearly three times what they were when the line was operated by steam. The operating expenses are about 6½d ($.13) per mile, including general expenses and directors' fees, but excluding interest and depreciation. It is impossible to determine what the expenses were under steam. A dividend of 8 per cent was paid by the company last year, and material increases in both gross and net earnings are confidently expected for the future. The gross receipts last year were £8700 ($43,500,) which was obtained by the operation of seven cars on the 6 miles of lines with eight motor and two trail cars used on holidays.

The company has as yet established no basis for a depreciation or renewal fund, but a substantial sum was carried to the reserve last year.

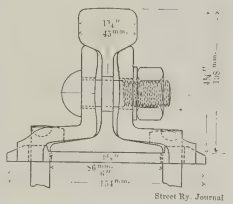


FIG. 15.—SUBURBAN RAIL SECTION—BRUSSELS.

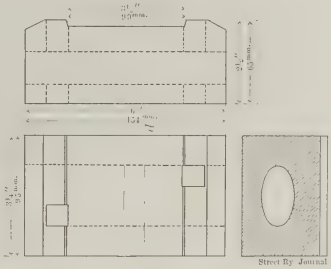


FIG. 16.—CAST IRON RAIL SUPPORT—BRUSSELS.

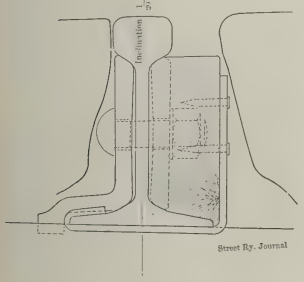


FIG 17.

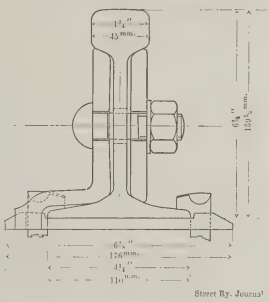


FIG. 18.

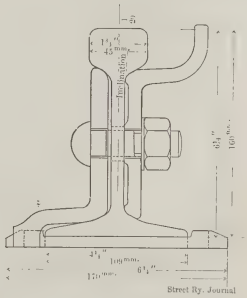


FIG. 19.

RAIL SECTIONS FOR PAVED STREETS—BRUSSELS.

BRUSSELS, BELGIUM.

The Société Anonyme des Chemins de Fer Vicinaux Belge owns and operates under liberal concessions from the government about 750 miles (1200 kilometers) of narrow gauge interurban and suburban railways in Belgium. The motive power on most of these lines is steam, on a few animal and on one—that between Brussels and la Petite-Espinette, a distance of six miles (9.72 kilometers)—electric. This electric line was formerly operated by steam locomotives drawing several passenger cars, but in October, 1894, the first section, about 3.72 miles (6 kilometers) in length, was put in operation by electricity, and the results have been so completely satisfactory to the company that contracts were placed in 1896 for the conversion of other important lines of its general system from steam to electricity. The contract price for the installation of certain of these lines in Central Belgium was 1,075,000 francs ($215,000) and it was one of the conditions of the contract that the contractors should build and equip the power station and furnish electric energy for a period of three years at a cost of .195 francs per train kilometer ($.062 per train mile); this price to include not only the furnishing of electric power, but also the repairs and renewals of the power station apparatus, overhead electric construction and the motor cars. It was stipulated in the contract that two-sevenths of the money paid to the contractors during the three year term should be passed to a renewal fund for the benefit of the street railway company. The "train" in each case is to consist of one motor car and one trail car.

The contract for the equipment of the line at Charleroi was similar in form to that outlined above. In this case the total length of line to be equipped was 14.25 miles (22.95 kilometers) and the cost of the installation was 1,163,790 francs ($233,000). The contractors also agreed to operate the line for three years and to furnish power, maintain power station apparatus, overhead construction and motor cars for the sum of .0149 francs per train kilometer ($.0338 per train mile), the railway company agreeing to operate not less than 575,000 train kilometers during the year.

The character of installation on these two new lines is to be in practically all respects the same as that on the line from Bordeaux to la Petite-Espinette, presently to be described, except that lattice work poles are to be used on the line in Central Belgium instead of tubular poles, while on the lines at Charleroi the Dickinson trolley is to be used.

The following description of the installation from Brussels to la Petite-Espinette will be of interest.

Roadbed.—The roadbed on the urban section of the line is constructed as shown in Fig. 18. The rails weigh 30 kg. per meter (60 lbs. per yard) and are rolled in lengths of 9 meters (29.5 ft.) On a portion of this section a flange is bolted to the rail to form the groove, as shown in Fig. 19. Elsewhere, however, the pavement is kept in place by a wooden plank, as shown in Fig. 17, which is bolted to the rail and held in place by a malleable iron strap. The greater part of the suburban

track runs on the side of the road. The rail (Fig. 15) weighs 2.15 kgms. per meter (43 lbs. per yard) and rests directly on wooden ties except that in certain paved roadbed the rails are placed on cast iron blocks (Fig. 16) and which rest on the ties. The above methods of construction are the standard usage of the company in all its steam lines and have proven entirely satisfactory in practice. They were originally designed to permit the use of locomotives weighing about 60,000 lbs. (27,000 kg.), running on three axles, and the company believes that the strength is more than sufficient for electric motor cars which weigh but 20,000 lbs.

FIG. 20.—MOTOR TRUCK—BRUSSELS.

(9000 kgms.) As bearing on this point it is stated that the first section of the line on which the traffic is the heaviest has been in operation since February, 1892, first by locomotives and since October, 1894, by electricity. One hundred and sixty-six trains on ordinary days, and double that number on Sundays and holidays, pass over this section of the line, and for the year ending Sept. 30, 1896, the total traffic amounted to 215,000 train miles (347,680 train kilometers.) No difficulty has so far been experienced. The company estimates that the wooden ties should last for fifteen years at least, the 43 lb. rails for thirty years and the 60 lb. rails for forty years, while the joints should have as long a life as the rails, and the bolts, is divided into sections of 500 meters (1640 ft.) in length, and the feeders are so connected at switch boxes placed on the poles carrying the trolley wire breakers that in case of accident to the trolley wire in any section, that section can be cut out without interfering with the rest of the line, while in the case of the breaking of the feeder the trolley wire section affected remains in connection with the rest of the system though at reduced voltage. The method of connection is illustrated in Fig. 21. The company is satisfied with its overhead and underground feeder system and no changes are contemplated.

Power Station.—The power station equipment is of 450 k. w. capacity. Babcock & Wilcox boilers, McIntosh & Seymour horizontal compound condensing engines, and generators of the Thomson-Houston type are used. Of the latter there are three 100 k. w. four pole machines belted to their engines and one six pole 150 k. w. generator direct connected to its engine. The cost of motive power has been about 15 centimes per train kilometer, equivalent to $.0468 per train mile, and the cost per kilowatt hour has been about 7.5 centimes per train kilometer, equivalent to $.0234 per train mile. The contractors for the installation guarantee that the cost shall be no more than the figure first named and this figure is to include by contract a reserve or renewal fund equivalent to two-sevenths of all the sums paid to the contractors.

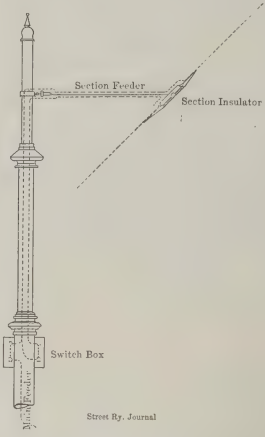


FIG. 21.—FEED AND TROLLEY WIRE CONNECTIONS—BRUSSELS.

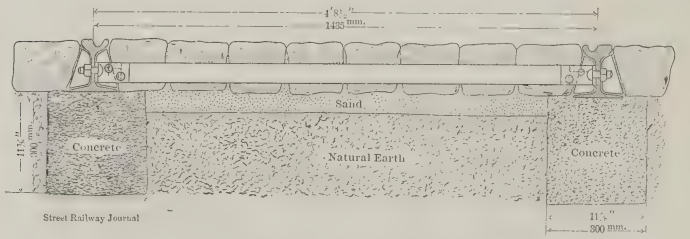


FIG. 22.—ROAD CONSTRUCTION—LIÉGE.

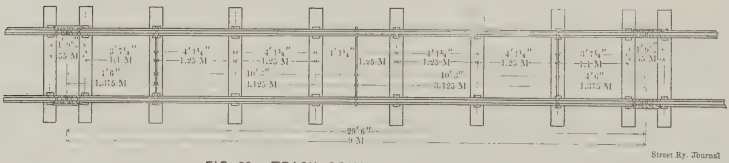


FIG. 23.—TRACK CONSTRUCTION—BRUSSELS.

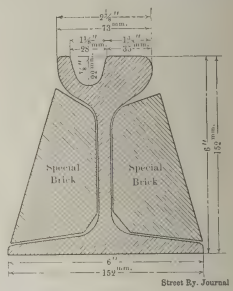


FIG. 24.—RAIL SECTION—LIÉGE

tie plates, etc., as the ties. No changes are contemplated in this standard form for future installations, as it is considered satisfactory in all respects.

Overhead Electric Construction.—No opposition to overhead wires has been manifested by the public, and there is no doubt of the popularity of the system. The company will, however, replace poles, so far as possible, by rosettes fastened to the sides of the buildings along the way. The trolley wire is of copper, No. 0 B. & S. gage, measuring 8.2 mm. The span wires are of steel, from 5 to 6 mm. in diameter. The overhead appliances are of the Thomson-Houston pattern. The feeders are carried in a brick lined trench 31½ ins. deep, and are insulated with jute, armored with lead and steel wire. The trolley line

The only change which the company would make if the work were to be done over again would be to adopt somewhat larger units in the power station.

Car Equipment.—The company possesses twenty-four motor cars which carry second class passengers, sixteen closed trail cars, divided into first and second class compartments, and four open trail cars also so divided. On ordinary days the company runs eight trains. On Sundays and holidays this number is usually increased to sixteen. The type of car used on this line is shown in the accompanying engraving (page 198). Motor cars are not run separately, but a trail car is always attached. The two cars together have seats for forty-four persons and standing room for about forty in addition. The motor cars are

equipped with motors of the G. E. 800 type. They are guaranteed to reach speeds on grades as follows:

Grades.	Miles per hour.	Kilometers per hour.
7 per cent.	5.0	8
6 "	6.2	10
5 "	7.4	12
4 "	8.6	14
3 "	10.5	17
2 "	12.4	20

By municipal ordinances speeds are not to exceed 10 kilometers (6.2 miles) per hour within the city limits and 30 kilometers (18.6 miles) per hour in the suburbs.

The cars are rather too heavy, and the company in its future work will reduce this weight, particularly the weight of the trail cars. The type of car is considered to be well suited to the requirements, as is proven by the rapid increase in receipts. The electric cars have been found able to take grades with far greater ease than the steam locomotives formerly used, and the company is perfectly satisfied with this feature of the change of motive power.

Financial Results.—The conversion to electric traction has been coincident with extension of the lines, and it is difficult to know exactly to what extent the large increase of receipts which has been brought about in the last two years is due to electricity. The gross receipts of this line for the last three years have been as follows:

1894.	195,280 francs.	$39,056
1895.	256,074 "	51,215
1896.	302,000 "	60,400

During 1894 the road was operated a little over nine months by steam and slightly less than three months by electricity.

The "expenses for traction" have been reduced about 30 per cent and the increase of net earnings has enabled the company to make "very satisfactory" returns upon the additional capital required for electric equipment. It is expected that both gross and net earnings will increase in future, particularly as it is intended to give a heavy service on a greater length of road than is the case at present.

LIÉGE, BELGIUM.

The city of Liége is the center of an important coal and iron mining region and has large manufacturing interests, particularly in the line of firearms, engines and electrical apparatus. Its population is about 160,000. It has several tramway systems, on all of which electricity is being rapidly introduced. One of these systems is owned by the Société Anonyme des Tramways Liégeoise and has been operated by electricity for about four months only, and it is impossible as yet to give definite results in the way of gross and net earnings, but the results have not so far shown a material increase.

Roadbed.—This company owns 12 kilometers (7.44 miles) of track, of which the greater part is single track, with turnouts placed 500 meters (1640 ft.) apart. The rail used is shown in Fig. 24, and is of the Phœnix type, weighing 38 kg. per meter (77 lbs. per yard). In paved streets concrete stringers 300 mm. × 300 mm. (12 ins. × 12 ins.) support the rail, and the track is kept to gage by tie rods and paving blocks. Special bricks are used to fill the spaces between rail and paving blocks. Part of the line runs on a large boulevard, and there the rails are laid at the side of the street on metal ties spaced 1 meter (39.4 ins.) apart, but whenever paved streets are crossed switches are laid as above to prevent uneven settling of the pavement. No defects have, of course, been developed in this construction during the short period of operation. The cars ride very smoothly, especially on the section laid on ties where the elasticity of the track is greater than on the paved streets. On the line having the greatest density of traffic about 120,000 motor cars pass over the track per annum.

Overhead Electric Construction.—The Union Elektricitäts Gesellschaft, employing General Electric appliances, has built the overhead structure. There has not been any marked opposition on the part of the public to the introduction of the overhead wires. On the greater part of the road rosettes are used instead of poles, the latter being found only on the boulevard and in front of the buildings

MARKET DAY IN SOUTH STAFFORDSHIRE, ENGLAND.

whose height is insufficient to permit of their use, or where the necessary consents cannot be obtained. No trouble is anticipated in extending the system.

The trolley wire is No. 0 B. & S. gage and is in duplicate throughout the entire length of the line so as to avoid the use of frogs and switches. The feeder wires are four in number and are connected with the trolley wire at four points on the line. The return circuit is made through the rails, with connections at four points to return feeders which are placed underground and covered with sandstone and a layer of brick. The trolley wire is divided into sections of 500 meters (1640 ft.) in length.

Power.—Electric power is not produced by the tramway company, but is furnished by the Société Liégoise d'Electricité, a local lighting company, at a cost of 15 centimes ($.03) per kilowatt hour. This company has installed three 150 k. w. generators made in Liége, direct coupled to Willans non-condensing engines of 240 h. p. each, running at 350 r. p. m., at a boiler pressure of 147 lbs. Babcock & Wilcox boilers are used. In practice two of these three units are necessary, the third being held as reserve.

Cars and Equipment.—The cars used by the company have a total capacity of thirty-two passengers with twenty seats. They are equipped with one 20 h. p., G. E. 800 motor each. The company owns forty motor cars of which thirty are in regular service. No trail cars have been used up to the present time, but it is the intention to purchase some soon, as on special days and in certain hours of the day the present car equipment is not sufficient for the traffic.

General Financial Results.—As before stated, it is yet too early to know exactly what can be accomplished by the adoption of electricity. The Union Electricitäts Gesellschaft, which has built and equipped the system, is under contract to operate it for two years at a cost of 15 centimes per car kilometer (equivalent to $.048 per car mile) this amount including the cost of current, the repairs of trucks, motors and electric equipment of cars, the overhead structure, and a tax paid to the municipality of 5 centimes ($.01) per kilowatt installed.

CAR AND POWER STATION—SOUTH STAFFORDSHIRE.

STREET SCENE IN SOUTH STAFFORDSHIRE.

BIRMINGHAM, ENGLAND.

The city of Birmingham is the center of the famous "Black Country" of England, its principal iron manufacturing district, and is almost as rich in suburbs as is Boston, Mass. A number of street railway companies operate independent systems in Birmingham and vicinity and almost every kind of motive power, including steam, cable, overhead electric and storage battery systems have been put into practical use in this district. An American syndicate now has large interests in the tramway system of Birmingham proper.

One of the Birmingham District street railway systems is that of the South Staffordshire Tramways Company, which operates about 29 miles of track (23 miles of road) between a number of the suburbs of Birmingham, and connects them with one of the street railway systems of the city proper. About 8 miles of this route, namely, from Bloxwich through Walsall to Darlaston and Wednesbury, are operated by the overhead electric system and the remainder by steam. (See map page 203.)

Roadbed.—The roadbed is a grooved girder rail, weighing 76 lbs. per yard, laid upon a bed of solid concrete, 6 to 9 ins. thick, extending about 21 ins. outside each rail. This roadbed has been in service for fourteen years with steam, and no change was made on the electric line when electricity was introduced. The roadbed is still good, but the rails will require renewing within a year or two. There has been comparatively light traffic over the system, as but fourteen engines and cars have been run in daily service until recently, although now the steam lines require from thirteen to twenty-four cars, and the electric line from ten to sixteen cars. The concrete is perfectly good, and the paving blocks have from six to ten years' additional life. J. J. Robins, the company's general manager and engineer, states that he is well satisfied with the roadbed, and the only change which he would make would be a slight change in the section of the rail.

Overhead Construction.—The general character of the overhead construction is seen in the accompanying illustrations. The poles are of plain iron types, with brackets of length to suit the width of the streets, and are without ornamentation. They are erected on one side of the road only, as there is a general unwillingness on the part of the public to grant the right to put up span wires, and for this reason the Dickinson trolley is used, having a long side reach to the trolley wires. The trolley wires are No. 000 B. W. G. hard drawn copper, and the feeders

are all of the armored, single conductor, cable type, with bitumen insulation. The electric line is divided into sections of 1 mile in length, which are fed separately. Mr. Robins states that he can suggest no changes from the present overhead structure in future installations, except that where the streets are wide enough, he would prefer to use center poles, with double trolley wire, doing away with all overhead switches as far as possible.

Power Station.—The power station equipment consists

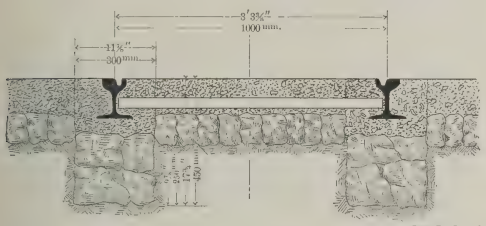


FIG. 25.—ROADBED CONSTRUCTION.—BASEL.

of three Elwell-Parker dynamos, of 87.5 k. w. each, running at 450 revolutions, driven by ropes from three horizontal, compound, condensing engines, of 125 h. p. each, which run at 100 r. p. m. Lancashire boilers are used.

Car Equipment.—The type of car used is shown in the accompanying illustration. Its equipment is with Elwell-Parker motors, and the speed limit imposed by the Board of Trade Rules is 8 miles per hour.

BASEL, SWITZERLAND.

Basel is a city of about 75,000 inhabitants and is the chief commercial and banking city of Switzerland, with important manufacturing interests as well. Until recently the city had an omnibus service only, but there has since been built an electric line of 11 kilometers (6.8 miles) in length on which twenty-eight cars are in daily operation. This line is the property of the city and is operated by the cantonal authorities. It is not intended to be worked for revenue, but it is expected that a fair interest be paid upon the invested capital and the profits over and above this interest will be devoted to the construction of less profitable lines in the outlying portions of the city. The receipts of the electric tramway are more than double those of the old omnibus line. The city has established a renewal fund for maintenance of road and equipment, and a sinking fund for cancelation of the indebtedness, towards each of which it passes annually out of earnings 2½ per cent of the total invested capital.

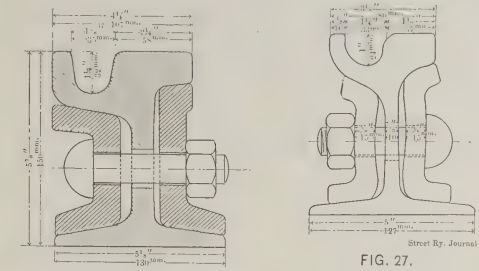


FIG. 27.

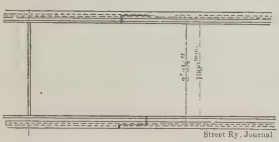
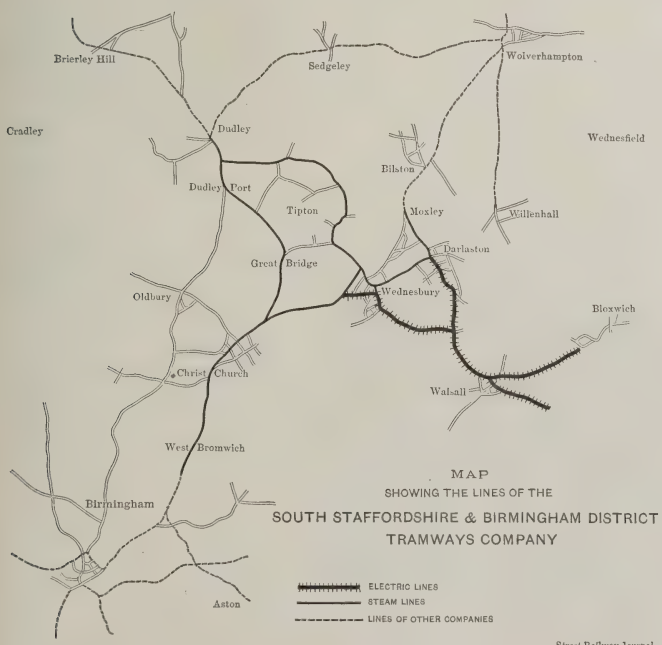


FIG. 26.—RAIL SECTIONS—BASEL.

Roadbed.—On the first line built in Basel the rail shown in Fig. 27 was used, but this has proven too weak for electric traction, especially at the joint, and for the more recent lines two types have been used, the relative merits of which have not yet been determined. One of these (Fig. 10, page 195) is a combination rail of the Haarmann system. The second type is illustrated in Fig. 26, and is evidently much stronger than that of Fig. 27, of which it is a modification. Both Fig. 26 and Fig. 27 are built by the Phœnix Company. The way in which the track is laid is shown in Fig. 25.

The rail shown in Fig. 27, has been in use about two years and on this line about 300 motor cars run per day. Neither of the new types has yet been put into service, but the lines will be opened this spring. The company believes that the old rail should last from eight to ten years and the new rail should have not less than double this life.

Overhead Electric System.—Every effort has been made in Basel to put up an overhead construction as little offensive as possible to the eye. Largely for this reason the Siemens & Halske trolley shown in the accompanying illustration has been selected, as it makes it possible to do away with nearly all the overhead appliances necessary for wheel trolleys and to reduce the number of span wires to a minimum. The company states that there is little or no wear of the conductor. The trolley wire is of hard drawn copper wire 8 mm. in diameter, corresponding to about No. 0 B. & S. gage. The span wires are of steel, 6 mm. in diameter. The feeders are carried underground and are iron bound lead cables having a sec-



tional area in copper of about 186 sq. ins. or 120 sq. mm. The company is entirely satisfied with its overhead system.

Power Station.—The total power station capacity is 320 k. w. which is divided into two belt driven six pole units of 70 k. w. each and one direct connected twelve pole unit of 180 k. w. There are four Cornwall boilers and two engines of 80 h. p. capacity each, and one engine of 300 h. p. capacity. All three engines are of the tandem compound type. The smaller engines run at 80 r. p. m. and have flywheels about 5 meters (16.5 ft.) in diameter.

The total cost of motive power is about 10 centimes ($.02) per kilowatt hour.

Cars and Equipment.—The type of car used in Basel is shown in the accompanying engraving. These cars seat sixteen passengers and there is standing room for eleven on the platforms. They are run at a maximum speed of 20 kilometers (12.4 miles) per hour, which is the legal limit. Both the company and the public appear to be entirely satisfied with them.

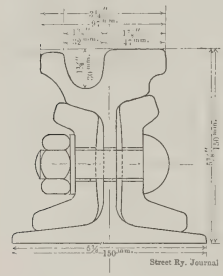


FIG. 28.

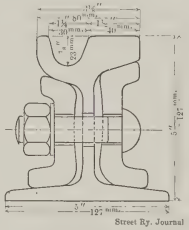


FIG. 29.

FIG. 30.—ROADBED AND RAIL SECTIONS—HAGEN.

The electrical equipment consists of a 20 h. p. two pole Siemens & Halske motor with rheostat regulation.

THE OLD BRIDGE ACROSS THE RHINE AT BASEL.

Each car is also equipped with a mechanical lever brake and an electrical brake short circuiting the armature.

The company is entirely satisfied with the methods of construction and equipment which have been adopted and would make no changes were the work to be done over again, except that the type of rail shown in Fig. 26 would be adopted from present knowledge instead of lighter sections.

HAGEN, GERMANY.

This is a town of 35,000 inhabitants in the province of Westphalia, Prussia. Its manufacturing interests are in the line of iron and textile fabrics. Its street railway system is under the control of the Hagener Strassenbahn and consists of about 8 kilometers (5 miles) of track, of which 3.2 kilometers is operated by horses with thirteen cars and the remainder by the electric accumulator system with 8 cars. The horse lines are in process of transformation into electric lines and extensions are planned. All lines outside the city limits will be operated by the overhead wires supported by wooden poles, and on passing into the city the trolley will be pulled down and the accumulators carry the car through the business streets, this being a method frequently found in Europe, and known as the "mixed system."

TYPE OF CARS USED IN BASEL.

Roadbed.—The horse railway roadbed is shown in section in Fig. 30, and is, of course, unsatisfactory for electric traction. Another section, which has been used with reasonably good results, is shown in Fig. 29. but the section used at present for all reconstruction work is that shown in Fig. 28, from which the best results are expected. The foundation for this type of rail is concrete. None of these sections have to bear a heavy traffic and it is expected that the life will be long.

Cars and Equipment.—The company owns eight closed accumulator cars seating twelve, four teen and sixteen people, with standing room for twelve. Two hundred and twenty volt motors are used of 12 and 15 h. p. capacity, the former having spiral gearing and the latter cog wheels. The speed of the cars is limited by local ordinance to 15 kilometers (9 miles) per hour. The new cars now in course of construction will be equipped with two

15 h. p., 500 volt motors and the equipment arranged, as aforesaid, for operation by the "mixed system."

Power Station.—The company owns no power station at present, but one will be built this year.

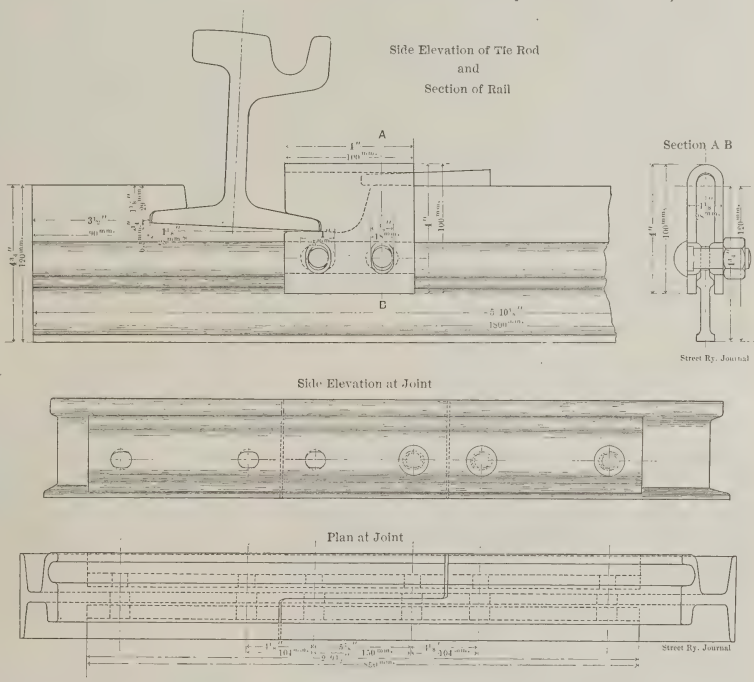
Financial Results.—The partial equipment of the Hagen system by electricity has brought an increase of about 30 per cent in the gross receipts, this increase being due, in the company's opinion, solely to the greater speed of the cars. The operating expenses have decreased about 18 per cent and the resulting increase in net income has made it possible to raise the rate of dividends paid from 5 per cent to 6½ per cent. The gross receipts in 1895 were 86,000 marks ($20,640) and for 1896 118,000 marks ($28,320). The company expects a further increase in profits after the transformation of the system has been completed.

HAMBURG, GERMANY.

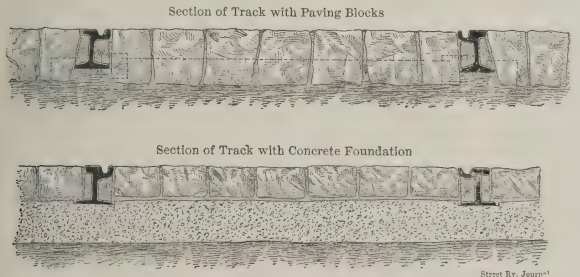
This famous "free city" of Germany, which forms by itself one of the independent states of the German Empire, is one of the chief commercial centers of Europe, and has a population of about 750,000, including its immediate suburbs and the city of Altona, which is practically a part of the city. It is entirely self governing in all municipal affairs.

Its street railway system is owned and operated by one large company and two small ones, all operated almost wholly by electricity, Hamburg occupying in Europe the position of Boston in America in that it was the first important city in Europe to adopt electrical equipment on a large scale. The principal system is controlled by the Strassen-Eisenbahn-Gesellschaft in Hamburg, whose concession expires in 1925, in which year the system will revert to the municipality at a fixed price. Meanwhile the company is taxed at the rate of about $.002 per passenger, which amounted to about $60,000 in 1895. The company operates in daily service 350 motor cars and 300 trail cars on 164 kilometers (101 miles) of track, of which 67 kilometers (42 miles) is second track. The company's capital stock amounts to about $3,750,000 and its funded debt to $2,250,000, the total capitalization being equivalent to about $60,000 per mile of track.

Roadbed Construction.—The general character of the company's standard roadbed construction for electric service is illustrated in Figs. 31 to 37. The rails weigh 52.6 kg. per meter, or 106 lbs. per yard, and are well supported by 33 in. joints. This rail has been in use since 1894 and about 800,000 cars per annum run over that portion of the mileage carrying heaviest service. So far there has been no trouble at the joints or elsewhere, and while the company does not feel that it yet has sufficient data to form a basis for good judgment it hopes for a life of twenty-five years from the rail. No changes in this method of construction are in contemplation.



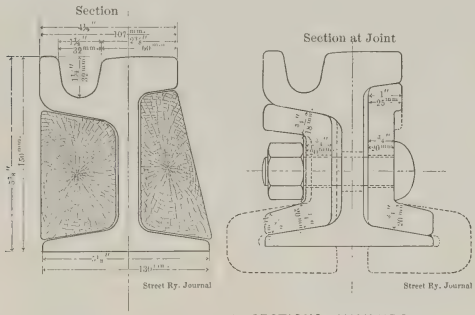
FIGS. 31 AND 32.—ROADBED CONSTRUCTION—HAMBURG.



FIGS. 33 AND 34—ROADBED CONSTRUCTION—HAMBURG.

Overhead Electric Construction.—The streets of Hamburg, are in general, very narrow, and without special care the overhead construction might become a serious eyesore. The greatest pains have therefore been taken with this department of the installation and the result has been entirely satisfactory to the company and to the people. Rosettes fastened to the buildings are used to support the span wires wherever possible, and much ingenuity has been developed in devising supports of sufficient strength and of the utmost possible simplicity, particularly at the public square. In Fig. 38 is shown the construction used on the Gansemarkt. There are also a large number of plain side poles, and where center poles are used great attention has been paid to ornamentation. These poles are made of welded steel tubing. There was little opposition on the part of the public to the original installation of the overhead structure, and there is none whatever to its extension. The trolley wire is of hard drawn copper, 8.2 mm. in diameter, corresponding to No. 0 B. & S., and the span wires are of galvanized steel, 5 mm. in diameter. The anchoring wires are

6 mm. in diameter. The feed wires are armored cables laid in the ground along the side of the street and tap into the trolley wires at nineteen points on the system. The



FIGS. 36 AND 37.—RAIL SECTIONS—HAMBURG.

lines are divided into sections by section insulators every 500 meters (1640 ft.). The overhead material was supplied by the Union Elektricitäts Gesellschaft.

Power Stations.—The street railway company does not furnish its own power, but purchases it from the Hamburgischen Elektricitäts Werken, it being one of the terms of the street railway company's contract with the city that this electric light company shall furnish power for the

STANDARD CAR—HAMBURG.

operation of the electric lines. The rate charged the street railway company is about $.031 per kilowatt hour for the first 2,500,000 k. w. hours used and $.03 per kilowatt hour thereafter. At present the company is using an average of about 3700 amps. at 500 volts throughout the day, and the lighting company uses about 2.87 lbs. of coal per kilowatt hour. In the new station which the lighting company is building there will be six 1200 h. p., triple expansion, condensing engines, each direct coupled to two generators. The speed will be 75 r. p. m. Seven of these generators will deliver current for the railway service at 540 volts, and the remainder for lighting at 250 volts. Jet condensers are used in these power stations and the water is cooled by a tower system.

Car Equipment.—The type of cars used in Hamburg is illustrated in the accompanying engraving on this page. This car seats twenty passengers. The cars are kept in fine condition and are brilliantly lighted with ten electric

FIG. 38.—OVERHEAD CONSTRUCTION—GANSEMARKT, HAMBURG.

lights. The Thomson-Houston trolley is used and the trolley base is protected by a casing. The cars run at from 7 to 8 miles per hour in the city and from 9 to 11 miles per hour in the suburbs. The maximum speed allowed by law is 18 kilometers (11 miles) per hour.

The cars are equipped partly with one and partly with two motors of the G. E. 800 type, furnished by the Union Elektricitäts Gesellschaft.

Financial Results.—The results of electrical equipment have been most favorable from a financial as well as a technical standpoint. The lines operated by electricity carried 7,108,973 passengers more in 1895 than in 1894, this increase being equivalent to 32.23 per cent, while the increase in gross receipts was 880,919 marks ($211,421), equivalent to 34.9 per cent increase. This increase is partly owing to the extension of the system as well as to electrical equipment, for the gross and net receipts per kilometer showed a decrease in 1895 of about 22 per cent. The company's gross receipts amounted in 1895 to about 3,400,000 marks or $800,000. The rate of dividends paid by the company was increased from 3 per cent in 1894 to 5 per cent in 1895.

LYONS, FRANCE.

Lyons, capital of the Department of the Rhône, is the second city in point of population in France, and had in 1891, 416,000 inhabitants. It is located at the junction of the Saône and of the Rhône, which form a tongue of land upon which the greater part of the city is built. It is one of the finest cities in Europe, and has magnificent quays along the river, stately mansions and capacious warehouses. As a manufacturing town it has long maintained the first rank, and its silk manufactures are the most important in the world.

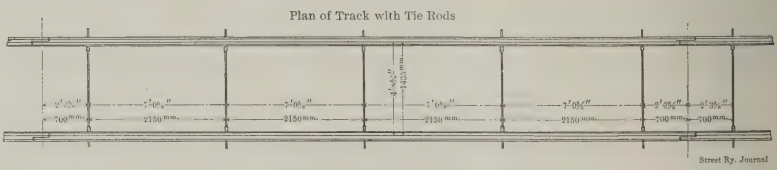


FIG. 35.—ROADBED CONSTRUCTION—HAMBURG.

The principal line in the city is that owned by the Compagnie Générale des Omnibus et Tramways. This company was one of the earliest in France to adopt electric power, having equipped its Oullins line with electricity in 1894. The equipment was furnished by the Compagnie Française pour l'Exploitation des Procédés Thomson-Houston, and a full description of the line was published in the STREET RAILWAY JOURNAL for March, 1895. The results secured

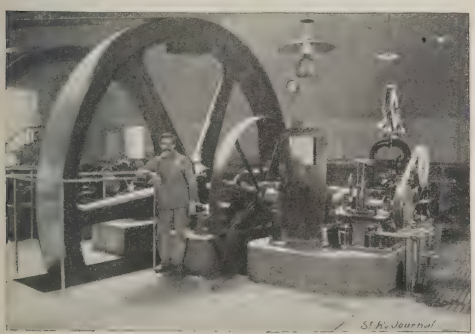
SCENE IN LYONS.

LINE WAGON AND CAR—LYONS.

on this division were so satisfactory that the company has since greatly extended its electrical equipment.

Roadbed.—The system is laid with the Marsillon rail, a section of which is shown in Fig. 41. This rail has proved inadequate under the heavy electric service, and to strengthen it the company has been installing during the past winter a number of the Falk cast welded joints. A view of the traveling cupola used in melting the metal is shown on this page. The results secured with these joints have proved so satisfactory and the cost of this work has been so much less than that of reconstruction that the company has decided to use the same kind of joint over all of its lines, about 53 kilometers (33 miles) in extent.

Overhead Electric Construction.—Both bracket and span wire construction are used. The poles are of steel in four sections and the ordinary ones about 8.3 meters (27½ ft.)



OULLINS STATION.

WELDING CUPOLA—LYONS.

in height and set in concrete. They are extremely tasteful in design and set at intervals of about 40 meters (132 ft.) on straight track and a little closer together at curves. Rosettes fastened to the house walls are used in narrow streets and in some cases brackets are bolted to the wall for the same purpose. Rubber buffers are used to prevent the vibration of the wires communicating themselves to the house walls. At the center of the city a surface contact system of distribution will be installed for a short distance to avoid the use of overhead wires at that point.

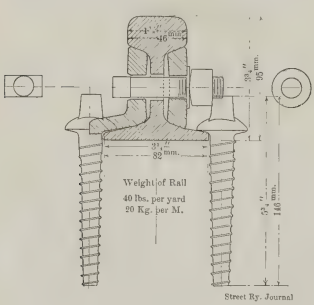
Power Station.—The old power station is located at Oullins Depot on the banks of a small stream, from which water is taken for the boilers and for condensing purposes. The boilers are of the semi-tubular type and of Lyons manufacture. The engines are of the Duverger type and built by Piguet & Compagnie. They have single cylinders, are condensing and have a rated capacity of from 100 to 230 h.p. as the admission of the steam is varied up to one-fourth. The speed is 100 r. p. m. The engines are belted to four pole, 100 k. w. G. E. generators. The new station now building will contain four 400 k. w. G. E. generators direct connected to horizontal engines built by Piguet & Compagnie.

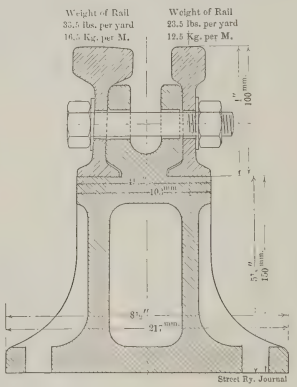
Rolling Stock.—The rolling stock will consist of 150 cars each equipped with two G. E. 800 motors. The standard type of car adopted for new work is similar to that shown on this page. Each car will be furnished with a speed indicator.

Besides the new electric construction on the main system in the city of Lyons, considerable electric railway construction is going on in the neighborhood of Lyons, connecting that city with the many attractive towns in the neighborhood. Of these, the most important work has been carried on by the Société Anonyme du Tramway D'Ecully, which has in operation, under construction or proposed, five different lines arranged in the form of a fan with a common terminal at Lyon-Vaise, which is served from the city by three tramway lines and by a line of omnibus boats on the river Saône. All of these lines serve the extensive mountain region situated to the northwest of Lyons, and present a very interesting study on account of the many curves and sharp grades which they contain. Of this system, one line, 3 kilometers (1.9 miles) in length, has been in operation for

two years, and another of the same length has been completed and will soon be put in operation. Franchises for all the others, it is expected, will be obtained during the course of the present year.

Track.—The type of track adopted varies according to its location in streets or over the company's own right of way. In streets, paved or macadamized, the company has adopted the Marsillon rail with rails weighing 16.5 kg. per m. (35 lbs. per yard) and center rail 12.5 kg. (20 lbs. per yard), resting upon iron chairs bound together by bolts. The latter rest upon a gravel bed. Where the road is on its own right of way a Vignole rail, weighing 20 kg. per meter (40 lbs. per yard) resting upon cross pieces one meter apart as in ordinary railroads. These rails have given good satisfaction. Along straight roads they act perfectly; on curves however it is difficult to maintain the gage of the Vignole rail, and in future the weight of the rails will be increased. The Marsillon rail permits of increasing the width of the groove in the curves, which is advantageous as regards flange wear. Though one line has been in operation since the end of October, 1894, no defects of any importance have developed in the track. Eighty motor cars per day pass over any given section of the line or 29,200 per annum. The Marsillon rail is stronger under a given load than the Broca rail; hence comes greater resistance to the vibration caused by moving cars. The joints will be made with tapering splice bars, meeting under the head of the rail and locked by bolts shown in the accompanying sketches.





FIGS. 39 AND 40.—TYPES OF RAILS—LYONS—ÉCULLY.

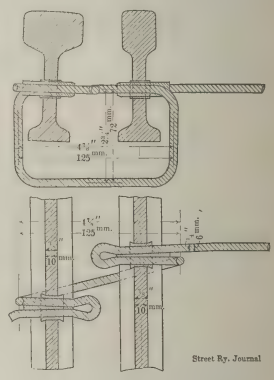


FIG. 41.—METHOD OF BONDING MARSILLON RAIL.

Overhead Electric System.—This is of the usual pattern. The overhead material is that of the Aetna and Medbery types, with which Americans are familiar. The trolley pole is somewhat novel. It is of pitch pine with a sliding contact. The public is becoming accustomed to the sight of the overhead wires and no objections are now being raised to it. The whole street railway system of Lyons is now being changed to the overhead trolley. This proves that overhead wires on the existing suburban lines have not aroused any very serious objection. The trolley wire is 8.25 mm. (.33 in.) in diameter and for one cross wire a cable of galvanized steel wire 6 mm. (.24 in.) in diameter with cotton center.

Power Station.—As the power station is equidistant from either end of the line no feeders, either overhead or underground, have as yet been required. The generators in use are two in number and of 90 k. w. each. So far this equipment has been sufficient for the maximum demands of the line, but it will be doubled at the opening of the new lines.

The boilers are semi-tubular with double heads. The engines, with cylinder dimensions 400 and 800 mm. (15¾ ins. and 33 ins.) are condensing with variable cut off. They were built in Lyons. The generators are of the Thury type, with six poles and drum armature and are overcompounded. The engines, which run at 90 r. p. m., are direct belted to the generators.

The cost of the electric motor force including water, fuel, labor, maintenance and operating expenses last year was 30 centimes per kilometer (9.7 cents per car mile).

If the power house were to be reconstructed the managers of the company state that they would connect their generators and engines by countershafting instead of by direct belting. This seems to be progression backwards, but the advantage of less dependence for the continuous operation of the station upon the freedom from accident of each machine, outweighs, in the opinion of the managers, the advantages of direct belting.

Cars.—The cars are closed with longitudinal seats and large platforms. The interior is divided into two compartments, one for first class and the other for second class passengers. The gage is 1 meter. The motors are of the Thury type, each one of 25 h. p. By municipal order the cars are not allowed to run faster than 10 kilometers (6.2 miles) an hour within the city limits, and by ministerial act not faster than 20 kilometers (12.4 miles) outside the town.

So far as the general operation of the tramway is concerned it is giving good satisfaction to the managers of the company, and the service seems to be popular also with the public. If, however, the company were to re-equip its lines, it would probably adopt (1) the Siemens rod trolley instead of the trolley pole, (2) radial instead of fixed axles, (3) seats for one class of passengers only, doing away with second class seats, and (4) grease lubrication instead of oil in the motor bearings, as the oil penetrates into the motor windings and dissolves the insulation.

Financial Results.—This trolley line took the place of an omnibus service which did not cover its expenses running once an hour at 50 centimes (10 cents) fare. The present gross receipts are 50,000 francs per annum, with an average fare of 13 centimes. As the investment outlay is not yet completed on account of the early opening of new lines, no dividends have yet been declared. The usual daily service is performed by two cars, but on Sundays six cars are sometimes run.

The net earnings are distributed as follows:

1. Five per cent goes to a statutory reserve fund, which must equal one-tenth of the capital.

2. Twenty per cent goes to a special reserve fund held against the necessity of unforeseen supplies.

3. Five per cent interest is paid on the capital invested.

4. Of the remainder, 40 per cent is devoted to additional payments for stock dividends, and 60 per cent is carried to the sinking fund.

The Raleigh Electric Co. will purchase five new cars.

The Financial Results of Cable and Electric Railway Operation in the United States.

I.—The Combined Street Railway Systems of New York, Massachusetts and Pennsylvania.

Seekers after light on street railway matters frequently ask such questions as these: What is the cost per car mile for operating an electric railway? How many times per annum is the population of an American city carried by its street railway system? At what percentage of the gross receipts can an electric railway be operated? How much has electricity increased the earning power of American street railways? Such questions as these are absolutely unanswerable as stated. If there is any one department of human knowledge—or ignorance—where it is unsafe to generalize, it is in the field of street railroading. Results found in one group of cities are often radically different from those of another, and it is sometimes a hard matter to reconcile these differences and to determine with any approach to satisfaction an underlying law governing such widely differing cases. On one railway the "operating expenses," so called, are but 50 per cent of the gross receipts; on another with much the same physical characteristics they may be 75 per cent. The operating expenses per car mile range from eight cents to twenty-five or thirty cents, as the result of a hundred influences more or less easily understood by those who look below the surface, but puzzling enough to the uninstructed. The difficulty of separating an increase of traffic due to the introduction of electricity from that due to the extension of mileage which in almost all American cities has been coincident with the introduction of electric equipment, needs only to be stated to be appreciated. And it is equally clear that the traffic density and consequent gross earning power per mile of track of the Broadway Railway, in New York City, must be immensely greater than that of a line in a small country town.

In this, and succeeding papers an effort will be made to partially unravel the tangled web of street railway results in America, more by a careful discussion of what has taken place on individual systems and groups of systems than by setting forth broad and far reaching laws governing the whole industry. A few such laws exist perhaps, but they are of the simplest possible character and lead to general understandings rather than to mathematically correct conclusions. Two or three of these "laws" are conveniently discussed at this point.

The gross earning capacity of the complete street railway systems in American city areas increases in a kind of geometrical ratio with the population served. For example, in cities of from 40,000 to 50,000 population, gross receipts of from $3.50 to $4.50 per capita may be expected; in cities of from 50,000 to 100,000 inhabitants, $5 to $6 per capita; in cities of from 100,000 to 500,000 inhabitants $7.50 to $10 or $12 per capita, and in cities above 500,000 inhabitants still larger gross earnings per capita are found.

In large cities where cars are necessarily run at slow schedule speeds and frequently make only from 70 to 80 miles each per day, the operating expenses per car mile would naturally be, for this reason alone, greater than would be the case in the smaller towns where cars sometimes make from 125 to 150 miles per day at much higher schedule speeds. Gross receipts per car mile are also affected by this smaller divisor and are larger in the more important cities than in the minor ones. Of course other influences

	Massachusetts.			New York.			Pennsylvania.		
	1885.	1889.	1896.	1885.	1889.	1896.	1885.	1888.	1896.
Capital stock	$ 8,077,100	$12,290,740	$30,727,818	$28,450,444	$32,685,328	$107,561,509	$12,847,495	$18,527,567	$ 81,897,738[b]
Funded and floating debt	$ 4,945,388	$ 8,449,240	$30,470,928	$25,194,458	$33,600,428	$117,290,095	$ 6,110,689	$10,126,539	$ 43,486,601[b]
Total stock and debt	$13,022,488	$20,739,980	$61,198,746	$53,644,902	$66,285,756	$224,851,604	$18,958,184	$28,654,106	$125,384,339[b]
Total permanent investment	$13,350,908	$20,098,802	$58,783,099	$50,998,604	$61,385,406	$203,928,301	$ 9,577,213	$11,515,100	$116,290,535
Miles of track	376	621	1,368	836	966	1,737	457[a]	533[a]	1,562[a]
Number of cars	2,114	2,942	4,913	4,903	5,900	8,292			
Total receipts	$5,108,715	$7,518,325	$14,852,952	$16,999,067	$18,574,105	$30,237,092	$7,487,637	$8,837,619	$18,791,554
Operating expenses and taxes	$4,231,927	$6,145,635	$11,038,727	$12,555,063	$14,742,252	$19,013,579	$4,895,477	$6,063,739	$10,621,691
Earnings from operation	$ 876,788	$1,372,690	$ 3,814,225	$ 4,444,004	$ 3,831,853	$11,223,513	$2,592,160	$2,773,880	$ 8,169,863
Car miles run	18,167,619	24,259,491	53,613,685						
Passengers carried	100,746,786	148,189,403	292,358,943	327,725,714	368,496,648	672,498,760	142,085,936	190,506,017	376,502,551
Stock and debt per mile track	$34,600	$33,400	$44,700	$64,200	$68,600	$129,400	$41,500[a]	$53,700[a]	$95,700[a b]
Total receipts per mile track	$13,600	$12,100	$10,900	$20,300	$19,200	$ 17,400	$16,400[a]	$16,600[a]	$12,000
Earn. fr'm op'n per mile track	$ 2,300	$ 2,200	$ 2,800	$ 5,300	$ 4,000	$ 6,500	$ 5,700[a]	$ 5,200[a]	$ 5,200
Total receipts per passenger	$.0507	$.0507	$.0508	$.0519	$.0504	$.0450	$.0527	$.0464	$.0499
Operating expenses per pass'r	$.0420	$.0415	$.0377	$.0384	$.0400	$.0283	$.0345	$.0318	$.0282
Earn. from oper. per pass'r	$.0087	$.0093	$.0131	$.0136	$.0104	$.0167	$.0182	$.0146	$.0217
P. c. op. ex. to total receipts	82.8	81.8	74.3	73.9	79.4	62.8	65.4	68.6	56.5
P. c. earn. from oper. to total permanent investment	6.6	6.8	6.5	8.7	6.2	5.5	27.1	24.1	7.0
P.c. div's paid on capital stock	6.30	6.82	5.87	7.83	4.41	5 08			
Total receipts per car mile	$.2812	$.3099	$.2770						
Op. ex. per car mile	$.2329	$.2533	$.2059						
Earn. from op. per car mile	$.0483	$.0566	$.0711						

[a] Of road, not track. [b] In 1895, not 1896.

are at work also in the larger cities tending to raise both gross receipts and operating expenses per car mile, but this smaller car mileage per day is one of the most influential.

The gross receipts per mile ought to increase rapidly with the population served, and this for obvious reasons. The street railway systems of many cities are, however, so heavily overbuilt that the gross receipts per mile are often smaller than in cities of considerably less size.

To street railway managers considering a change of motive power these two questions naturally present themselves:

1. Can the city in question be properly served by continuing the use of the present motive power? Can the increasing traffic offered to the cars be taken care of without discomfort to passengers? Can absolutely necessary extensions into the suburbs be made without imposing too great a loss on the operating company?

2. In changing the motive power will the net percentage return on the new investment be increased or diminished as compared with that on the old?

Sometimes a change is first considered from the point of view of profit earning capacity, and sometimes it is forced upon managers by the impossibility of dealing with the local transportation problem, except by some radical improvement.

Now on the question of profit earning capacity, the experience of other systems will, if properly interpreted, be of value, but if examined in a merely superficial manner, the results may be wholly delusive. The road chosen for examination may have been among the first to adopt the improved motive power; it may have purchased imperfect apparatus and made grave engineering mistakes; it may have bought everything at a cost far higher than current prices; it may have overcapitalized the cost of making the conversion, and it may be managed unwisely or extravagantly. The true method of finding out the real advantage of a new motive power over an old as realized in any particular city is to make an investigation on the following general lines:

What would be the comparative cost *at present prices* of building and equipping (*a*) a railway system equipped with the new motive power, and (*b*) a railway system equipped with the old motive power, to occupy the same routes and to run the same number of car miles per annum as is now done by the system equipped with the new motive power, and what would be the comparative gross receipts, the earnings from operation and the net returns upon the relative capital investments. In solving this problem all the light possible should be obtained from

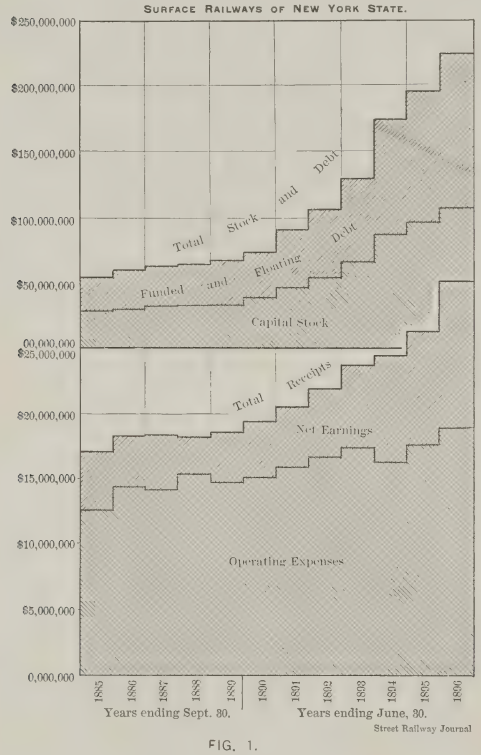


FIG. 1.

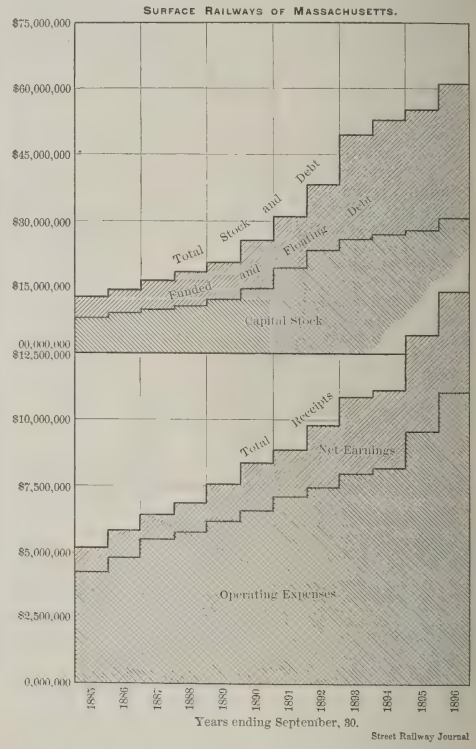


FIG. 2.

present and past results with the new and the old motive powers, but when all is said and done there will necessarily be a large number of questions to be decided by individual judgment. An example of this method of dealing with the question of the comparative economy of horse and electric traction may be found in an article on the West End Railway, of Boston, appearing in the STREET RAILWAY JOURNAL for March, 1896, page 205. In this particular case it was found that an electric railway practically duplicating the West End system as it existed on Sept. 30, 1895, but using the then prices for all equipment material, would cost $17,237,000, and a horse railway system to run the same number of car miles would cost $12,592,000. The comparative operating statement of the two systems would stand about as follows:

	Horse Railway System.	Electric Railway System.
Gross receipts	$6,654,038	$7,624,277
Operating expenses	5,292,978	4,873,998
Earnings from operation	1,361,060	2,750,279
Taxes	237,500	325,300
Net income	1,123,560	2,424,979

The electric system thus showed a net income equivalent to 14.07 per cent on its investment, while the horse railway system showed an earning power equivalent to 8.9 per cent upon its necessary investment.

It is impossible, however, within the limitations imposed by these pages to deal with many problems of comparative economy in this manner. Instead of this, the actual results of operation for the past ten years of individual systems and groups of systems will be shown in diagrammatic form, and the "curves" will be analyzed and explained so far as it is possible to do so.

For many years the annual reports of the Boards of Railway Commissioners in Massachusetts and New York

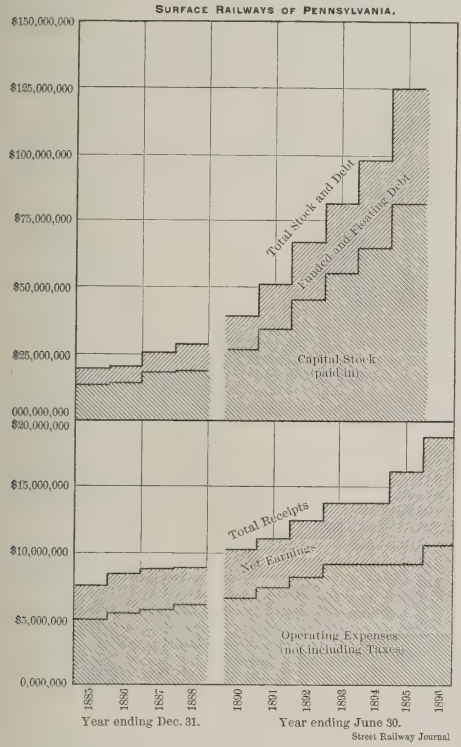


FIG. 3.

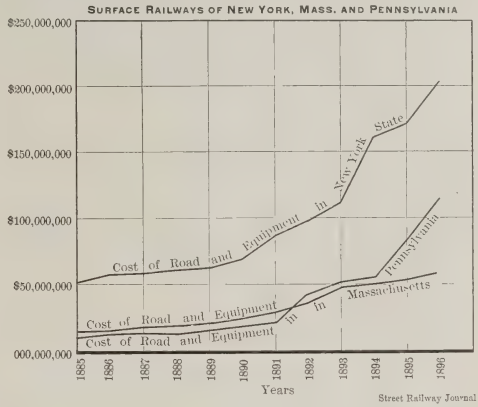

SURFACE RAILWAYS OF NEW YORK, MASS. AND PENNSYLVANIA
$250,000,000
$200,000,000
$150,000,000
$100,000,000
$50,000,000
000,000,000
Cost of Road and Equipment in New York State
Cost of Road and Equipment in Pennsylvania
Cost of Road and Equipment in Massachusetts
1885 1886 1887 1888 1889 1890 1891 1892 1893 1894 1895 1896
Years
Street Railway Journal

FIG. 4.

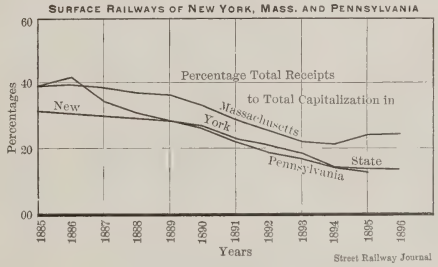


FIG. 5.

have been of great value to students of street railway finance, partly because in these two states is found over 20 per cent of the street railway mileage of the entire country, partly because the street railways of the two states, both large and small, are, with few exceptions, successful and profitable undertakings, and partly because the method of making up the reports has remained so nearly uniform through a long series of years as to make comparisons from year to year of great value. The annual reports of the Department of Internal Affairs in the state of Pennsylvania have also been of considerable value, since they too have been published for many years back, and since in Pennsylvania is found about 10 per cent of the entire street railway mileage of the country, but in ways presently to be explained, these reports are less reliable than those of New York and Massachusetts.

In 1885 there were about 1650 miles of surface railway track in the three states mentioned, and practically all were operated by animal power. During the next two or three years the possibilities of electricity as a motive power were forced more and more prominently upon street railway managers, and the success of the first large installation at Richmond, Va., in 1888, brought about its experimental adoption by a number of street railway companies upon outlying divisions of their systems. It happened that a vigorous crusade against overhead electric light wires in several of the principal cities of the country had been brought, at about this time, to a successful conclusion, and the difficulty of obtaining permission from municipal authorities to put up a complete overhead wire structure only twenty feet above the ground for the moving of street railway cars, in the face of the fact that electric light wires were being forced below the surface, may easily be understood. Nevertheless, the economy of electric traction, the immediate popularity of electric cars wherever introduced, and the influence upon municipal expansion of so flexible a motive power, even then partially understood by far sighted capitalists, were factors which overcame all opposition, and in 1889 and 1890 the conversion to electricity of the old horse railway systems commenced in earnest, together with a large increase in new mileage, to be operated by electricity. Syndicates were formed to purchase horse railway properties and introduce electricity, and capital rushed in from all quarters to take part in the large profits believed to be involved in this field for construction and operation. An exaggerated idea of the value of franchises and of the power of electricity to increase the earning power and reduce the operating expenses became prevalent. Prices for rails, construction, material, cars and electrical apparatus were high—motors, for example, from three to five time the figures of to-day. Money was easily raised through financial channels for almost any electric railway enterprise, and when money comes easily carelessness and waste are frequently the order of the day.

Capitalization—Under these circumstances the total

capital liabilities and the capitalization per mile of track increased with great rapidity. In 1885 the combined capital liabilities of the three states amounted to about $86,000,000, equivalent to about $51,000 per mile of track; by 1888-89 the stock and debt had risen along what were evidently normal lines of increase, to $116,000,000, equivalent to $54,000 per mile of track, while in 1895-96 the capital liabilities amounted to $411,000,000, equivalent to $88,000 per mile of track. In Massachusetts the net increase per mile of track during the twelve years has been but $10,100; in New York it has been $65,200 and in Pennsylvania it has been $54,200. The story of this increase can be clearly read in the accompanying diagrams, from which it will be seen that to all appearances the maximum capitalization per mile of track in each of the three states has been reached and may be expected to decrease rather than increase in future, except that in New York State it is possible that the influence of the street railway system of New York City, which is but just now adopting improved motive powers on a large scale, may force these figures still higher for a year or two. It is true, however, that nearly all available street railway territory in the larger cities of the three states has been exhausted and the mileage now building will be in the suburbs and between cities and towns. This construction will cost less per mile of track than if the new lines were located in the larger cities, and the tendency will be towards a decrease in the total average capital liabilities per mile of track in the respective states.

Now, this enormous capitalization, amounting to $411,000,000 (about 25 per cent of the entire capitalization of American street railway systems) undoubtedly contains a certain amount of "water" injected by the various syndicates and promoters through whose hands the properties have passed, but it is probably true nevertheless, first, that the difference between the actual accumulated cash investment in the properties, and the par value of the capital liabilities outstanding, is much less than is generally supposed; second, that it is a much less than the promoters and syndicates intended it should be; and third, that the present cost of duplicating the tangible assets *plus the present cost of purchasing rights of way* would probably be not much less than the outstanding capitalization. Engineering and financial mistakes have been made, most serious in their consequences to the properties. These mistakes have had, and will have to be paid for and the burden of doing this has necessarily come upon the stockholders. Even, therefore, in cases where their stock represented little or no original investment, it represents to-day a great deal, and is likely to be in future classed as "fully paid in," in one form or another. Again, while the cost of duplicating the tangible assets alone would be far less than $88,000 per mile as a general average of the three states, it is true that the franchises and privileges obtained from the municipalities and the abutters could not be had to-day without the payment of enormous sums, owing to the increase in value of city property brought about in every case by the existence of these transportation agencies, and it is not far from true therefore that the combined properties are worth a large proportion at least of their capital liabilities.

One more interesting comparison may be made in connection with the capitalization of the properties of these three states. In 1885, 58 per cent of the total capitalization was represented by capital stock and 42 per cent by funded and floating debt; in 1888–89, 55 per cent was represented by capital stock and 45 per cent by funded and floating debt, and in 1895–96, 53 per cent was capital stock and 47 per cent funded and floating debt. In Pennsylvania, the proportion of debt to capital stock has been ap-

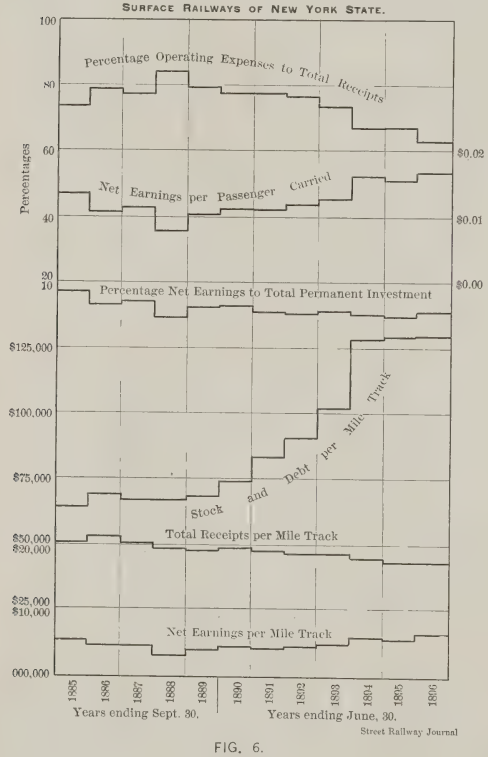

Surface Railways of New York State.
Percentage Operating Expenses to Total Receipts
Net Earnings per Passenger Carried
Percentage Net Earnings to Total Permanent Investment
Stock and Debt per Mile Track
Total Receipts per Mile Track
Net Earnings per Mile Track
Percentages
Years ending Sept. 30.
Years ending June, 30.
Street Railway Journal

FIG. 6.

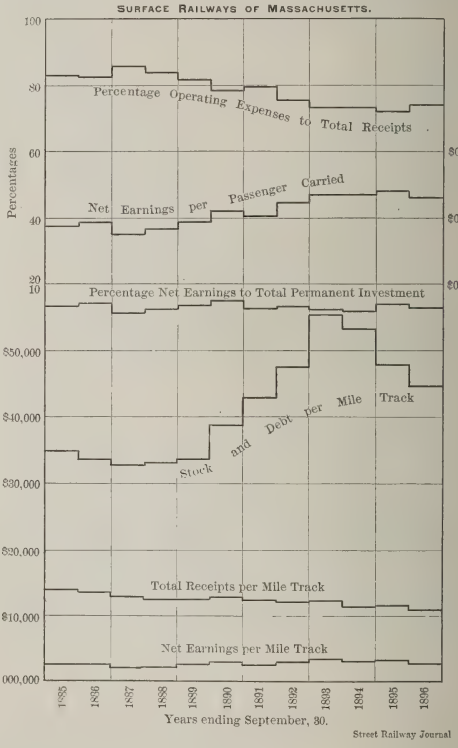

Surface Railways of Massachusetts.
Percentage Operating Expenses to Total Receipts
Net Earnings per Passenger Carried
Percentage Net Earnings to Total Permanent Investment
Stock and Debt per Mile Track
Total Receipts per Mile Track
Net Earnings per Mile Track
Percentages
Years ending September, 30.
Street Railway Journal

FIG. 7.

parently considerably less than in the other two states, but the actual figures are in reality somewhat different from those represented in the diagram, the reason being that a large proportion of the capital stocks of the Pennsylvania companies which are combined in the figures represented by the diagram are really not "outstanding," but are held in the treasuries of various "traction companies" whose stocks are also represented in these same figures. It is impossible, as a matter of fact, to tell what proportion of the actual cash investment in the properties of Pennsylvania is represented in the funded and floating debt, and what proportion is capital stock "paid in."

Total Receipts.—In 1885, the combined street railway systems of Massachusetts, New York and Pennsylvania earned nearly $30,000,000 equivalent to about $17,700 per mile of track; in 1888–89, the earnings had shown a normal increase to about $35,000,000, equivalent to $16,500 per mile of track; and in 1895–96, they had increased in far more rapid ratios, as will be seen by the diagrams, to about $64,000,000, equivalent to $13,700 per mile of track. The total mileage in 1885 was 1669; in 1889, 2120 and in 1896, 4667.

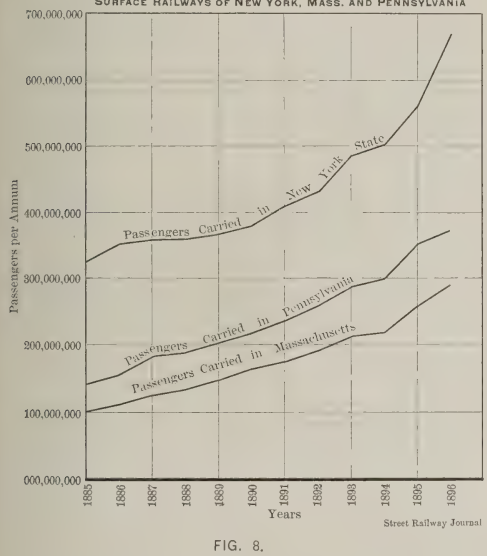


FIG. 8.

From a superficial view of these figures it might be hastily concluded that inasmuch as the mileage has evidently increased at a rate more rapid than the gross receipts, as is shown by the reduction of the receipts per mile, the notable increase in the total receipts is due, not so much to electric equipment as to the increase of mileage. More careful thought upon the matter will, however, lead one to the conclusion that the influence of electricity in increasing the total receipts must have been remarkable, since it has so nearly succeeded in keeping up the average earning power per mile of the entire mileage, in spite of the fact that the 3000 miles of track built since 1885 must necessarily have been in territory far less valuable, as regards density of traffic, than that served by the 1600 miles found in operation in 1885, which must have been, broadly speaking, laid down in the principal streets and along the best traffic routes of the different cities. The inference may also be drawn, with considerable reason, that the gross earning power per mile of these properties is destined to increase in future. When the era of street railway extension shall have passed away, and the companies are in a position to devote their entire attention to developing traffic on existing lines, it will undoubtedly be found that the traffic density on the new mileage will be constantly on the increase, and the curve of gross earning power per mile of track will start upward, to reach perhaps larger values than any so far seen.

It is much to be regretted that an investigation of the gross receipts per capita served during this twelve year period of street railway operation cannot be made, but the difficulties in the way of obtaining even approximately correct figures are insuperable.

In Fig. 8 may be seen comparative curves showing passengers carried in the three states. It will be seen that the scale of operation is much larger in New York State than in Pennsylvania and Massachusetts, and that it is larger in the former than in the latter. These curves of traffic have been quite steadily on the increase in Pennsylvania and Massachusetts, but the increase has been much more rapid in New York State, and in 1896 has been al-

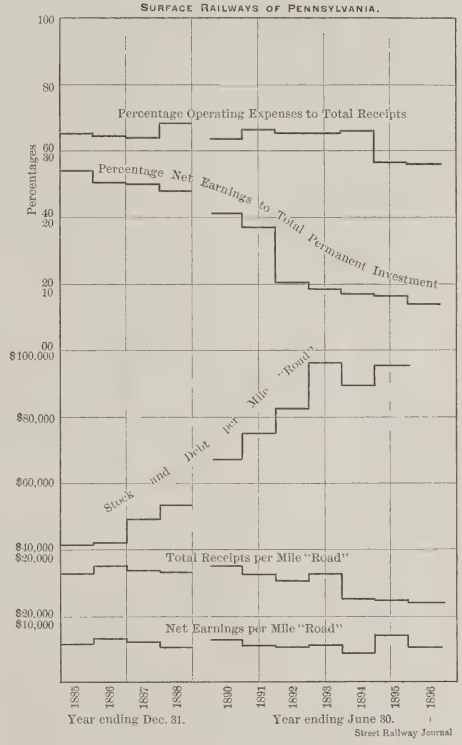


FIG. 9.

most phenomenal. The influences of the financially unfortunate years of 1893-94 are seen in all three states, the ratio of increase being less than in previous or subsequent years.

The curves in Fig. 5 are interesting as showing that in no one of the three states has the increase in total receipts kept pace with the increase in total capitalization. Massachusetts makes the best showing, but even here the results in 1896 were but 24.2 per cent of the total capitalization as against 39.2 per cent in 1885. In New York State the total receipts are now but 13.5 per cent of the capitalization, and in Pennsylvania but 12.8 per cent (in 1895). This means that if the combined properties of Pennsylvania could all be operated at 50 per cent of the gross receipts it would be possible to make a return of but 6.4 per cent on the total par value of the capital liabilities.

The total receipts per passenger carried in the three

states were in 1885, $.0519, in 1888-89, $.0494, and in 1896, $.0476. This decreasing rate of fare may and should be credited to electricity in considering the advantage to the public.

The total receipts per car mile in Massachusetts were $.2812 in 1885, $.3099 in 1889, and $.2770 in 1896. The car mileage of 1896 was nearly three times that of 1885, and these figures make it evident that the street railways of Massachusetts are to-day giving a more generous service to the public than was the case in 1885.

Operating Expenses.—In 1885, 73.3 per cent of the total receipts were consumed by the entire street railway systems of the three states in paying operating expenses and taxes; in 1888-89 the cost of operation was 77.1 per cent; and in 1896, 63.7 per cent. If we exclude the figures of Pennsylvania, which for reasons hitherto stated, are by no means as reliable as the other two states, we obtain as the respective percentages of operating expenses in the three years, 75.9 per cent in 1885, 80.1 per cent in 1880-89, and 66.6 per cent in 1896.

It is, of course, needless to say that to improved motive powers alone is to be attributed these falling ratios of operating expenses to total receipts. An inspection of the curves in Figs. 2, 4 and 6 will show very clearly the period when this reduction began. It should be stated in this connection that the horse railway properties of New York City have always been operated at an extremely low percentage as compared with similar systems in other cities, the reason being found not so much in economy of administration, though that has been an element in the case, but in the large gross receipts per car day and per car mile, owing to the unusually large proportion of short distance riding in New York City.

The operating expenses per passenger carried amounted in 1885 to $.0380, in 1888-89 to $.0381 and in 1896 to $.0303. This means a reduction due to electricity of 20 per cent in the cost of carrying a passenger.

In Massachusetts the operating expenses per car mile were in 1885 $.2329, in 1889 $.2533, and in 1896 $.2059. This shows a reduction of about 20 per cent in the cost of operating a car mile, and it should be said, moreover, that the "car mile" of 1896 is a very different thing from the car mile of the horse railway days on account of the fact that much larger cars, having in some cases nearly double the passenger capacity of the old horse railway cars, are now common on electric railways in America.

Now, the "operating expenses," so called, appearing in the table and diagrams herewith do not include any reasonable allowance for depreciation of plant and equipment, as it is not, unfortunately, the custom of American street railway managers to pursue a conservative policy in this direction, although there are, of course, honorable exceptions. It is difficult to say what additions should be made to the operating expenses as reported officially in order to obtain approximately correct figures, but it is probably true that with the best modern roadbed and equipment known today an equal car service could be given on the same track mileage, and all allowances made for depreciation on a conservative basis, at figures little, if any greater than those quoted here. In other words, the actual charges for repairs and renewals upon the imperfect track construction, cars and equipment purchased in the early years of electric traction have been extremely large, and in many cases this imperfect track and equipment has been replaced with more modern types, the cost of the replacement being charged sometimes to "betterments;" sometimes to operating expenses and usually to a combination of both. This feature of street railway finance and its various applications will be dealt with specifically in subsequent papers in connection with the results on individual systems.

Net Earnings.—The test of these improved motive powers is found in a comparison of the old and the new percentages of net earnings to the total permanent investments. For reasons which may be easily inferred from the above discussion, it is impossible to arrive at any close figures of the actual cash investment in the street railway properties of the three states under consideration. This much may be said, however, that with the possible exception, of the street railway companies of New York City, the figures given for "total permanent investment" in 1888–89 were not far in excess of the actual cost of plant and equipment and the net earnings were quite surely at least as large as they ought to have been with proper methods of accounting. In Massachusetts this return upon the investment was 6.8 per cent, in New York (including New York City) 6.2 per cent, and in Pennsylvania the return was apparently 24.1 per cent. The Pennsylvania figure is not at all reliable, but at the same time it is probably true that the horse railways of Philadelphia and Pittsburgh, in particular, were unusually valuable properties and were in that year capitalized at very low figures per mile of track. This is indicated by the fact that the great traction companies of Philadelphia are to-day paying to roads which they lease, guaranteed dividends ranging from 10 to 60 per cent on the paid in capital stock.

It appears from the table and from the diagrams that the annual net earnings have largely increased during the past twelve years. In Massachusetts the percentage return upon the (balance sheet) investment is almost exactly the same to-day as it was in 1885 and in 1889. In New York it is now but 5.5 per cent, as against 8.7 per cent in 1885 and 6.2 per cent in 1889, but in view of the extremely heavy capitalization in New York, amounting to an average of $129,500 per mile of track for city and suburban roads together, it is certainly a remarkable thing that it has been possible to keep the percentage return anywhere near the present figure. In Pennsylvania there has been a heavy fall in the percentage return on investment, owing to the multiplication of "traction companies." Attention should again be called, however, to the fact that the final figures in Pennsylvania, namely, 7 per cent, are considerably below the truth, on account of the fact that the net capital stock outstanding is undoubtedly less than the figures indicate.

After taking this broad view of the financial results in New York, Massachusetts and Pennsylvania, it will be next in order to commence the discussion of the results of individual street railway systems, and this will be done in subsequent papers.

Notes on the Diagrams Figs. 1 to 9. In Figs. 1 and 2 the curves of capitalization represent the capital stock issued and the funded and floating debt outstanding of the operating and leased roads of Massachusetts and New York. The total receipts are, of course, those of operating roads only. The operating expenses include taxes, but do not include rentals paid to leased companies. The difference between the total receipts and operating expenses so made up, therefore represent the "net earnings" resulting from operation and properly applicable to a return on the combined capitalization of the operating and leased roads. In Fig. 3, the capital stock is that returned as "paid in" and is in amount considerably less than the par value outstanding. For the year ending June 30, 1896, paid in capital stock is not obtainable owing to lack of uniformity in the returns. The total receipts cover receipts from passengers, mail and express, but do not include miscellaneous receipts which are so made up in Pennsylvania as to be delusive as a total of the systems of the state. The operating expenses include taxes, on real estate, but no other taxes. Six months' earnings are omitted, from Dec. 31, 1888, to June 30, 1890, owing to change of date in ending of the financial year.

In Figs. 6, 7 and 9, the "Total permanent investment" referred to is returned under that name in Massachusetts and under "Cost of road and equipment" in New York and Pennsylvania. In Figs. 6 and 7, the "mile track" includes second track and sidings. In Fig. 9, the "mile road" is believed to be somewhat ambiguous, covering in some cases the length of main track only, and in other cases the length of second track and sidings. These figures therefore cannot be properly compared with "miles of track" of Massachusetts and New York.

In other respects the diagrams and table are self explanatory.

In the article on page 169 of the March issue entitled "Overhead Construction for Suburban Lines" by J. F. Macartney, the cost of one mile of trolley wire should have been given as $230 instead of $130.

The New Orleans Traction Company has published for general distribution a neat folder showing the different points of interest reached by its lines.

A Comparison of American and European Wheel Practice, With Notes on General Condition of Service.

By P. H. Griffin.

In Europe the electric wheel is passing through a stage of development very similar to that which took place when electric railways were first operated in this country. The situation is, however, complicated in Europe by the use of rails having the lip on the inside brought up even with the rail face, thus forming an opening shaped like the letter "U," and about ⅞ in. wide, with sharp corners at the top. To allow the necessary clearance, flanges not over ⅝ in. in thickness or depth must be used; even this small allowance is insufficient to permit free passage through curves, and, in consequence, heavy frictional contact, combined with heavy side strain, always occurs. Naturally engineers demand the lightest flange section that can be secured, and manufacturers find it most difficult to provide wheels with flanges that will stand service. Chilled iron and steel tired wheels are used, and cast steel has also been tried to some extent. The chilled iron flanges resist wear much better than steel, but are liable to chip off if cars are driven at speed into curves or over obstructions.

In comparing the results obtained from the two types of wheel, the advantages claimed for the chilled wheel are that it has no parts to become loose; that it resists wear in very high degree when of good quality; that the first cost is much less than that of the steel tired wheel, and the value when worn out much greater; and that the cost of renewals and repairs is very small. The disadvantages ascribed to it are that when slid flat it cannot be turned down in the ordinary lathes found in railway workshops; that when narrow grooved rails are used flanges of light section are required which are liable to chip off; and on account of the hardness of the chilled surface, less friction and braking power are obtained, than with steel tires.

The advantages claimed for steel tired wheels are that the center will last indefinitely; that the tires can be renewed when worn out, and turned down in an ordinary lathe when partially worn; and that the flanges do not chip or break in service. The disadvantages of the steel wheel are rapid wear of tires, especially on flanges, the latter, when of light section under heavy traffic, wearing down very quickly; loosening of parts, due to strain of starting and stopping of cars; damage to crossings, switches and special work by the heavy blows delivered on them when the tires are worn unevenly; heavy expense of wheel service in first cost of wheels, renewals and repairs, and labor and machinery required to maintain the equipment. The advantages claimed for steel tired wheels are based largely upon results obtained on steam railways, but as the conditions of electric and steam service are radically different it does not follow that corresponding results will be obtained, and questions of this kind can only be determined by the results of practical experience. In some cases the construction of roadbed and equipment has been carried out under disadvantages, old track and equipment having been remodeled for use. All of these experiences were obtained some years ago in America in like degree when electric railways were in process of development, and it is therefore probable that progress in overcoming them will be made on the same lines followed in this country.

In considering the merits and demerits of either type of wheel it is fair to distinguish between temporary and permanent conditions. It is natural for engineers abroad to favor the steel wheel composed of different parts because it is well known and generally used on steam railways. In America 95 per cent of all railway cars and locomotives are equipped with chilled wheels.

There are in America about 14,000 miles of electric railways and 40,000 cars in service, 75 per cent of the latter having four and about 25 per cent having eight wheels per car. This makes a total of about 200,000 wheels in this kind of service. Of this total not 1 per cent are steel or steel tired wheels. It can therefore be fairly said that whatever the probabilities are for the use of steel wheels on American electric railways, they have not, up to the present time, made much progress in that direction. This is not stated to the detriment of the steel wheel or its makers, but as a simple fact. Steel wheels have in some cases been tried on an extensive scale, but the results were not of such a character as to make the railways or manufacturers feel disposed to experiment further.

It is the opinion of some engineers abroad that the chilled wheel is used in America because it is cheap, but that is far from the fact. American electric railways of the best class do not stop at any expense that will improve service and give better results, and certainly in no country has the development and operation of electric railways been carried to the high standard that it has in this country.

The two principal difficulties in electric wheel service are the giving out of flanges through rapid wear, or chipping off, and the flat spots produced by brake sliding. Some railways experience little trouble with either, and others find a great deal. For brake sliding the remedy lies principally in the care with which brakes are used. This must continue as long as brakes are applied to wheels. The use of mechanical and magnetic track brakes will be referred to later on. There is a great difference in the class of men employed by different companies and the skill and intelligence with which the work is done. If brakes are applied quickly under full pressure, and sand is used liberally to increase friction, flat spots are sure to result. It seems to be the pride of some motormen to see how close cars can run to a given point and stopped through excessive use of brake power. Under such circumstances trouble with flat spots is certain to occur. If brakes are properly adjusted and applied, and sand cars run over the track as often as necessary according to weather and season, brake sliding will never become excessive.

Flange service is indeed a most difficult problem under some conditions. Theoretically, the steel flange is best for light sections, but practically, a few months' wear unfits it for service. The chilled flange resists wear satisfactorily, but as stated, is liable to chip off if improperly used, if the track is not in good condition, or steam railway tracks are to be crossed where proper crossings are not provided. It is possible to reduce the chilled surface of the flange and thereby increase strength, but this necessarily takes from the wearing capacity. Some engineers expect the wheel maker to undertake the entire solution of this trouble and demand wheels with flanges that will resist any service imposed on them—a pretty difficult undertaking when the wheel maker's possibilities of strength and wear are bound up in a section of metal less than ⅝ in. square. When conditions of the kind referred to exist, and it is not claimed that engineers are always responsible for them, it is necessary to make an investigation into the exact causes of the trouble, to remedy them as far as possible and to provide precautions against damage resulting from conditions that cannot at once be improved. The principal difficulties of flange service are due to the practice of running cars at considerable speed into and through curves, especially at the foot of grades. In the latter case a piece of metal will sometimes be taken out of the flange exactly as if broken out with a heavy blow, and yet no trace will be left as to the cause of the trouble.

In comparing the conditions and general results of wheel service in Europe and America it is found that the greatest difference at present is due to the fact that in America railways are operated with but few tools and a small staff of workmen for making repairs. The expense of wheel service is considered to include all cost of repairs and renewals. In Europe expenses of this character are considered rather as part of the general operating expenses, and it is usual to maintain a considerable plant and force of employes for such work. It is likely that practice in this respect has followed the lines of general steam railway practice in Europe, but it remains to be seen how far the conditions of electric service will admit of like treatment.

Thus far, with new equipment, repairs on electric railways, if they have been considerable, are certainly less than they will be later on. The rapid wear of steel wheels, especially on light flanges and the heavy expenses involved in keeping the wheels in proper order in general, may be something that railway companies will prove willing to assume, but it is not likely that such will be the case. Comparisons are most likely to be made between the general results of wheel service, and in due time the same conditions are likely to prevail in both countries.

Results in electric wheel service are influenced in great degree by some conditions that do not seem of much importance. Great care should be given to wheels and brake shoes to see that shoes take a proper bearing on the surface or tread of wheels. When shoes fitting over the flange are used there should always be a good clearance between the sides of the groove in the brake shoe and the flange. The depth of the groove should not be too shallow, otherwise contact will only take place between point of flange and outer edge of the brake shoe and wheel tread, until the shoes become worn to a proper bearing. It should not be the intention to wear away the sides of flanges by brake contact—service will do that quickly enough. It is desirable to keep the flange to proper depth, and not allow it to grow deeper on account of wear of wheel tread, with consequent damage to special work and the loss of traction. When the tread of the wheel is worn away without corresponding wear on point of flange, the latter bears on the bottom of the groove of the rail and makes it impossible to secure proper traction between the wheel and rail. On some railways much attention is given to economy in consumption of brake shoes, and the amount used per week or per month is closely watched. It is much better practice to use brake shoes giving good frictional contact, and thereby secure proper brake service, than to practice economy by interfering with such a result. The bearing surface of brake shoes should be turned or ground so as to fit the wheel accurately. There is not the slightest doubt that brake sliding is due in large measure to the fact that old wheels are fitted with new shoes or old shoes are used on new wheels, proper contact not occurring until after the cars have been run for some time and the shoes worn down. It is not excessive pressure on a few points that gives proper service, but proper contact over the entire surface of the shoes with moderate pressure. The adjustment of brake levers is most important and should form the subject of very careful attention and investigation to see that it is not in the power of motormen to throw heavy pressure on the brake shoes and stop the revolution of the wheels, causing the flat spots as well as entire loss of control over the car while the wheels are sliding.

Good traction depends on proper contact of wheels and rails and this is prevented by several causes: flanges too deep, either through wrong construction in the first instance or through the wear of wheel treads; rails not laid true; rails out of position through service. The displacement of rails prevents proper contact between the wheels and rails, but a small part of the rails being touched by the wheels. This can easily be detected by an examination of rails as the bright surfaces indicate exactly where contact occurs. If rails are laid flat, wheels with coned tread should not be used, for this prevents contact until wheels are worn down. No doubt many difficulties are due to first conditions of service being wrong. After a time things may improve with use and wear, and the lack of proper first conditions may be remedied; but it is not safe to count on service to improve what was wrong in the first instance; the results are quite as likely to be in the opposite direction. On the two most important necessities of service, traction and braking power, there is room for marked improvement. Careful attention should be paid to grooves of rails, as they are liable to be partially filled with sand or dirt packed and rolled hard by flanges, especially in winter time when the accumulations are frozen, causing wheels to run almost entirely upon flanges. It would seem advisable to use some device for cleaning the grooves of rails in such cases, and it certainly would not be a difficult matter to accomplish. Careful attention should also be given to the grooves of brake shoes where the latter cover the wheel flange. In a case recently noticed by the writer, brake shoes were in use with grooves so different in shape from the wheel flanges fitting into them that when brakes were applied the shoe gripped the wheel flange tightly and caused the wheels to slide, producing flat spots. This continued until the wheel flanges had cut away the grooves in the brake shoe to a proper shape. Even then the accumulation of dirt and grit carried up by the wheel when revolving caused the sliding of wheels with every severe brake application.

On the subject of brake shoes alone a great deal might be said. To them more than anything else is due a large part of the trouble with brake service, brake sliding and flat wheels. Some railway companies give little attention to the quality of the brake shoes used, and castings of very poor material and finish are accepted. These are frequently made from patterns that have been in use so long that they have become entirely out of shape. Perhaps the patterns are parted to the center and through wetting of the mould, rapping and drawing of patterns, the castings have a heavy ridge down the center, which must be worn off in service before proper contact can be secured. There are many styles of brake shoes intended to resist wear and thus decrease expense. Most of them have blocks of iron and steel inserted in the wearing surface. No doubt there is a saving in the weight and cost of the brake shoes, but it is likely to be accomplished at many times the cost in poor brake service and the consequent results. Good brake service depends upon friction, and to bring in contact with the hard surface of the wheel another surface calculated to resist wear by preventing friction cannot but interfere with the result desired. Increased pressure becomes necessary in proportion to lack of friction until finally it becomes impossible for the wheels to revolve, and brake sliding ensues. The trouble is largely due to the chilling or hardening of the iron around the blocks placed in the mould. Shoes are sometimes used with wholly or partially chilled surfaces. This seems so contrary to the purpose for which brakes are intended that it is not necessary to discuss it. In cases where more attention is given to the weight of brake shoes than to the efficiency of brake service it can hardly be expected that the latter can be kept up to the proper standard.

It would seem that the best brake shoe should be made of good close grained metal, not so hard that it cannot be worked or drilled without difficulty. The shoes should be carefully made and all fins and projections removed so that proper contact will take place between the wheel and shoe when the latter are first put in service. The shoes should be tested for these conditions when received. The patterns should be made of metal so as to retain their shape, and whenever practicable the patterns should be made so as to have the face of the shoe cast in the bottom of the mould.

As proper traction and brake service depend entirely upon proper contact of wheel and rail it is manifest that in just the degree that this is not secured the service will be injured. The difference between the service of wheels that simply carry loads and wheels that also give traction is very great. In the former case contact is not of much importance; in the latter case everything depends upon it. The difference between the hardness of steel tired and chilled wheels is considered by some engineers abroad as of much importance because it is claimed that greater traction can be obtained from the former. No doubt the softer steel tired wheel gives increased traction, but only at the expense of increased wear. Electric railways in America have not experienced difficulties through lack of traction on account of the use of chilled wheels. Cars equipped with them run up and down severe grades without difficulty, and in winter cars are run over tracks coated with snow and ice without the trouble that some engineers in Europe claim to find under ordinary conditions. If the contact of wheels and rails of electric railways was of the

same character as in ordinary steam service the result might be different; but passing an electric current through wheels and rails undoubtedly produces a certain amount of magnetic contact which enables the electric cars to run up grades that would be impossible if other descriptions of power were used. It is quite certain that when difficulties in securing proper traction with chilled wheels are experienced there are other causes largely responsible, for it would be impossible that such difficulties could prevail in Europe and not be experienced in America.

Experiments have been made with track brakes operating both by pressure and magnetic contact. If the latter can be made practicable it will afford a solution of the whole problem of brake service. The principle of magnetic brakes is based on the use of brake shoes brought in contact with rails instead of wheels. When the brake shoe is applied, magnetic contact is caused between the shoe and the rail and brake power is obtained in any desired degree by varying the intensity of the current. As the contact does not depend in any degree upon the load or weight of car there can be no danger of accident. If such a result could be brought about, wheel service would be relieved from one of the greatest hardships it now has to endure. It is a curious situation which makes it necessary that wheels should be composed of hard and wear resisting materials—consequently those which reduce friction—in order to give proper service, and that on the other hand they should require to be composed of materials which will produce friction, in order to give the best brake service. With brakes applied to wheels it is a well known fact that efficiency decreases as speed increases, and thus control is really less at high than at low speeds. This is the reverse of what it should be. If the magnetic track brake is possible the situation would be entirely changed, as speed would have nothing to do with brake efficiency. The subject seems well worthy of study and investigation.

One of the best reasons for the great progress made on American electric railways is the practice of one company investigating and profiting by the experience of another. Superintendents and engineers are vitally concerned in the results obtained by each other, and in general they do not hesitate to profit by joint experiences. An important feature of electric railway practice in America is the close attention given to details. Expenses of all kinds are separated and closely scanned, and superintendents and engineers are required to keep up a good average of results in these matters. Many systems are operated under one general ownership, inspections are frequently made, results of all kinds are compared, and it naturally follows that practice is steadily advanced to higher ground, with corresponding results. This advanced position has naturally led to much investigation and study of American practice on the part of engineers and railway managers operating or contemplating operations in Europe, and to the growth of an acquaintance between them which has proved very aggreeable and beneficial to all concerned. This has led also to a considerable introduction of American practice and equipment abroad and to corresponding results in cases where our engineers or managers of railways have found developments of a higher order in the many complicated questions they are called upon to solve.

Papers Read at the Convention of Street Railway Accountants at Cleveland, March 23-24.

From Horse Car to Electric Accounts.

BY H. L. WILSON.

The property accounts of the horse railroads were generally few in number and in most instances were only divided into real estate, construction and equipment. At the present time the directors or officers of most roads wish to know what car house, equipment of same, power stations, steam and electric equipment of same, track, poles, overhead trolley lines, overhead feeder lines, feeder conduits, feeder cables for same, cars, trucks, motors, snow plows and other vehicles, machinery, tools, etc. cost, and in some instances want even greater detail than the above, or in other words, what the different kinds or methods of construction cost in certain streets or districts, and what the different makes of equipment cost. To one who has not had the experience it may seem very much of a task to keep all this information, but it is often very surprising to find how much can be accomplished with system when it is thoroughly understood. It is, of course, necessary to have more or less help from the men who are actively engaged upon the work. As a general rule, they do not appreciate the importance of the accounting department, but will in most instances do all in their power when a system is laid out for them to follow, if it is not too complicated, and as these men are not hired for their ability to consider these matters any more than we are to build or equip the road, care should be used to make them as little trouble as possible.

While the accountant may not be employed for his knowledge about the practical mechanical construction or operation of the railway, he will find that in many ways it is very desirable to obtain as much information on these subjects as possible. If he is able to discuss understandingly with the managers and heads of departments about the construction, equipment and operation, it will be found very much easier to keep records and accounts that will be valuable to all the parties interested in the management of the company.

At times it often appears as though the amount of detail which some companies have is more thay ever would be required, but no one can tell when he may be asked to give some particular item of information and when the time does come the person requesting it is almost sure to be in a hurry and is usually very much surprised if it cannot be furnished at once.

The managing director of a consolidated road in one of the large cities was in our office one afternoon when the president sent word that he wanted to know the number of feet and kind of track built on each street since the road was consolidated, and when word was sent back that the statement would be ready the following morning, he seemed very much surprised. He wanted to know if similar questions could be answered as promptly, and when told that they probably could, made the remark, "It must be a happy board of managers that can ask such questions and receive answers so promptly." It was only about a year afterward that the company which this gentleman represented was forced to go into the hands of a receiver. Possibly if their accounts had been kept in a different manner, their condition might have been brought so forcibly before them at some earlier date, that this could have been avoided. If not, there might have been some records that would have been of much value to the persons who reorganized the company.

In this connection it seems to me to be a very important part of the accountant's duty to make all the entries on the books so very plain and explicit that if referred to years afterward or by another person there can be no question about the meaning.

In the days of the horse railroad there were some companies, generally owned by one or two men, who cared to have few or no accounts. They knew how much money it cost to start their business and after that the only thing they thought of was how much they could get out of it. In one large city in the West that I know of, there was a road of this kind where, so I have been informed, the man who practically owned it would walk into the office while the conductors' returns were being counted and help himself to whatever cash he desired. Whether he wanted it for business of the company or private use was never known. It is unnecessary to state that the books in this office were never balanced, and yet the owner grew rich and sold the road for about $2,000,000 although what he had to sell outside the franchise rights was worth very little. The best managed horse roads kept comparatively few accounts, those in charge being generally satisfied if they knew what it cost to repair track, to repair cars, to repair buildings, to feed horses, to repair harness and general equipment, and to pay for operating labor. You might almost say this is as much as they know now, but the detail in any large well managed company is kept in such a manner that these accounts are so subdivided that very much more is available and constantly required.

John Locke, the eminent English philosopher, once wrote, "The skill of keeping accounts is a business of *reason* more than of arithmetic." I think that when a system is to be started "reason" should enter very largely into it.

First. What is it we want to know?

Second. What is the shortest and best way of obtaining this information?

When the electric roads were started the first question was a very hard one to answer, and I think that most companies found before long that they had more or less complete records of what they did not care particularly to know, and not enough of what they should have liked to have found out.

When anything new is introduced the projectors always claim a great deal, and the companies who wished to introduce electric power on the street railways were certainly no exception to this rule. The important thing to find out was whether or not all their claims could be substantiated, and this was where the accountant's duties began. As the company with which I am connected was the first to take hold of this new system of propulsion on a large scale, our experience may be as interesting as any.

The first line was built and the cars equipped by the electric company, and it guaranteed to keep the equipment in order for a specified sum per car mile.

Very shortly after they wanted to pass this business over to the company and the latter agreed to take it. Naturally the managers and directors were anxious to see if they could do this work as cheaply as was claimed, that they might have some basis on which

to work when they considered the advisibility of adopting electricity on other lines. The next time any new equipment was added it was of an improved pattern, and the question came up, How much cheaper can this be maintained than has been the former? Improvements came along so very fast in the early days that this was a considerable undertaking, but the information obtained proved so valuable that it is practically continued to the present time, with constantly improving methods, which makes the same information available with very much less work.

When the electric road was in its infancy it was frequently almost an impossibility to get many of the small parts necessary to maintain the equipment, as most of the manufacturing companies were bending all their energies to get out complete new equipments. In many instances when parts were obtained the price seemed to be out of all reason. This drove some of the larger companies to the necessity of establishing what might almost be termed manufacturing plants, and this, of course, added new features to street railway accounting.

The more important companies, as a general rule, now divide their operating expenses into a larger number of accounts, but how many they might have at this time if horse power had been continued is mere conjecture.

General expenses which can be, and in most instances are, separated into such accounts as salaries of officers and clerks, general expenses of offices, stationery and printing, legal expenses, inspectors' services and expenses, insurance, rents, etc., would apply equally well to either.

The material and labor used in the maintenance of buildings was generally included in one account in the old days, but in many instances is now subdivided into such accounts as repairs to car houses, repairs of shop, repairs of power station buildings, repairs of miscellaneous buildings, and sometimes a separate account is provided for such items as maintenance of miscellaneous fences, sewers, etc.

The maintenance of track is now one of the most important accounts with which electric railways have to deal and is capable of considerable analysis with good results. The total cost of this work on the West End Street Railway Company for the last fiscal year was over $938,000, and this was separated into such accounts as, superintendence, engineering and general expenses; labor repairing track; labor of teamsters; labor of watchmen, etc.; timber and ties; rails and fastenings; frogs, switches and guard rail; paving blocks; sand, gravel and cement; maintenance of track department, carts and vehicles; maintenance of track tools and equipment; use of horses, and miscellaneous expenses. A small road would not care for all this information, but when the expenditures amount to almost a million dollars in any one department, it is well to know for what it has been expended. Experts when called upon in the early days decided that the wear and tear upon the tracks by electric cars was about 45 per cent greater than the horse cars, but the accounts show that this was underestimated, as the cost of the material and labor that go to make up a mile of track in a large city at the present time would build several miles of old construction, and the life of the latter would be much longer if operated in the old way.

Maintenance of rolling stock was in most instances in the old days one account, but at the present time is generally so separated that those operating the company know what it costs to maintain the car bodies, the car trucks, the car fenders, the snow plows and carriages, wagons and vehicles, and in some instances these are so divided that the cost of the summer or open car equipment and the winter or closed car equipment is kept separate.

The principle difference in the operating expenses of the old companies and the new comes in the subdivision of what goes to make up the cost of the motive power. In the days of animal power, there was at most provender and bedding, shoeing, veterinary, harness repairs, horse renewals and stable labor. To-day there is labor in power stations, fuel, oil, water and miscellaneous supplies for power stations, maintenance of steam equipment of power stations, maintenance of electric equipment of power stations, maintenance of underground conduits, maintenance of underground cables, maintenance of overhead feeder lines, maintenance of poles, maintenance of overhead trolley lines, maintenance of track wiring or bonds maintenance of motor armatures and fields, maintenance of motor gearing, miscellaneous maintenance of motors, maintenance of controllers and rheostats, and maintenance of trolleys.

The cost of power furnished from the stations is also capable of considerable analysis and quite often with very good results. Where there is more than one station the cost per mile or per car hour or both, or total cost per kilowatt hour is information which it is often desirable to know. Some want to know the amount of water that is evaporated per pound of coal consumed, or cost of coal per kilowatt hour or answer to some similar questions. This not only gives a basis of comparison between the different power stations on the company's own road, but if another corporation is willing to give its cost of operation there is an opportunity to compare the plant and the results often give some valuable knowledge as to what kind of boilers, engines or generators it is for the advantage of the road to purchase for some contemplated addition or new station.

Many of the horse railway companies kept a separate account of the cost per day or per meal of feeding horses in the different stables, in order to compare the efficiency of the men in charge. The condition of the animals was, of course, a very good check, as if neglected in any way it would at once be apparent.

If the maintenance of motor accounts are kept separately by car houses and the total cost computed per car mile run it gives an extremely good comparison of what the different foremen in the car houses are capable of doing with the mechanical equipment in their care, as if a man is extravagant it is immediately detected, and as they know that their expenditures are being closely followed they are extremely careful of both their material and labor, yet realize that their work cannot be neglected as a delay on a street is now much more serious than it used to be. This information is not only valuable for the purpose mentioned above, but also as a basis of deciding when it is cheaper to buy new equipment than to continue operating the old, and the accounts are the only way that this knowledge can be obtained.

The revenue accounts have received considerable consideration lately and this to my mind is a very important department of the accounts. Not only is it important from the standpoint of the company, but equally so from that of the conductor, who has a large personal interest in knowing that he is to be protected as well as the corporation. No one is infallable and if the collector of fares thinks a mistake has been made in the office he should be encouraged rather than blamed if he wishes to look the matter up. If he should call and the error is found to be a mistake of the clerical force it gives him a very bad impression and in the long run probably acts to the disadvantage of the company, as his experience will be thoroughly talked over by the men in the lobby of his car house and perhaps travel over the entire division. On the other hand, if the seeker after information meets with a rebuff he is very sure that he has been cheated and is liable to try and get square with company. The force in the office working in this department should therefore use every care possible to avoid mistakes and be sure and treat the conductor with proper courtesy if he wishes to investigate any shortage with which he may have been charged.

It is only within comparatively recent years that a registering device for fares has been in use on street railways. When this was first introduced into Boston many conductors resigned, claiming that it was implying that they were dishonest, but at the present time any honest man ought to feel that this is only a mechanical device to help him keep his accounts.

The total miscellaneous earnings of many companies are divided among the different lines, but on some where the routes number away up in the hundreds and in many instances run over tracks used by several other lines, this is found impracticable. The best way that I know of to keep well informed about what the different lines are doing is to make a report once or twice a month of the passenger earnings per car mile on each route operated. If this is done anyone interested can see at a glance whether the number of trips should be increased or diminished or allowed to remain as they are, and if the patrons claim that they are not having the facilities that their patronage warrants this record will at once prove or disprove their claim. If it is figured only by trips it hardly gives a fair comparison on a large road where the lengths of a line vary.

Some of the largest companies have several divisions, any one of which is as large as a majority of the roads now operated, and have a separate superintendent in charge of each. Where this is the case, if the transportation expenses are divided and the cost figured per car mile run, the manager has an opportunity of knowing what his subordinates are doing. Of course, when comparisons of this kind are made it is necessary to take into consideration the territory operated by the different divisions, as one might be largely in the crowded streets of the city, while a large part of the mileage of another might be over suburban lines where the speed would make a considerable difference both in the earnings and expenses.

In many places the opinion prevails that an electric road is a veritable gold mine, and that the management can afford to do almost anything in the way of extension of lines and improvement of facilities, as well as pay large sums for taxes of different kinds, and perhaps maintain the streets through which the cars are operated. One of the most important things that the accounts are called upon to prove is that the company is doing all that ought to be expected of it, considering the amount invested, the operating expenses and the patronage given by the riding public.

THE RELATION OF ACCOUNTANTS TO MANAGERS AND EMPLOYES.

BY P. V. BURINGTON.

Managers as a class have well fixed ideas as to what the investors in street railways desire, but too often these ideas are far more local in the application than otherwise, and when data and figures are furnished as to operation, investors are often unable to make satisfactory comparison with the figures of similar corporations, in which they may have like interest, so that the value of one kind of securities placed beside another of like character cannot well be determined. One manager furnishes a statement of operations with an abnormally low operating per cent, while his construction and equipment accounts are apparently exorbitant. Another reports little or no construction and equipment and an abnormally high operating per cent. These statements placed together in the hands of the investor naturally lead him to distrust them both; the first on account of the possibility of trying to shoulder upon construction and equipment (to be lost sight of for the time being in property cost), what should have been in a great measure placed in maintenance; and the second on account of a possible scheme to wreck the value of the property and its net earning capacity by loading maintenance with all kinds of expenditures, and by this means discourage security holders to the brink of unloading their holdings at a sacrifice, resulting to the benefit of promoters of the scheme.

Managers of the general affairs of a street railway are not always in the position to estimate from day to day how and in what account channels expenditures are finding their way. It is at this

point I would have the accountant first school himself as to what to do and how to do it, and then systematically assert his independence. It is no credit to the accountant to go hit and miss in order to accord with the notions of this and that one. Neither is it a duty or kindness to the manager not to set wrong matters right, and place things where they belong.

When I speak of independence, do not understand me to mean either arrogance or obstinacy, but rather a well bred and well schooled insistance, if you please—just that kind of independence that gives character; and where is the sensible manager who will not respect this?

When the writer first entered street railway service, some six years ago, it was with some misgiving as to whether the new era of electric power would bring with it a higher order of service than obtained in the horse car days. The then existing order of inferior intelligence and character of employes was too apparent everywhere, entailing lack of courtesy to the public, and far too often exhibiting acts of uncalled for brutality. Both arrogance and coarseness of superintendents and foremen, and rude and familiar intercourse of employes, was much too prevalent, and proper names were lost sight of in nicknames. It is gratifying to be able to say that the higher order of intelligence required from the highest official to the lowest employe to operate street railways by electricity, is rapidly and steadily relegating these unwholesome features from the service. With greater intelligence, naturally comes higher standards of character, greater respect for discipline and proper courtesy to the public.

In all this the accountant has a part to play. His position requires a steady and unremitting watchfulness of the manner in which reports of any character are made, noting the weakness of one and the thoroughness of another, promptly investigating the one and commending the other; each to be done with courtesy and without familiarity. If you find an employe in error in his reports do not require correction without explanation, but rather call him to your office, go over the work with him and establish his confidence in your claim. You cannot spend a few minutes to the interest of the company more effectually than in this. Matters of this kind should never be submitted by accountants to employes on cars or before the public. When riding on a car, be seated as a passenger, and insist that clerks do the same, and that they enter into no familiar talk with employes. The familiarity of a clerk many often lead to telling important matters of the company not intended for general gossip; to the discussion of methods of checking reports and of detection of dishonest returns; of fancied favoritism shown one to the detriment of another, and a score of other things calculated to create uneasiness and distrust. If you have methods peculiarly your own by which to ferret out dishonest work, they should not be known outside the office. When the results have resolved themselves into proof, they should be promptly submitted to the manager for his action. If an employe has a grievance which does not concern you, he should not be argued with, but rather referred at once to the proper officer.

The office should be understood as the only place where business is transacted, except such affairs as may be delegated to inspectors or other officers as a part of their duties, and this place should have the business air of an express, counting room or bank, in which transactions are made quickly and with business courtesy. Nothing will more surely establish confidence with employes than an observance of these, and nothing more surely be an incentive for them to perform their duties in a like manner. By adopting these higher business principles, the accountant not only paves the way of respect for himself, but contributes largely to the enforcement of correct rules of discipline desired by the management.

There are at times many exasperating errors committed by employes, which require great patience in treatment, but when you have a case of this kind, always remember that not all the virtues can be expected to exist in the average man. Patience and moderation will find the remedy. If you find upon investigation that the supposed error comes back to you as the fault of the office, be quick to both acknowledge and correct it. Give every man his just due, and he will be more likely to accord you like treatment.

In conclusion let me say, that if the brief outline here given as to the relations of accountants to managers and employes shall serve to quicken a nobler and more efficient sense of what may be accomplished in the realm of street railway accounting, the object of this paper will have been accomplished, and I believe that we may safely anticipate the hearty approval of our superior officers.

Naming and Standardizing Apparatus.

BY J. P. E. CLARK.

Until I received notification of the proposed convention of street railway accountants, it had not occurred to me how completely the auditor, accountant and office had been ignored at conventions, in the preparation of papers read thereat, the general discussion ensuing, and even through the columns of the various journals published throughout the country devoted to street railroads and their interests.

Active and thorough research for data, useful in compiling this paper, revealed to me forcibly that the auditor, accountant and the best method of office work and record had been "lost in the shuffle," as, in looking over carefully the files of street railway journals of several state and national conventions, I found absolutely nothing relative to the subject, except in a brief and general way. When the important relation of the office to the practical managing department of the street railroad is considered, it is surprising that the state of affairs just mentioned exists. That this condition is radically wrong, none will gainsay.

This conference of street railway accountants, called for the purpose of arranging, if possible, a standard method of accounting, which can be adapted to meet the requirements of both the larger and smaller roads, will have accomplished valuable results, if the purpose of the convention is fully carried out.

In order to successfully accomplish the desired end it becomes necessary, as far as practicable, for the operating department to standardize and name equipment, apparatus and parts of every description, also materials of all kinds used in construction, in order that the various articles purchased as new outfit or used in repairs and maintenance will be charged under the proper heads. In view of the fact that a storekeeper's catalogue, recently published by an enterprising street railway manager, for the general use of street railroads, contains some 225 different headings, with numerous items under each, in many instances upward of one hundred, a person is overwhelmed at the outset by the vast number of articles used in the operation and maintenance of a street railway system. The first general impression gained is that the naming and standardizing of the apparatus and equipment is a hopeless task. A more detailed investigation of the catalogue, however, reveals that a majority of the articles mentioned therein are of minor importance and could be easily disposed of by a more general classification, so that, from the standpoint of the number of articles used, a standard could be arranged without great difficulty. There is, in my mind, a greater obstacle to overcome in standardizing and naming apparatus than the one I have just commented upon, and that is the fact that no two electric railroads are equipped alike. The style and pattern of car bodies, trucks, type of motors, station apparatus, the miscellaneous equipment and the character of work and material used in track and overhead construction vary according to the requirements of the respective roads, thereby precluding the possibility of as complete a standardizing of equipment and apparatus as might be desired or has been attained by steam railroads.

I also confess that I do not consider it altogether essential to street surface railroads that an absolute standard should be adopted. I do, however, firmly believe that there should be a formula arranged that would enable the accountant to enter charges under their proper headings and that there should be an understanding and agreement between the practical managing department of the various street railroads as to what constitutes motor parts, trucks, car bodies, generators, engines, boilers, station appliances, and all other classified equipment, and I submit that there should be detailed accounts and necessary forms for same, showing exactly the expense of maintenance and repairs, not only of the different classifications, but of the sub-classifications. The most important step in accomplishing the desired standard, and arriving at a fair and equitable basis of comparison, is that there should be a plain straightforward distinction made between cost of maintenance, repairs, renewals and betterments, and a standard form agreed upon so that when operating expenses of various roads were compared, the person, director, stockholder or bondholder making the comparison would know whether the figures shown were based upon similar charges.

The standardizing and naming of material used in the construction department,as far as practicable, is as necessary to the accountant as in the operating department and in my opinion can be more easily accomplished. While a perfect standardizing and naming of apparatus, equipment and material used in the operation of street railroads may be possible, a classification sufficiently explicit and complete can be arranged and the parts and material pertaining to the respective classification properly assigned. In this way the accountant will be enabled to enter charges under proper heads and when statements are submitted to the operating department the latter may have the satisfaction of knowing that the account, "repairs to steam plants" does not include any charges properly belonging to "removal of snow and ice."

An important factor in enabling the auditors or accountants to make proper classification is to familiarize themselves as far as possible with the practical operating department of their respective roads, and become acquainted with the appliances in use and the parts necessary to their repair. The operating department should in turn afford the office daily classified reports of repairs made and material used and give necessary details and information, thereby enabling the accountants to perform their work intelligently and with confidence.

A Simple System of Interurban Accounting.

BY W. B. BROCKWAY.

Our total mileage is about forty, twenty-five of which comprises the longest electric belt railroad in the United States. At the farthest point on the belt away from Toledo, a city of 140,000 people,are situated two towns of about 2500 inhabitants each. They are separated by the Maumee River which we cross on a steel bridge of our own. At one of these towns the road branches off for a distance of about 15 miles to Bowling Green, a town of about 8000 people. We own our own right of way situated just inside the dividing line between the highlands and the farmlands, except about 8 miles in the city of Toledo, over which we have a traffic agreement, but operate our own cars. It is necessary also to keep in mind that some cars go simply around and around the belt, thus giving opportunity for continuous rides, while others go out from Toledo on one side of the belt down the branch, and returning, take the opposite side of the belt, thus completing it. It naturally follows then, that in consideration of

the peculiar arrangement of the road, the tremendous fluctuation of the traffic, which in winter is about 45,000 passengers per month, and in the summer is as high as 130,000 per month, that the arrangement of our accounting should be based somewhat differently than some others. And so in comparing our methods with what you do, may I ask you to keep these circumstances in mind?

In planning the system of accounting for this changeable traffic, a system which will not be in the way while the rush is on in the summer and yet will give the satisfaction (and we all know how changeable that satisfaction is) demanded by the stockholders, I have departed somewhat from the systems I have seen for electric railways and have adopted as closely as possible the system in use upon steam railways. In adopting their methods I have taken the position that interurban and street railway accounting in the details of the operation are dissimilar, while interurban and steam railroad accounts in the same way have more in common.

It is probably unnecessary to say anything about our general books so I shall confine myself almost wholly to the method of gathering and compiling our earnings and operating expenses. But there is one thing which may interest you, and that is the method of gathering the several accounts into the general ledger. I charge everything possible from the books of record directly into the ledger and so save journalizing, I use less than a page of our journal each month.

And now, in the first place, as the earnings of the road come entirely from the tickets sold upon the cars or in the offices, it is proper to start with a description of them. The tickets sold upon the cars by the conductors are two in number, one north bound and one south bound. They are of the duplex style and so arranged that all possible traffic from any station to any other station, whether one-way, round-trip, half-fares one-way, half-fare round-trip, or half or adult city-fare may be sold by the conductor with but one punch mark to show the station from, the station to, and the kind of traffic.

We thus obtain that which is most essential, the saving of the conductor's time in the rush of heavy traffic, and we lessen the chance of possible errors by having but one punch mark show all that it is necessary to show. We have used these tickets through all kinds of traffic and we think we have the much vexed ticket question as nearly solved as possible. To lessen the possibility of arguments with passengers, conductors are instructed to spoil all tickets in which a chance error occurs in punching, and return them to the office, instead of trying to cancel one punch mark and make a correct one.

It is in our conductors' reports, however, where the greatest difference is noticed between most systems and ours. We do not require a report of the whole day of the car from start to finish and a summary of each trip's earnings upon the remittance envelope and so duplicating the clerical work of the conductor, taking his time and increasing his chances of error, but at the end of each round trip or part of a trip he makes out a report for that round trip, encloses it in its envelope with the cash for that trip, and that is all there is to it. By this we save the comparison in the office of the trip envelope record with the report for the whole day, and we ask for but little more for our round trip report than is necessary to fill out the record on the customary trip envelopes only.

These reports are, as I have inferred, small, but cover all our possible needs. The tickets are assorted by values, the number of tickets of each value is shown; the number of half fares and their total value; the number of express packages and the total receipts from them; the total number of return tickets collected; the total number of all passengers except free tickets and the total cash for the trip. The conductor shows his time of passing or arriving at five places on the line, from which record the time of himself and motorman are figured. On his last report for the day he shows the hours and minutes in service claimed, and the closing numbers of his tickets.

When a conductor is relieved before completing the round trip, he and the conductor relieving him make two separate reports, but use the same trip number. In other words, in having a trip instead of a daily report, we do not enlarge the conductor's labor, but lessen it. We have less work in the office and I think we obtain as satisfactory results.

In accounting return tickets we use the whole round trip fare when the ticket is sold, giving that day credit for the whole value of the ticket instead of letting the day of sale have half and the day of return have half. When the return comes in, the reports of the day show how many were lifted and, of course, they are counted in the number of passengers carried.

The earnings book is almost an exact counterpart of the conductors' reports, having columns provided for nearly all things shown on the report, with the exception that all tickets sold by the conductor outside of half fares, express and local city fares are shown in one total number and their total value. Where two conductors have the same round trip, one starting and the other completing it, the two reports are combined and shown as one on the record. As the round trips are numbered so also is there a space provided on the record so that it will show what any particular round trip was worth. At each change in time I affix a new time card to the page for the day of effect to show the changes in any particular run for comparison at any time. Each day's page is complete in itself, but the total receipts to date and the total passengers to date are carried forward from day to day. At the end of the month each day's several totals are carried forward to a page where the whole month is shown, and as already referred to, postings are made directly into the general ledger from this book.

As the tickets have no actual value when issued from the office, the conductor receipts for one hundred tickets at a time. A record is made of these issues and the conductor charged. Each day the tickets, returned with their value punched, are assorted numerically and checked in on a sheet having one hundred numbers printed—as soon as the one hundred tickets are shown as having all been returned, a simple check mark on the ticket register cancels the charge against the conductor. Should any ticket not be returned, the conductor is required to pay the highest value of the ticket. The tickets are then assorted by stations from and stations to, and filed away in a case for the purpose, having a pigeon hole for each station from and to. By the way, when I wanted this case made, the price quoted was entirely too high and I would not order it, but obtaining forty-nine cigar boxes with square ends, knocked out one end, tacked the cover down, piled them in the shape I wanted and fastened them together with light boards. It looks much better than I thought it would, fills all the needs required of it, and best of all, cost but eighteen cents, instead of $23. The tickets thus filed are counted each week to lighten the labor, and at the end of the month a traffic statement is made, showing the number of tickets sold from one station to another. The tickets are then enclosed in rubber bands for ready reference, shelved for one month and then burned. It is customary, perhaps, to keep the tickets for a longer period, but we have had but a single instance to refer to the shelved tickets, and that developed within two weeks after being filed.

As to the operating expenses and the distribution of them I have again gone to the steam railroads for assistance. I have taken the Official Classification of the Interstate Commerce Commission so far as it applies to our needs. This classification is the result of the labors of a committee of the Association of American Railway Accountants, an association similar to this. Their method of charging items in operation is very clear and is the result of long experience, and I would suggest that their plan be examined before finally adapting one of our own. All payments made during or for any month in operation are distributed upon the vouchers and the several columns of the voucher record are charged directly from that record into the general ledger. Car, line and track foremen furnish a daily statement to the office of the amount, kind and value of labor and material used; whether for repairs or for construction. The total material used from the storeroom is compiled in the office and charged from the journal.

We pay but once a month, but the time allowed is kept daily.

A record of the power house meter readings is also kept daily at a given time; this, on the office record, shows the reading of the generator, the number of watts used for the twenty-four hours, the total cost per day, the number of cars run and the average cost per car per day. We buy our power so that when the bill does not agree with our record we want to know why.

And now, in closing, just a word about the payment of vouchers. Since the road commenced construction up to the present time, we have not paid out one cent by check, so called. All vouchers when ready for payment, are stamped as good for payment at such and such a bank, when properly dated and signed, and we have had no trouble, it is needless to say, about receiving the vouchers back, properly signed, and that quickly. Papers pertaining to the voucher are never attached, but bear the same number, and when the voucher is returned through the bank they are filed inside of it. We close our books, of course, at the end of the month, but the voucher record is held open for several, usually ten, days, to permit the entrance of all bills for that month, so that, when the balance sheet is finally taken off on the fifteenth it shows the actual earnings and expenses for the month in question.

Thus, in brief, I have outlined the general points of our system of accounting interurban traffic. I believe it is simple and it has proven itself effective, but as I said in the beginning, circumstances are different and so must systems of accounting differ and still be similar. I understand, of course, that we have not the only system of accounting and I presume I shall understand it more fully after the discussion which may follow me, but preceding that discussion I feel as though we are at least not encumbered with a number of unnecessary ways of reaching the desired results.

I have also tried to keep in mind that simplicity of accounts means not only that my successor (for none of us always stay in the same place all our lives) may the more readily pick out my methods of work, but that it requires less time to work a simple system to the results, less clerical help in manipulating, and thus is more economical in the matter of office expenses, etc., as shown on the balance sheet.

Transfers.

BY FRANK R. GREENE.

The subject of transfers is always an important one to street railway men, and should be given a great deal of thought and study on the part of the street railway accountant, as well as the general manager. While it is an important factor in the earning power of a road, it also presents problems that the auditor should be familiar with, for, on close inspection, many loopholes for leakage may appear which, if not closed up, may prove costly to a company.

The company with which I am connected has its own printing office, located in the general office building, and in this manner we reduce to a minimum the chance of dishonest employes of the printing shop carrying on an illegal traffic in transfer tickets, which is more likely to occur where the tickets are printed at a public printing office.

We print about 100,000,000 tickets each year, or about one for each passenger carried, some passengers requiring two tickets on a single continuous trip, while others receive one. We, of course,

print a considerable number more than we expect to use, and these are returned to the general office and destroyed. As the month, year and day are printed upon the face of the transfer, we usually print them from two to three months in advance. They are then assorted and put in packages and sent out to the several depots only one day before they are used. The conductor receives a package of new transfers each morning as he goes to work. All transfers unused by the conductor are turned in to the receiver at the depot, when his day's work is done, together with those he has collected as fares. After the canceled ones have been duly examined and checked with his trip sheet, they are all thrown into a large bag and sent to the general office where they are destroyed by being dumped into the furnace. The Chicago City Railway Company operates about thirty different lines, and originally printed about fifty different forms of transfers, while to-day we issue only twelve different forms. While formerly the conductor punched out the hour and the street, after ascertaining from the passenger to which line he desired to be transferred, to-day he is able to punch his tickets before starting upon the trip, giving to all transfer passengers at the time fare is paid a like ticket. This is an important improvement as it gives the conductor more time to attend his other duties.

We, of course, use the different colors to represent different lines, which materially assist the receiving conductor in quickly reading the transfer correctly. As passengers on some of our lines are entitled to receive a transfer only on the payment of a cash fare, it is necessary to issue the transfer at the time fare is paid. On other lines where we issue a transfer on a transfer it was the custom formerly to collect the fares first and issue the transfer later. This, I think, is bad practice, as the passenger can easily impose upon the conductor in this way, and we have adopted a rule that all transfers be issued at the time fare is paid.

Next month we shall make still further changes in the form of our tickets, by adopting the coupon style, which will permit us to issue transfers only upon the payment of cash fares on all lines at time fare is paid. The time limit, one hour, has remained the same as on our tickets, and we find that it is satisfactory for our system, but a shorter limit might answer for a smaller road where the conductor has more time to devote to this part of the work As most of our patrons require one change of cars to reach their destination, the loss is very small in consequence of the passenger giving away his ticket. Formerly it was the custom to ring up transfers the same as cash fares, but we soon found that this was bad practice, as the conductor could easily obtain unused transfers from conductors from intersecting lines, punch them accordingly and turn them in as part of his collection to balance the register account. Now our conductors only ring up cash fares or tickets that have been sold for cash. This, I think, is a very important item when considering the subject of transfers, and should be given thorough investigation by all roads that are in the habit of registering transfers. It is the custom of some roads to have a separate register for transfers, and yet I doubt very much if this is any improvement over the old plan, as the passenger seldom notices anything beyond the usual tinkle of the bell and does not look to see whether the bell is located over the door of the car, or up the conductor's sleeve.

I doubt the advisability of using any form of ticket that does not have the date printed or stamped upon it, and yet I have not given this phase of the question sufficient thought to determine if other forms are not advantageous in some cases, when considering the question of economy as against fraudulent uses and abuses of the transfer ticket. Our custom is to "railroad" them, if I may use this phrase, as from the time they leave the strong room in the general office till they have become useless and have been duly consigned to the fiery furnace, their brief existence of active life is measured by two nights and a day. It is well, as is the custom with most roads, to identify each transfer issued by the several conductors, in order to trace irregularities, by special punch or stamping the number of the conductor upon the face of the ticket before issuing. We have found occasionally that a dishonest conductor would give away transfer tickets at certain points or thereabouts and in order to shield himself from exposure, would fail to stamp his number thereon. By systematically placing pin holes in the tickets used on a certain day and by the additional aid of detectives at certain points on the line we were able to trace these irregularities to the proper person.

Monthly Closing of Accounts.

BY DANA STEVENS.

Most of us have experienced the annoyance of having bills (of which we had no previous intimation) reach us long after the supplies were furnished or service was performed. The well known device, attractive lettering across face of requisitions directing how and to whom bills are to be forwarded, accomplishes the desired result to a great extent; however, directions in illuminated caps would not keep some from "going wrong." These we must know and carefully watch. Receiving belated bills does not always mean dereliction on part of creditors; sometimes they are overlooked or held by other departments, and the first suspicion of such liability reaches accounting department in shape of draft or a "please remit."

Perhaps the following suggestions, if carried out, would tend to insure accounting department closing books monthly without the omission of any entry which properly would appear. Direct that all invoices and bills of any nature be forwarded direct to the accounting department—have accounting department furnished with carbon or press copies—of all contracts and orders. Notice of date of appointment, and rate of compensation of new employes should be furnished proper time keeper, and copy of said notice forwarded accounting department.

The accounting department should be notified of completion of any contract, and also, immediately upon receipt of materials and supplies, manifest should be furnished accounting department stating from whom, what and quantity. Upon receipt of such notice the accounting department will make proper record to insure return is not overlooked, and forward the invoice corresponding with copy of order and received manifest to department in question for certification of bill as to prices, etc. This also, to an extent, guards against any carelessness on part of receiving clerk, as an invoice can be carelessly checked, but an accurate list of materials received cannot be made without exercise of due care.

The accounting department receiving notice of receipt of materials and holding copy of order for same, but no invoice, will take steps to obtain bill without further delay, impressing upon creditor in question the importance of always sending bills promptly; this should prevent future annoyance from that party. When invoice covering an order is received, and proper time has elapsed for receipt of goods, if no manifest of receipts have reached accounting department, inquiry can be made. Before closing month's business, any incomplete transactions can be looked into, and proper explanation reached.

All materials and supplies that are not properly chargeable direct to operating expenses or other similar accounts, but are held for gradual consumption, are to be charged to stock, the storeroom clerk reporting daily to the head of the department all issues and the number of the account chargeable (as shown by classification of expenses, etc.); the head of the department will approve the report, if correct, and send the same to the accounting department, where the reports will be compiled into a monthly distribution and credited stock account. Each storeroom will furnish monthly a statement of the amount of goods received, amount of issues and balance of stock on hand, which must agree with the amount shown for that account on the accounting department's balance sheet.

Pay rolls should be checked against previous rolls, and current copies of pay roll authorities and distribution of expenses compiled for the monthly entry.

The accounting department should keep a list of regular monthly entries, such as pro rata of interest, insurance, taxes and all debits or credits that regularly occur each month. This list checked off monthly as entries are made, is perhaps unnecessary, but is a safeguard.

Expense and earnings accounts should have balances brought down monthly, but not to be closed into the income account, except annually.

The practicability of the foregoing ideas depends largely on the volume of business to be handled, and also the efficiency of clerical force in other departments, and time that can be devoted by them to this branch of the service. In many instances it might be more feasible for the store department to voucher its own bills and pay rolls, simply turning them over to the accounting department to check. Be that as it may, the same line could possibly be followed by the store department, and, in conjunction with the accounting department, result satisfactorily.

Suggestions for a Standard System of Accounts.

BY C. N. DUFFY.

Beyond any question of a doubt, I think it will be admitted by all operating officials that a "standard system of accounts, classification of operating expense accounts, and form of report that will admit of comparison and diffuse information between companies," is not only desirable, but a consummation most devoutly to be wished for. The operating officials meet annually to talk on all questions pertaining to the operation of their roads, read, listen to and discuss papers, exchange opinions and experiences, but have no means of knowing if they profit by the information received and imparted, by a comparison of results, as would be possible with the adoption of a standard system.

It is entirely practical to adopt a standard system without changing the methods and system now in use on any one road, provided the accounting officer arrange his figures to conform with such standard as may be agreed upon, supplementing his present system with whatever is necessary to take care of the changed conditions. For example, a peculiar road might object to abandoning or changing its present system because the officers, directors and stockholders are familiar with it, or because they do not wish to throw away the ruled account books, forms, etc., now in use, or because they are obliged to keep their books and accounts as prescribed by a State Board of Railroad Commissioners. In such a case it would be perfectly feasible for the accounting officer to follow the classification of operating expense accounts adopted, arrange his figures to conform with the same on blanks prepared for that purpose and yet leave his present methods and system unchanged.

With regard to the question of methods now in use, one of the first things that suggests itself, is that of charging in operating expense accounts, purchases of materials and supplies. On some roads it is the custom to charge such purchases when the goods are received, on others when the bills are paid, on others when the goods are used. Undoubtedly, the last named is the only method that is absolutely correct, but it is not possible to use this method, unless the road has a storekeeping system, which, of course, is the proper and best system. Small roads cannot afford the expense of a storekeeping system, as it is useless to have a storeroom without a complete system of bookkeeping and checking. The argument that unless goods are charged only when used, that the exact cost of operating for any one month can not be determined, is true, but is not of such great importance. The result of the year is what we all look to, and not of any one month. Besides in order to get at even an

approximation of the exact cost of operation for one month, it is necessary to estimate and pro-rate the month's proportion of the yearly expense of water license, taxes, insurance, interest, and extra weekly pay rolls, on roads that pay their employes weekly. Then too, there is the damage account. With the liberality so characteristic of the juries of the present day, a road may be called upon to pay and charge up in one month, a sum equal to the average amount of any year. This is a condition that every road is ever confronted with and one that cannot be controlled. On some roads, the month's proportion of the estimated amount that will be charged up to damages in the year is pro-rated, and carried like insurance, taxes, etc. Take the items of coal for heating cars, and salt for track; on the majority of roads it is customary to buy these articles in large quantities in the fall of the year, pay the bills then, charge them on the office books to the accounts they properly belong to, and not put them on the store room books. On some roads, where purchases of material and supplies are charged when the bills are paid, the bills being paid regularly each month, purchases are made to conform with what a month's requirements are. I know of one system, with a total expense account of $765,000, in the year 1896, where the purchases of material and supplies of every kind charged in operating expenses, were only 12 per cent of the total expenses; of that amount, 40 per cent was for power house coal. Whatever may be the practice in vogue on any road, as to the charging of supply bills, it will not affect the adoption and use of a standard system, but uniformity of methods is desirable, if not absolutely necessary, to accomplish the result to be attained.

The one object that should be uppermost in the mind of the accounting officer of a street railway, is to keep his operating expense accounts in such a way, that the management of the road will profit by the information. In order to have a classification of operating expense accounts that will admit of this, there is great danger of having too much subdivision and itemization. This necessitates not only a mass of figures, but a corresponding amount of detail work that sometimes proves unwieldly. Another source of trouble is the difficulty of putting into practical operation, any system or standard that may be adopted, I refer to the dependent position occupied by the accountant, with reference to the necessary information and discrimination that must be relied upon from subordinates and heads of departments, as to the basis of charges. This is especially true of pay roll charges. Printed classification books and special ruled and printed time books do not remove the difficulty. It is one thing to have a theroretically perfect system, another to have it properly carried out. While this is true, it is highly essential for the accountant to have a system that will show in a comprehensive and practical way, just how the money of the company is being spent as compared with the preceding year, with such details of statistics that he can answer any question put to him. Above all, the accountant should be something more than a mere bookkeeping machine. He should be thoroughly posted on the affairs of the company and have a general knowledge of the operation of the road in all departments. Without these qualifications, his sphere of usefulness and the value of his services will necessarily be limited.

One of the problems that are perplexing and troublesome to solve in actual practice, is the separation of maintenance charges from operation or transportation charges. On this question there is a difference of opinion as to what properly constitutes a charge to either one, separately. Some hold that certain expenses of the electrical plant, the cars, motors, and electrical car equipments, track and roadway, are operation or transportation charges and not maintenance charges. Others contend that such expenses are maintenance charges. For example, carbon brushes for the dynamos, repairs and renewals of fare registers, trolley cord, motor brushes, etc., are classed operation or transportation expenses by some, because these expenses are incurred or rendered necessary by the operation of the cars. Others argue, that every expense of this kind is a maintenance expense, because it was incurred and rendered necessary in order to maintain the dynamos, fare registers, cars, motors, etc., in perfect condition, or in the same condition as prevailed when the operation of the road commenced, notwithstanding that the wear and tear was incidental to, and the result of operation of the cars. With regard to track and roadway, the same difference of opinion and practice exists. The expense of cleaning and sanding the track and removing snow and ice is considered by some a maintenance expense, by others an operation or transportation expense. It appears to me that the expenses of the electrical plant, the cars, motors and electrical car equipments, previously referred to, are properly maintenance charges; the expense of cleaning and sanding the track, removing snow and ice, operation or transportation charges. This question of distinction between maintenance and operation or transportation charges, is one that could be discussed to such length, that our patience would be exhausted and our minds brought to a state of hopeless confusion.

This distinction and the application of it applies not only to those items previously spoken of, but to many others. For example, shop machinery, tools and appliances; water, sand and salt cars; snow plows, sweepers and scrapers; wagons and vehicles. It is the universal practice, I believe, to charge to "Maintenance of Buildings," all expenses incurred in connection with the repairing of buildings. Some accountants keep a separation of power houses, repair shops, car houses, stables, offices, etc.; others do not. If it is thought proper to transfer the cost of maintaining any particular building or buildings to the account chargeable for its use, in order to ascertain the total expense of that account, as, for instance, power houses to the cost of producing power, car houses to the cost of operating the cars, etc., the separation should be made. Again we are confronted with the problem of making the proper distinction, as there will, of necessity, be charges to both maintenance and operation or transportation, in "Maintenance of Buildings" account. In the operation of the road, this question of distinction between charges is not one of great moment, although it is desirable that the lines should be closely drawn, that the separation will be clearly defined and as distinctly made as possible. Regardless of the separation of maintenance from operation or transportation, the practical general manager would probably be more interested in knowing, and the accountant should be able to tell him, the cost of power per kilowatt hour, per car mile, per passenger; the cost of repairs and renewals of the steam and electrical plant, with such itemization as would be considered important; the cost of fuel, water, lubrication, supplies and tools; the cost of lighting the power house building, and such other information concerning the operation of the power plant as he may desire, the cost of each car and car equipment per car mile and per passenger separately, making a separation of car bodies, trucks, fixtures and trimmings; the cost of wheels, brake shoes, painting, glass, seats, curtains, registers, etc.; the cost of oiling, lighting and heating a car; the cost of lubricating the motors, the cost in detail of the different parts of the motors and car equipments; the cost of the track per single mile, the track and roadway, the line, the expense of watering, sanding, salting and cleaning separately; making a separation of the ties, rails, fastenings, joints, special work, paving, crushed stone and ballast, etc., with such other details and statistics as may be found valuable or important.

On the question of statistical information concerning the operating expenses of a road per car, per car mile, per passenger, per mile of single track operated, conditions must be taken into consideration and complete data pertaining to them fully and explicitly set forth. It is important to know the kind of cars in use, whether single or double truck and how many of each, the number of open and the number of closed cars, the size of the car bodies, whether or not trail cars are operated, the type and capacity of motors, the number of car miles made over each mile of single track operated, showing the motor and trailer miles separately, the passengers carried per car mile, giving the adults and children, fare and transfer passengers separately. The car mile units appear to be the only basis to figure on, but for the purpose of comparing results, it is sometimes misleading and unsatisfactory, by reason of the conditions previously referred to. Some time ago a road operating double truck, closed motor cars and single truck, closed motor cars with closed and open trail cars, for its own information and education gathered data and statistics to determine which was the best kind of car to operate, from every standpoint. In making up the figures, it was found that the only way in which a comparison could be made with any degree of correctness or satisfaction, was to figure on the seating capacity available, with each style of car operated. It must not be inferred from this, that the basis of figuring operating expenses should be per passenger carried per car mile, and not per car mile run, as roads enjoying a heavy traffic, would have a great advantage over those having a light traffic and there could be such a thing as running car miles without carrying passengers.

With reference to construction and equipment accounts, too much care cannot be exercised in making charges. Frequently the management of roads charge to construction and equipment, expenses that properly belong in operation. This is all wrong and should not be done under any circumstances. This practice is apt to prevail on roads that do not make a favorable showing. Any expenditure that is not absolutely and actually an *increase*, *betterment* or *addition* to the property of the company, should be classed and charged as an operating expense. It is desirable to keep such subdivisions and itemization of construction and equipment accounts, as will enable the accountant to have full and complete data, showing the cost in detail of each account, and of the items that compose each account. An indexed "Cost Book" will be found a convenient reference, having the cost of the principal items, indexed under the proper headings. It is important that the accountant should be in a position to give any information that may be called for, concerning construction and equipment accounts, as he should be able to answer any question that may be asked him, concerning operating expense accounts.

While on the subject of construction and equipment, it will not be out of place, even at the risk of appearing to overstep the boundaries and duties of his position, or of assuming the responsibilities that properly belong to those higher in authority than himself, for the accounting officer to draw attention to the necessity of charging off annually, a certain amount for depreciation, wear and tear, etc., of the property of his company, and of the creation of a sinking fund or surplus account, that will really be what it means, having the amounts credited to it invested in some safe interest earning investment, so that when the time comes, as it surely will come, sooner perhaps than is anticipated, when it will be necessary to renew the power plant, cars and motors, track, buildings, etc., that the money will be on hand available for that purpose, and that the company will not be obliged to increase its bonded indebtedness, even if it is fortunate enough to be able to dispose of the bonds.

The argument, that the maintenance of the property prevents any depreciation or wear and tear, and therefore there is no necessity of charging off an amount annually to such an account, will not hold good in actual practice, as has been forcibly demonstrated in the last ten years in the change from animal to cable and electric power, and still more so, on those roads that first changed their power from animal to cable, and then to electricity.

LETTERS AND HINTS FROM PRACTICAL MEN.

Double Truck Cars in Denver.

The Denver Consolidated Tramway Company,
Denver, Colo., Feb. 23, 1897.
Editors Street Railway Journal:

The article on the advantages of double truck cars by Mr. McCulloch, which appeared in the October issue of the Street Railway Journal, treated the subject in a most thorough manner, and confirms our experience in many respects. We first began the operation of eight-wheel cars in the summer of 1891, adding to our equipment from time to time, and at present about one-half of our motor cars are of that style.

Mr. McCulloch's figures, demonstrating that a single truck car can be run cheaper than a double truck car, are undoubtedly correct; but his conclusion that an eight-wheel car is preferred and demanded by the public, and for that reason must be run, seems to us to outweigh all the arguments against it. The double-truck, cross-seat car is very popular with our patrons; and we have determined that our future orders shall be for that kind entirely. They prefer it because it runs faster and more smoothly, and because they can face the way the car is going and look out of the windows, and not sit staring at each other, or be obliged to stumble over each other in getting in and out.

Our men also prefer that kind of a car, because it enables them to do their work more quickly and better, and with more safety to themselves. We have had several accidents to conductors caused by their stepping from one car to another and resulting in several instances, in maiming them for life. Several passengers have also fallen, in attempting to get from one car to the other, while they were

COMBINATION CAR IN DENVER.

in motion. We use combination cars on a number of our lines.

Our climate is such that people prefer to ride in open cars nearly the whole of the year, there being but very few days when the clear, bracing air does not invite people to ride outside; so that we must either run a trailer or a combination car. We changed a number of our 16 ft. and 18-ft. cars, putting on an open part about 11 ft. in length. Our future orders will probably be for cars 36 ft. in length, 14 ft. open and 14 ft. closed, with 4 ft. platforms. By means of storm-curtains and a glass partition at the end, the open part of the car is made comfortable in stormy weather. The closed part of the car is run ahead, so that passengers on the open part are sheltered from the wind, and smokers can enjoy their cigars in comfort; a thing impossible on the grip cars of our competitor.

The combination car being adapted to all kinds of weather, obviates the necessity of having one class of cars for summer and another for winter, and the consequent changing of motors twice a year. We find that an eight wheel car also permits of much greater speed, a thing which the traveling public greatly desires. The galloping motion of short cars on rough track is entirely obviated, and the imperfections in track are not nearly so apparent to the passengers.

Better traction is afforded with an eight wheel car, because the load is placed where it is needed. Our observation has been that people will get into the trailer, in preference to the motor car; loading down the former, and often leaving the latter unoccupied.

Another advantage of an eight-wheel car, is that it enables us to check up the conductor better. It is difficult for an inspector to check up two cars at the same time; and again, the conductor may collect fares on one car and ring them on the other; but with an eight-wheel car, the entire load can be checked accurately. We use a double faced register on the combination cars.

Two of the disadvantages of an eight wheel car are, the additional cost of truck repairs, and the increased time required for unloading passengers; however, we are strongly of the opinion that altogether the advantages far outweigh the disadvantages, and we shall continue to use that style of car.

C. K. Durbin,
Superintendent.

The Wear and Care of Wheels.

Terre Haute Car & Manufacturing Company,
Terre Haute, Ind., March 9, 1897.
Editors Street Railway Journal:

I have carefully read Mr. Cooper's articles in your February and March issues and take pleasure in saying that I believe that he has given an exhaustive treatise on this subject, though I am in rather a poor position to criticise as I simply make wheels and do not run them. The most notable thing in the article is its extreme fairness, Mr. Cooper not being inclined to make the wheel maker responsible for something he has nothing to do with.

About the only point upon which I take issue with him is where he permits mating or putting on the same axle two wheels (although he does not approve of it) varying $\frac{1}{8}$ in. in diameter or $\frac{3}{8}$ in. in circumference and especially when he shows how easy it is, by means of a metal tape, to get two of practically the same circumference. He calls attention to getting the wheels onto the axle at too great a distance apart or too close. This happens very frequently and is due in part to carelessness, and in part to a difference of opinion as to where the gage line should be measured, on account of the series of curves where the tread goes over into the flange. It is also due, sometimes, to the inability of people to measure, no matter how clean their spectacles and rule are.

We run up against this very frequently in mounting new wheels on old axles. We have had complaints made of the flange being too high, the person saying it was more than 1 in. in height, when, in fact, it was a scant $\frac{5}{8}$ in., having been ordered $\frac{5}{8}$ in. We never undertake a contract of any size for wheels and axles without demanding a wheel gage from the road. About a year ago, we furnished a thousand axles to go under a lot of new cars for one of the biggest systems in the country and, had we used a standard gage, we should have pressed the wheels on a good $\frac{1}{4}$ in. too close together.

In regard to grinding, I would say that I question its

economy, as the cost of taking the axles from under the car and returning it is, of course, the same as if it were a new wheel and, instead of putting back a new wheel with a long life, an old wheel with a short life is returned under the car, especially if the flat spot was of any size.

Lewis J. Cox, President.

Track Construction without Ties in Detroit.

The Detroit Railway.

Detroit, Mich., Feb. 23, 1897.

Editors Street Railway Journal:

In the construction of this railway a considerable amount of track was laid without ties, in streets that were paved with brick or asphalt. The construction, which was described in the Street Railway Journal for January, 1896, and which provided an 8 in. concrete foundation for the rails with tie rods every 10 ft., is giving the very best of satisfaction. At the present writing we find the alignment of this track better than where oak ties were used, upon a 6 in. concrete foundation. In only two or three places has the track gone down so as to be noticeable and these are on an asphalt paved street, and with track that was laid the first day we tried this kind of construction. We think therefore that these defects were caused partially by our inexperienced men; and partly because the base of the trench was not broad enough for the soft treacherous soil we have here in many places. The concrete should be made about 18 ins. wide on base, and tapering to 12 ins. at base of rail. This in a measure would be regulated by the support that can be derived from the concrete under the pavement, but in the case of a street paved with asphalt and using a 7 in. rail, the concrete beam or foundation course, is entirely below the concrete under the asphalt, and consequently receives but very little support from that source.

With this one improvement, which is to be determined by the nature of the soil, we can recommend trench work construction, where tracks are to be laid in streets that are *already* paved with asphalt or brick, on a concrete foundation, as being a method giving the best of satisfaction, and costing, for labor, concrete material, etc., from 50 per cent to 65 per cent less than where tie construction is used, and the company has to pay for the pavement disturbed.

F. A. Little,
Civil Engr. Det. Ry.

Current Consumption of Electric Heaters.

Schuylkill Valley Traction Company.

Norristown, Pa., Mar. 13, 1897.

Editors Street Railway Journal:

The article on heating cars by electricity on page 160 of the March number of the Street Railway Journal has attracted my attention, and I notice you give a wide range in current consumption of electric heaters by different companies. For the benefit of those who have not made any tests we would state that we have experimented in different ways with ten cars of late.

First we ran our heaters full capacity until 10 o'clock in the morning and while in service took the readings of the ammeter every ten seconds for an hour. After 10 o'clock all heaters were turned entirely off and we again took readings every ten seconds for an hour, striking the average of amperes used, heaters on and heaters off. At this time the travel was practically the same.

Another test was made by taking a car out over the road with an ammeter on the dashboard in the heater circuit. Again after midnight when the cars were all in the barn, and the day's work finished, we turned the heat on in ten cars, all lights out, at our three car houses. The temperature was raised from 35 degs. outside to 48 degs. in the cars at the end of the line and 52 degs. in those near the station. The cars are 16 ft. inside measurement, and are equipped with four heaters each.

The result of the three different tests was about the same, i.e., that the power used for heating the cars was from 20 to 22 per cent of that power used for both propelling and heating. I am speaking now of the Consolidated Car Heating Company's heaters of the latest type which we regard as good—perhaps the best. In short it takes about 5 h. p. or from 6 to 7 amps. of current to heat a car in the way described.

R. M. Douglass,
Gen. Man.

Cost of Station Operation in Brooklyn.

The accompanying table gives the cost of operation of each of the power stations of the Brooklyn Heights Railroad Company per kilowatt hour for the year 1896. The figures given include all payments made for station account, the repair charges including all repairs to buildings as well as to machinery. The statement is particularly interesting as it affords an opportunity of judging the relative economy of direct connected and belted units, and of condensing and non-condensing engines in the same city, and therefore under practically the same conditions as to cost of fuel, labor, etc. The "grand average" was determined by dividing the total costs by the total kilowatt hours of the three stations. The number of cars run during the winter is about 900 and during the summer about 1100. The steam equipment of the stations is as follows.

Eastern Station.—Twelve batteries of boilers 500 h. p. each, Babcock & Wilcox; four cross compound condensing engines 2000 h. p. each, F. P. Allis; four 1500 k. w. generators, direct connected, General Electric Company.

Southern Station.—Eight batteries of boilers 500 h. p. each, Babcock & Wilcox; six cross compound condensing engines 1000 h. p. each, E. P. Allis; twelve 500 k. w. generators, belted over belt tightener, General Electric Company.

Ridgewood Station.—Four batteries of boilers 500 h. p. each. Babcock & Wilcox; three tandem compound non-condensing engines 700 h. p. each, McIntosh & Seymour; six 300 k. w. generators belted, General Electric Company.

Statement of the Cost of Operation of each of the Power Stations of the Brooklyn Heights Railroad Company, per Kilowatt Hour, Year of 1896.

	Eastern Station	Southern Station	Ridgew'd Station	Grand Average
Operation.				
Fuel and Supplies. . .	$ .002958	$ .003507	$ .005702	$ .003507
Labor	.001896	.002815	.003393	.002402
Repairs.				
Supplies	.000179	.000235	.000197	.000199
Labor	.000256	.000370	.000295	.000296
Total	$ .005289	$ .006928	$ .009588	$ .006387

Low Fares Defeated in San Francisco.

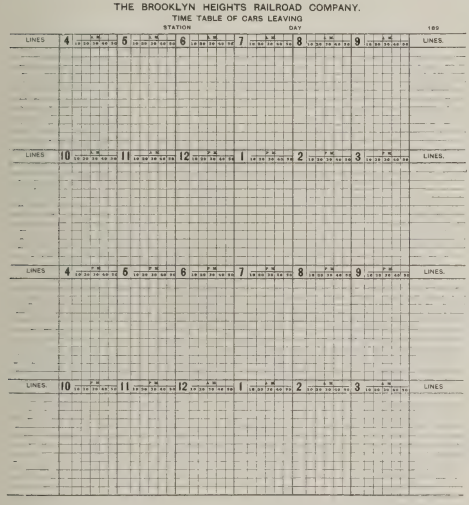
The chief event of interest in San Francisco recently has been the agitation about the Braunhart bill for the reduction of street railway fares in San Francisco. This bill, which was introduced into the State Senate at Sacramento, provided for the reduction of all street railway fares to 2½ cents. The bill provoked one of the warmest and most interesting debates of the session and was attacked by the business men of the state who recognized it as a blow at capital and as inimical to the interests of the entire community, and also by the street railway employes at San Francisco who adopted resolutions condemning the proposed legislation on the ground that in case of its passage their wages would necessarily be reduced. The bill was finally defeated in the Senate by a vote of thirty-five to six.

Time Table Report.

The accompanying engraving is a reproduction on a small scale of a new form of time table report recently devised by Ira A. McCormack, general superintendent of the Brooklyn Heights Railroad Company, of Brooklyn, N. Y., and in use now on that line. The object of the blank is to inform the general superintendent of the actual leaving time of the cars at different starting points. These blanks are furnished the starters at the several prominent points on the company's system and are filled out by them daily and forwarded to the general superintendent.

As will be seen, space is left at the top of the blank for the date and terminal station, and at the extreme left hand column for the names of the lines operated from that station. The actual leaving time of the different cars can then be entered up in the several blank spaces very simply, as follows:—Cars leaving at 4.02, 4.05 or 4.08 would be shown by simply writing 2, 5 or 8 in the square under 4 on the time table and so throughout the day. A check mark (✓) is made when the care leaves on the even hour.

By comparing this with the time table the general superintendent can determine whether the cars have been


THE BROOKLYN HEIGHTS RAILROAD COMPANY.
TIME TABLE OF CARS LEAVING
STATION DAY
189
LINES. 4 5 6 7 8 9 LINES.
LINES. 10 11 12 1 2 3 LINES.
LINES. 4 5 6 7 8 9 LINES.
LINES. 10 11 12 1 2 3 LINES.

late in leaving the terminal points. The record is not only convenient for this purpose, but also in case of any accident where the actual leaving time of the car may be an important point. At the foot of the table are contained blanks for recording the state of the weather at the different times of the day.

Last month a through electric line was opened between Paterson and Newark, N. J. The line will be operated jointly by the Paterson Railway Company and the Consolidated Traction Company, of New Jersey, the cars of both companies operating over the system from one city to the other. The line runs through a very attractive country, a large part of which has heretofore been unsupplied with electric transit facilities. It is thought that a large business will be done during the coming season in excursion traffic, especially by trolley party cars. These cars can be engaged from either company on a basis between the companies probably of about $5 as a guarantee for the car going out, and about $3 per hour for the time the car is in service. With an open car seating sixty persons this will give a party an outing for the evening for about twenty-five cents per passenger.

Carnival Traffic in New Orleans.

During the two days of the Mardi Gras Carnival in New Orleans, the New Orleans Traction Company carried 275,000 passengers and had in service an average of 240 cars, or forty more than last year. Not a single accident

CANAL STREET, NEW ORLEANS, AT CARNIVAL TIME.

was reported. This immunity was probably due to the fact that the company recently built two or three cross lines, by which the cars could be run around streets blocked by the procession.

The engraving presented herewith of the corner of Canal and Royal Streets during the passage of the carnival procession past that point gives an excellent idea of the crowds which gather in New Orleans at these times. The second engraving shows a Villero Street car decorated by its crew in honor of the carnival. Canal Street, upon which both views were taken, has probably a heavier street car traffic than any other street in the world. All the cars from the four different systems in the city center on

DECORATED CAR OF NEW ORLEANS TRACTION CO.

the five tracks in this street and an average of eight cars per minute pass the Lee Monument from 5 A.M. until 10 P.M. every day.

The portion of the station of the Louisiana Electric Light Company, which was purchased by the New Orleans Traction Company, is being rapidly equipped with new machinery. The Traction Company is also electrifying its Bayou Bridge line, 3 miles in length.

LEGAL NOTES AND COMMENTS.*

Edited by J. Aspinwall Hodge, Jr., and George L. Shearer,
of the New York Bar.

Survival of Actions for Personal Injuries.

A number of the states of our Union, including Illinois, Kansas, Vermont, Massachusetts, and South Dakota, have statutes which provide that a cause of action for personal injuries survives, or that an action begun for personal injuries which afterwards result in death can be revived. All these acts are, more or less, recent; and in all of the states there are ancient acts, which are similar to Lord Campbell's Act in England, and provide for the recovery of pecuniary damages suffered by the next of kin by reason of the death of a person which has been caused by the negligence or other tort of another.

The question has been raised in several of the courts of last resort as to whether, when the injury and death have not been simultaneous, both actions can be maintained; that is, whether, after the death of a person through injuries received by negligence, an action survives for the damages suffered during the lifetime of the deceased, recoverable by her personal representatives, precisely as an action in contract, which by common law survives; and whether an action can also be brought by the administrators, or other persons designated by statute, for the recovery of the damages accruing to the next of kin of the deceased and resulting from the death.

The following cases may be referred to in this connection: *Andrews v. R C., 34 Conn., 57; Holton v. Daly, 106 Ill., 131; Needham v. R. R., 38 Vt., 294; Bowes v. City of Boston, 155 Mass., 344; Belding v. R. R., 3 S. D., 369; Hyatt v. Adams, 16 Mich., 180; Whitford v. R. R., 23 N. Y., 465; McCarthy v. R. R., 18 Kansas, 46; Missouri P. R. R. v. Bennett, 47 Pac. R. (Kan.) 183.*

There is a decided conflict of authority in the above mentioned cases, as will be seen by a comparison of the Illinois case with the last mentioned Kansas case, the Illinois case holding that where an action is sought to be revived against the *tort feasor*, it, by some *legerdemain*, becomes transformed into the statutory action under Lord Campbell's Act, or the act analogous to it on the statute books; while the Kansas case, and others above cited, hold that the two actions are wholly distinct, and that both may be maintained, especially as they are for an entirely different set of damages, although the act which caused the damage is the same.

This manifestly would seem to be the only logical view to take. A single act oftentimes creates a number of causes of actions against its perpetrator, and the right to bring these various actions may be in one person or may be in several different persons. The most familiar example is the two actions which arise when a minor is injured through the negligence of another, and where an action is brought by his guardian *ad litem* (who perhaps is the father) for the damage done to him personally and the suffering he has endured, while another action may be brought by his father for the loss of services and wages of the son to which he is entitled. It would therefore seem that both good logic and the weight of authority support the decision in the Kansas case.

The right of action, it is to be noticed, accrues at a different date in the two cases. The action for personal injuries brought by the deceased between the time of the tort and his death, accrues at the instant the tort is committed, while the action arising out of the death accrues when death takes place; for the injury received will no more support the action unless it is followed by the death, than the death alone would support the action unless it results from the tort.

This discussion suggests a question, which we do not happen to have seen discussed in the books, to wit: whether recovery can be had by one who becomes entitled to the services of another some time after that other has received injuries through the negligence of a third party. It would appear to us that such an action could be maintained. It is curious to note in this connection that, if this is so, then four actions at least might, under a conceivable state of facts, be brought, because of the personal injuries inflicted upon a minor by a single act of negligence. To illustrate; an accident occurs to a minor unmarried female on the first day of January; on the first day of April she marries, and about that time becomes twenty-one years of age. The injuries have proved more or less serious, and finally she dies, as the result of the injuries, on the first of July. An action is brought by the guardian *ad litem* during the month of January for the personal injuries suffered by the girl, and simultaneously with this action one is begun by the father for the loss of his daughter's services. Shortly after the marriage the husband begins an action for the loss of the services of his wife through the injuries inflicted upon her. After her death, on the first of July, orders of revivor are entered in the three above mentioned actions, and a new action is brought by the person designated in the statute of the state for the damages resulting because of the death to the next of kin, or other persons mentioned in the statute.

It will be noted that none of these actions is brought for the same damages or for damages to strictly the same parties, though they all result from the same injury. The first action is for the suffering, inconvenience and loss occasioned to the injured party personally (irrespective of her earning capacity) from the first of January to the first of July, when she dies; the second is for the loss of her services or wages up to the time of marriage; the third, for the loss of her services subsequent to that date and up to the first of July; and the fourth for the pecuniary loss suffered by her next of kin or others mentioned in the statute.

FRANCHISES, ORDINANCES, ETC.

New Jersey.—A city, having authority under its charter to regulate the use of the public streets and highways, can enact an ordinance to compel passenger cars, operated by trolley or electric power, to come to a full stop before crossing intersecting streets; and such an ordinance, if enacted in the manner prescribed by the charter of the city, is legislative in its character, and will not be set aside as unreasonable in its purpose or effect.—(Cape May, etc., R. Co. v. City of Cape May, 36 At. Rep. 678.)

New Jersey.—It is within the authority of a city, under its police power to regulate the use of the public streets, to enact an ordinance limiting the rate of speed at which electric trolley cars of a street railway for the carriage of passengers may be operated in such streets.

The ordinance will not be set aside unless it be an unreasonable interference with the franchise or privilege conferred upon the street railway.—(State v. City of Cape May, 36 At. Rep. 679.)

Pennsylvania.—Municipal consent to the construction of a street railway connecting the municipality with other towns is limited to the construction of the proposed road as an entirety, and does not justify the construction of a road merely within the limits of the municipality giving such consent.—(P. R. Co. v. T. C. V. El. Ry., 36 At. Rep. 348.)

New York.—The owner of property abutting on a public street may sue to enjoin the unauthorized construction and maintenance by a street railway company of a siding track for its cars on the opposite side of the street.—(Irvine v. At. Ave. R. Co., 42 N. Y. Supp. 1103.)

Virginia.—Construction and operation under legislative and municipal authority, of an electric street railway, or conversion of

*Communications relating to this department may be addressed to the editors, No. 32 Nassau Street, New York.

a single track horse railway into a double track electric railway, is not an additional servitude on the street, for which abutting owners are entitled to compensation.—(Reid v. Norfolk City R. Co., 26 S. E. Rep. 428.)

New Jersey.—A city council, under the charter of the city, which confers power upon the council to make ordinances to regulate the public streets to prevent immoderate driving or riding, to provide the manner in which corporations or persons shall exercise any privilege granted to them in the use of the streets, to regulate the running of locomotive engines and railroad cars therein, and to protect persons and property, is authorized to enact an ordinance that all passenger cars operated by trolley or electric power in the streets of the city shall have proper and suitable fenders on the front of such cars to prevent accident, and that it shall be unlawful to operate such cars in the streets of the city without such fenders.—(State v. City of Cape May, 36 At. Rep. 696.)

Alabama.—In an action by a street railroad company to enjoin another from laying its tracks on a certain avenue occupied by complainant, and there crossing complainant's double tracks, the grounds alleged were that the avenue was too narrow for another track; that it would render very dangerous the common use of the avenue by vehicles and the cars of both companies; that the crossing was proposed to be made at a curve, where the grade was steep; and that defendant had another feasible route, only one and a half blocks longer, which would not cross complainant's tracks. The answer admitted that the crossing would be on a curve and grade, and that defendant could use such other route. *Held*, that it was error to dissolve a temporary injunction, on motion, where the averments of the bill not admitted by the answer were supported by ex parte affidavits of men familiar with the locality.—(Highland Ave. & B. R. Co. v. B. Ry. & El. Co., 21 South Rep. 342.)

New York.—The control of the state over the granting of street railroad franchises was not abrogated by Const. art. 3, §18, providing that no law shall authorize the construction of a street railroad without the consent of the local authorities; and therefore the sale of a franchise, though with the consent of the local authorities, is invalid, unless the statutory requirements are complied with.

The city is not a proper party to an action by a property owner to enjoin the unauthorized construction of a street railroad, though the lack of authority to construct results from the invalidity of the grant by the city of a franchise for such construction.

New York.—One whose place of business abuts on a highway may enjoin the unauthorized construction of a street railroad over only so much of the highway as is necessary for convenient access by his customers, and therefore an injunction against the construction over 7 miles thereof is too broad.—(Beekman v. Third Ave. R. Co., 43 N. Y. Supp. 174.)

Louisiana.—1. The general assembly did not intend to use the words "street railroad," in Act No. 135, of 1888, in any narrow or technical sense. Its evident purpose was to compel the city of New Orleans to make available for city purposes, and for the public benefit, in money, any local railroad franchise or privilege which was valuable and the amount to be derived from the granting of which was likely to be increased by being put up at public auction.—(N. O., C. & L. R. Co. v. Watkins, 21 South Rep. 199.)

LIABILITY FOR NEGLIGENCE.

Indiana.—In an action for injuries received in a collision at a railroad crossing, where it was alleged that the electric car and the locomotive approached the crossing in full view of each other, and neither made any effort to avoid a collision, it was not necessary, in order to charge defendant street railway company with negligence, to aver that those in charge of the locomotive gave the statutory signals on approaching a crossing.—(H. W. & E. C. El. Ry. Co. v. Spyzchalski, 46 N. E. Rep. 47.)

Louisiana.—It is negligence on the part of an electric street car company, in the construction and establishment of its plant, to so place one of its guy wires over the track of a steam railway company as not to afford sufficient space for the latter's trains to easily and conveniently pass, without risk of danger and injury to its servants and employes.—(Erslew v. N. O. & N. E. R. Co., 21 South 153.)

Kentucky.—Contributory negligence of a street railway passenger in projecting his arm out of the car window, whereby it was struck by a bridge, will not prevent recovery, where the conductor neglected to give warning, though seeing his danger in time.—(S. C. & C. St. Ry. Co. v. McCleave, 38 S. W. Rep. 1055.)

Kentucky.—Contributory negligence barred a recovery where a driver of a vehicle looked back, saw an electric car rapidly approaching, drove ahead, clear from the track, at a trot of 95 ft., and then, without looking back, attempted to cross in front of the car, mistakenly believing he had time to do so.—(Same v. Enslen, 35 S. W. Rep. 850.)

Pennsylvania.—Where one on foot was about to cross a street, and a car stopped just before reaching the crossing, each apparently expecting the other to wait, and then both started so nearly together that a collision was unavoidable, the question of contributory negligence was for the jury.—(Cleary v. P. & A. M. Tr. Co., 36 At. Rep. 323.)

Illinois.—A special finding in an action by one who, having fallen from a cable car, was run over by it, that, at the time plaintiff fell, the car was in motion, is inconsistent with a general verdict for plaintiff; the negligence alleged by the complaint being that after he had fallen off, and was on the ground, and while the car was not moving, it was suddenly started forward.—(Ebsery v. Chicago City Ry., 45 N. E. Rep. 1017.)

New Hampshire.—A carrier may expel a passenger who is drunk, and demeans himself so as to interfere with the comfort of the other passengers.

The expulsion of a drunken passenger from an electric car, shortly after sunset, upon a public highway, and near dwellings, is not the proximate cause of his death, caused by his wandering upon defendant's tracks, and being struck by another car.—(Edgerly v. Union St. Ry. Co., 36 At. Rep. 558.)

New York.—Negligence and contributory negligence are questions for the jury where plantiff's stage was struck by defendant's electric car going in the opposite direction while the stage was being driven along the street car track, the street on both sides of the track being impassable for a distance of 400 ft., and the driver first saw the car when he was in the middle of the obstructed section of the street, and the car was 600 or 800 ft. away.—(Delaney v. Yonkers R. Co., 43 N. Y. Supp. 225.)

New York.—Negligence and contributory negligence are questions for the jury, where defendant's electric car by which plaintiff was struck was not in sight until after plaintiff had turned his wagon across the car track in order to drive into his employer's yard as soon as the gate could be opened, from which position he could not move the wagon after the car came in sight, and the car could have been stopped, after the motorman saw the wagon on the track, in time to have avoided the collision.—(McGrane v. F. & C. P. El. Ry. Co., 43 N. Y. Supp. 385.)

Louisiana.—Any want of care on the part of the street car conductor, resulting in injury to a passenger, will make his principal responsible; but to call a boy passenger to the platform of the car, about to reach the boy's destination, the signal to stop the car having been given, will not be deemed negligence of the conductor, charging the carrier with responsibility for injuries to the boy from falling from the platform or car steps, the fall being due to his own imprudence.—(Cronan v. Crescent City R. Co., 21 South Rep. 163.)

Wisconsin.—Plaintiff a child thirty-one months old, while crossing a street, was run over by a street car. He started in the rear of a coal wagon which was moving north, and was struck by a car going south on a track 15 or 20 ft. distant from the wagon. There was evidence that the wagon had been driven some 100 ft. north after plaintiff passed from behind it, and was stopped before plaintiff was struck. Passengers on the car testified that they saw plaintiff when he started to cross the street, and also after he passed from behind the wagon. *Held*, that the jury were not bound to believe the testimony of the motorman that he did not see plaintiff until he was going under the car, and that a finding that the proximate cause of the injury was his failure to exercise ordinary care after he saw the child would not be disturbed.—(Slensby v. Milwaukee St. Ry. Co., 70 N. W. Rep. 67.)

New York.—Whether a car was prematurely started is a question for the jury where the driver directed plaintiff to enter the car by way of the front platform, and before she mounted the second step, the car was started, and she was thrown against the handles of the door, whereby she was injured.—(De Rozas v. Met. St. R. Co., 43 N. Y. Supp. 27.)

New Jersey.—When one who was passing on foot along a public highway, which had no sidewalk or path, but a side ditch and the rails of a street railway company whereon its cars ran in the same direction in which he was going were laid within about 2 ft. of the ditch, it was a question for the jury whether in walking along the track, or the narrow space between it and the ditch, he failed to do what a prudent man would do under the circumstances.

Plaintiff was a "little deaf;" but was not thereby excluded from the use of public highways; only his duty in respect to care for his personal safety is to be considered with reference to that disability.—(Buttelli v. J. C. H. v. R. El. Ry, Co., 36 At. Rep. 700.)

New York.—A verdict for plaintiff will not be set aside, as against the weight of evidence, where the issue was whether defendant's street car was in motion when plaintiff attempted to board it, and plaintiff testified that it was not, though his testimony was contradicted by that of the conductor and a passenger, and by a statement signed by plaintiff, made to a person employed by defendant to prepare the defense in its accident cases, who testified that he wrote the statement at plaintiff's dictation, and read it to him before he signed it, plaintiff testifying that he did not know what was put in the statement. Van Brunt, P. J., and Barrett, J., dissenting.—(Pohle v. Second Ave. R. Co., 42 N. Y. Supp. 1092.)

Texas.—In an action for the death of one killed by a street car, the defense was that deceased was drunk and paid no attention to warnings. The motorman testified that deceased did not heed the gong or the cries of witness, but staggered upon the track in front of the car. A justice of the peace testified that he refused to allow an autopsy which defendant desired in order to ascertain if deceased had been drinking. *Held*, that evidence that, just before he was killed, deceased did nothing which indicated that he was drunk or insane, was admissible in rebuttal. (San Antonio St. Ry. v. Renken, 38 S. W. Rep. 829.)

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Papers and correspondence on all subjects of practical interest to our readers are cordially invited. Our columns are always open for the discussion of problems of operation, construction, engineering, finance and invention.

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All matters intended for publication in the current issues must be received at our office not later than the twenty-second of each month.

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ONE of the most astute and far seeing street railway presidents in this country—a man who has deliberately and systematically educated himself in the science of railroading by the novel process of working his way up from the very beginning in every department of an important steam railroad system, resigning his position in each department when near the top in order to commence again at the foot of the ladder in another—recently expressed in a significant phrase a world of digested experience and practical wisdom bearing upon the management of men. "Rise above your own rules," he said one day to his superintendent when the latter asked his opinion on the question of laying off an old and faithful gripman whose record on the road had been almost spotlessly clean, but who had just become liable under the company's rules to the penalty of a suspension from duty on account of a minor accident. "That man has earned, by his faithful service, the right to a remission of the penalty in this particular case and you should grant it to him in spite of the charge of favoritism which may be brought against you" the president continued. "I sometimes look back to the days of my own early railroading when I felt it necessary to apply my rules strictly and impartially to all my men without regard to their records, and I think, with a keen pang of regret, how some of my best men were made to suffer because I feared to be thought a man of favorites." He was right—emphatically right—in holding that the successful manager must, so far as it is possible to do so, know his men and take account of the personal element in what is apt to be regarded as a mere administrative machine. It is true that no manager can personally know a thousand men or more, but when any case of discipline arises he can know the individual concerned in it through his record and through the heads of departments immediately in contact with the man and can rightly take this record into consideration in determining how a particular infraction of the rules shall be punished. As soon as a man feels that he is not a nonentity—a mere cog-wheel in the machine, whose loss will be felt only for the instant until another can be put in its place—he will acquire dignity and self-respect, together with a desire to deserve still further the confidence of his employers, and this will, in a large majority of cases, make him a loyal adherent of the administration. It will be difficult or impossible for outsiders to foment strike feeling among employes treated in this manner. On the road managed by this particular president, his men are enthusiastically loyal to him personally and have more than once driven the leaders of street railway employes' associations out of town with the statement that they would have nothing to do against the interests of "the old man."

* * * * *

The second remark referred to above was this: "I would rather pay one man $6000 a year to manage a department than four men $1500 a year." In other words, quality of brain matter counts more than quantity, and the right man as a department manager is worth many men of smaller calibre. This is the true principle of organization—to carefully choose executive agents and hold them responsible for a high grade or work. A custom which obtains on this road is for the president to meet his principal and subordinate officers at frequent periods in a sort of general conference, at which are discussed all kinds of difficulties arising in the operation of the system, in such a way as to often solve perplexing problems. In these conferences the president also discusses the detailed expenses on the road for the previous month as compared with other months and finds out reasons for differences in the results. This works in two ways, one, enabling the management to understand what is going on in its system, and the other, making the men doubly watchful to introduce economies, knowing that their work is being closely examined and good results appreciated. If a president or manager takes the ground that he is above talking with his minor employes or considering their suggestions he is quickly "out of touch" with them and is usually looked upon with indifference or positive dislike.

THE street railway accountants' convention, at Cleveland, last month resulted in the organization of a national association, which is to hold its next meeting in October, at about the time of the convention of the American Street Railway Association. It is then to be deter-

mined whether or not future meetings will be held at a different period in the year, or at a time such that those in attendance at this convention can have the benefits of the exhibits of the larger convention. Among those taking part at the Cleveland meeting were two general managers, thirteen secretaries or treasurers or both, nine auditors, two comptrollers and four accountants. It was particularly noticeable in conversation with these gentlemen that they had gone far deeper into the practical operation of their respective roads, and were personally more familiar with the details of apparatus and material and the purposes for which they were used, than can ordinarily be the case with steam railroad accountants. In other words, it appears to be true that, next to the general managers, the officials in charge of the accounts of many of our street railway properties know more about the costs and the practical working of equipment material than any other officials, and, in fact, it is from them that the managers themselves originally obtain their information about costs. Now it is undeniably true that it is by the close and careful study of details by the accounting departments of our street railways that economies are to be effected, and it is also true that it is only by constant comparisons of the experience of different roads on particular questions of economy, that costs can be brought down. If, therefore, there are as many different ways of keeping accounts as there are roads to keep them, the difficulties of making these comparisons are very great, and if, on the contrary, it can be made possible by such an association as this now formed to apply the broad principles of railroad accounting to the special requirements of street railways, and to carry out the division of earnings and expenses, down to the detailed accounts, along uniform lines, the problem of true comparisons between companies is made a simple one. This is what this new association will try to do, and a strong committee was appointed in Cleveland to present next October, at Niagara Falls, a suggestion for a standard distribution of earnings and expenses. This is only a small part of the many problems of accounting which such an association will pass upon from time to time, but it is certainly the first step towards better and more uniform practice than obtains at present on our street railway systems. It is probable that there will be more or less opposition by many companies, particularly in states where regular annual reports are not required by the state officials, to an association of this character, this opposition finding ground partly in the dislike to giving out information regarding policy or methods, partly in a fear that the states may more readily step in to regulate street railway matters if street railway accounts are standardized, but chiefly to an unwillingness to change existing methods for new ones. It seems to us, however, that all these objections are far outweighed by the practical advantages of standard accounting systems, not the least of which is the influence of proper methods in placing street railroading firmly and permanently in the ranks of stable and conservative investment enterprises.

Electric Railways in Europe.

Electric railway practice in Europe ought to be the best in the world. Our foreign friends know how to build fine power station plants for electric lighting service, they are required by municipal or national regulations to put up the best and least conspicuous distributing system possible, their roadbed construction for railroad and tramway service has always been solid and substantial, they have every motive for giving the people the best car service possible, and they have a wealth of American experience in the technique of street railway operation to draw upon —so that they ought to be able to avoid the mistakes which we have made and are even yet making. Nevertheless, it appears to be too true that every manager has to learn his own lessons in the hard school of personal experience, for certainly most of the electric railways of Europe are distinctly inferior to their American prototypes in many important respects.

The foreign roadbed construction illustrated in this issue of the journal is good, bad, and indifferent. The rails are generally too light. Many of the rail sections would not be tolerated in American streets because of the deep and wide grooves which can hardly help being dangerous to carriages or even wagons. Often the fishing angles are poor, but this difficulty is more common with the older than with the newer types of rail sections and may be trusted to cure itself as new rails are purchased. The joints, however, are in many cases distinctly poor, particularly where attempts are made to make three fits with the fishplates—a thing which can rarely if ever be accomplished in ordinary commercial rolling. From the general appearance of the sections and from the replies received to the questions asked by us of the managers as to the expected life of rails and roadbed, it would seem that the joint difficulties found in electric railroading in this country have not been understood or appreciated abroad, but that more attention has been paid to providing sufficient wearing material in the head of the rail than to properly supporting the joints. Many of the companies are experimenting with a combination rail which has a large number of separate parts, including bolts and nuts and where seven fits are required. Such a complicated construction would hardly find favor in this country.

As far as the substructure of the roadbed is concerned, this is usually very good. Beds of concrete or concrete stringers are used far more generally than in America, and metal ties are also occasionally met with. The result is, of course, an exceedingly solid and unyielding construction which answers well when car speeds are low. With higher speeds, however, it is generally conceded by American engineers that greater elasticity is needed in the roadbed in order to prevent disagreeable, jarring vibrations of the cars.

The overhead construction in foreign cities is undeniably good. The use of rosettes instead of poles for the span wires does away with the sidewalk obstructions and as far as is known, there are no compensating disadvantages. The poles wherever used in the cities are of iron and are more ornate in design than are commonly to be found in this country. In many cities the poles serve both railway and lighting purposes by consent of the companies or by municipal demand. Much care has been taken to avoid unsightly wire networks in squares or at corners. Sliding contact trolleys are often used instead of wheels, less because of intrinsic advantages than for the purpose of doing away with frogs, switches, etc., in the overhead structure. There is undoubtedly an immense advantage in getting rid of all these complicated appliances overhead, and it is much to be hoped that it can be done without involving trouble elsewhere, either by wear of the trolley wire or of the trolley itself. Where wheel trolleys are used on a

single track lines the plan of running double trolley wires to avoid switches is frequently used to advantage in Europe as here. The distributing systems are divided up into shorter sections than in America, so as to minimize delays to traffic and trouble in case of fires; but we imagine that the object sought has hardly been obtained by this means.

In the power stations small units are found more commonly abroad than is the case at present in America. This can hardly be because the advantages of large, direct connected units are not thoroughly understood, for in size of units used in electric lighting service, Europe has always been fully in step with America, and at times has even been in advance of our practice. The reason in most cases probably lies in the fact that electric railway history abroad is much the same as in America, in that single suburban lines have been built in many cities for the purpose of educating the public. It is to be expected that complete systems will later on be laid down on much broader lines. Nevertheless, there are one or two instances which are puzzling enough to American engineers. One of these is found in Hanover, a city with but 200,000 population, including its suburbs. Here the street railway company proposes to operate its plant, consisting now of less than 50 miles of road, with six power stations having a combined capacity of but 2150 k. w., divided up, as may be imagined, into extremely small units. It is hard to imagine what "local conditions" can justify such extraordinary expenditures in investment and operating accounts.

But it is in car equipment particularly that American and European practice most widely differ. The old time 12 ft., 14 ft. and 16 ft. cars used in the horse railway days on this side of the water have almost entirely disappeared from American streets, and cars less than 20 ft. in length of body are now rarely seen, while 26 ft., 30 ft. and even 40 ft. cars with double trucks are found in many cities. There are some advantages, it is true, in running comparatively small cars at frequent intervals through the streets, and it would seem probable that in European cities whose population is condensed into small areas, such a car service would be, for the present at least, the only way of keeping people from walking. Perhaps Americans are paying too much money for elegance and comfort in riding, but a ride in American street cars is certainly worth more than in the average European street car, judged from the standpoint of cleanliness, comfort and speed. The first and second class compartment principle is found quite generally on the street railways of Europe, and it will probably be hard to do away with roof seats in many of the cities on account of the not unnatural inclination on the part of the people to ride in the open air on pleasant days. Wherever this feature of street railway travel exists it is probable also that schedule speeds must be kept down to a low figure.

Car speeds in foreign countries are pretty generally low, the governments of the older countries in particular protecting with great care the lives and limbs of the governed. Perhaps we have gone too far in America in the opposite direction and have become too careless of accidents. However this may be, it is certain that without greater schedule speeds the suburbs will not be built up nearly so rapidly or nearly so far out from the business centers as has been the case in America.

The financial results of the adoption of electricity have been, in most cases reported in this issue, satisfactory to the companies or municipalities engaged in street railway operation. In two or three instances electric traction has not been on a scale large enough to judge of results. In Hanover the return on the investment in 1896, with nearly all the lines operated by electricity, is 6 per cent, where but 2 per cent was paid in 1891. In Zürich the results are not yet so favorable. In Brussels the increase of net earnings has enabled the company to "make very satisfactory returns upon the additional investment required for electric equipment." In Hamburg the rate of return on the investment is now 5 per cent, instead of 3 in the old horse railway days.

One admirable feature of European practice in street railroading, as in other financial enterprises, is the careful account taken of depreciation in determining the operating expenses of the year. A company which should make out its operating statement without including in its expenses a liberal allowance for future renewals of plant and equipment would be considered abroad as unworthy of confidence. In one form or another—either as "Reserve" or "Depreciation" or "*Amortisement*" or "Renewal Account"—this important feature of a true financial system is handled by foreign tramways upon some settled basis. One company, for example, passes 5 per cent of its net earnings to a special reserve fund to provide against impairment of capital and 20 per cent to another special reserve fund for renewals. It then pays 5 per cent interest on the invested capital if earned, and of the remaining surplus earnings, 40 per cent is added to dividends on stock and 60 per cent is carried to the sinking fund. It is to be feared that too many American street railway companies are drifting into heavy seas on this question of "deferred operating expenses."

In another respect European practice seems to be superior to American, and that is in the method of making franchise contracts with the municipalities. It is often said of American cities that they do not know how to protect their own interests and that they are recklessly "giving away" franchises worth millions of dollars without adequate compensation. This is occasionally true in part or in whole, but far more often it is an utter misconception of the true state of the case. When one finds, as in Philadelphia, that street railway corporations are obliged by contract to pave, from curb to curb, all streets through which their lines run, and to maintain this pavement during the life of their franchises, it certainly does not seem as if the latter were a "free" gift. If, in nearly all American cities, the cost of paving, renewals, taxes on gross receipts, taxes on real estate and personal property, cost of cleaning and watering streets, removal of snow and ice, and special burdens of all kinds are added together, the sum total will be found to be a very considerable *quid pro quo* for the franchise grants. What European cities have done is not so much to obtain more money in the gross from the corporations for municipal benefit, but to simplify the process of collecting such moneys, to regulate the imposition of these franchise burdens by a clear and staightforward contract by which the rights of all concerned are equally protected, to reduce the chances of misunderstanding and difficulties between the two parties to the contract, and to determine beforehand what shall happen at the end of the franchise periods, to the end that the street railway companies may know exactly what to anticipate in making their financial arrangements.

CONSTRUCTION

The Lorain & Cleveland Electric Railway.

THE city of Cleveland has become noted for the number of interurban electric roads radiating from it east, south and west. The Lorain & Cleveland Railway, one of the latest of these, will connect the Public Square, in the central portion of the city of Cleveland and the rapidly growing city of Lorain. Starting from the Public Square, the cars will be operated over an existing city line to Rocky River, 8 miles distant from the Square. The first part of the distance is through the business portion of the city, and the latter part through a thickly settled residence district, 3½ miles of which is in the hamlet of Lakewood. From Rocky River to Lorain a private right of way has been secured which the company owns in fee. This portion of the country is noted for its fine vineyards. The line is nearly parallel to the lake shore, and only a short distance from it. After leaving Rocky River, the line is practically devoid of curves and grades, and the company intends to make a running schedule of 30 miles per hour, which will require a running speed of from 45 miles to 50 miles per hour between stations.

In the track construction the practice of the best steam railroad companies has been followed. The track is laid with 70 lb. T rails in 60 ft. lengths, and of the Am. Soc. C. E. pattern. The small bridges are of masonry and steel beams and the trestles of masonry and Southern yellow pine. The greater portion of the roadbed is now completed and track laying has commenced.

The overhead construction will consist of the double trolley system, thus avoiding overhead frogs. The trolley wire is to be the Washburn & Moen Manufacturing Company's figure 8 wire, equivalent to No. 000. Cross suspension will be used, and the overhead material other than wire will be furnished by the Ohio Brass Company.

The rolling stock will consist of J. G. Brill Company's double track 40 ft. coaches, which will be equipped with high speed motors. The motor equipment has not yet been contracted for.

POWER STATION.

The power house is now in course of construction, and is 6½ miles from the Lorain terminal of the road, and about 12½ miles from the eastern terminal of the private right of way. It is located on the edge of Lake Erie, and about 850 ft. north of the track, a spur from the latter running to the power house. At the point where the spur leaves the main track will be built the car houses and repair shops, and south of this point will be a village. North of the track will be a 20 acre park, the power house being located in the northeast corner of the park. The greater portion of this park lies 22 ft. above the lake level and will undoubtedly prove a most attractive resort. The plans of the company are far reaching and comprehensive, everything being designed to provide for future extensions.

The illustrations given herewith are from some of the drawings on which bids were taken. After the make of the apparatus had been decided upon drawings in greater detail were prepared, but not completed in time to be used in this article.

The conditions governing the design were as follows:

1.—That as the road is for interurban service, and as there will be in the immediate future comparatively few cars operating and as each car will probably have four motors designed not only to give high speed, but rapid acceleration, the fluctuation of load will be great, and the momentary overload may be at times at least 100 per cent in excess of the rated capacity of the generators. Such being the case, proper provision was made in generator, engines and steam piping, so that no injurious effects would follow a steady 50 per cent overload, or a momentary overload of 100 per cent.

2.—As it is anticipated that in the near future a very considerable increase in the number of trains will be demanded, provision was made for a sub-foundation for an engine and generator of twice the capacity of those now being installed, and for the addition of 1½ times the boiler capacity.

3.—As even such addition will probably not be sufficient for the more distant future, the stack was designed for a still further addition, and the wall of the building between the building and the stack so arranged as to admit of being used as a fire wall and so allow for the extension of the building in that direction. The piping plans provide for the addition above contemplated, especially as necessitated by paragraph No. 2.

The next step after determining the output desired was, of course, to decide how the output could be obtained in the most economical manner. In order to obtain water for the boilers and also for the village and park, an intake of considerable size was necessitated, whether condensing engines should be used or not. As the lake is very shallow, it was found necessary to run 1200 ft. from the shore in order to put in a crib and obtain water free from anchor ice. The additional cost necessitated by a larger pipe in order to operate the engines condensing was found to add only a small percentage to the cost of the system required if non-condensing engines were used. It was therefore decided to put in compound condensing engines, the engineers believing that they would earn the interest on their additional cost, and that within a short time the traffic would so increase as to give the station a comparatively steady load.

As the ground level is 22 ft. above the lake level, it was decided to excavate as shown by the engravings. The earth thus secured was used to raise the track to enable the cars to run over the coal storage and at the same time allow the condensers to stand on the same level as the boiler room floor. The latter is only 6 ft. above the av-

erage level of the lake, which, however, at times, drops 2 ft. below the average level. The surplus earth and stone were utilized to make an embankment. This protects the bluff from the action of the waves and adds greatly to the appearance of the power house as viewed from the lake and the beach, a not unimportant point, as it will form part of the park grounds.

ELECTRICAL PLANT.

The generators will be two in number and of the Siemens & Halske 400 k. w. type. They will run at 80 r. p. m.; the voltage will be 630 at no load, and 700 volts at full load.

The switchboard is to be of enameled slate and is equipped with the usual instruments, including a Weston illuminated dial ammeter for each generator, and one for the total output, six Weston round dial ammeters for feeders, a Weston illuminated dial voltmeter for the bus bars, and a Weston illuminated dial, differential voltmeter to be used in throwing generators in multiple. There will also be a Bristol recording voltmeter, and a General Electric recording wattmeter. Special provision is made in the matter of double ground wires to the track and to the water pipes.

The switchboard will be lighted by a reflector similar to those used for lighting pictures. This does away with cross lights on the measuring instruments, and gives an even illumination over the whole face of the board. The projection of the reflector into the room is not objectionable, as the face of the board is flush with the wall of the engine room. This allows the engine room to be made of less width than would otherwise be the case, saving expense both in building and traveling crane; the crane hook also can not come in contact with the bus bars or connections; two very desirable features which are not infrequently overlooked. A bay in the rear of the board affords plenty of room for making connections.

The bus bars on the board are so designed that additional strips can be readily added when additional generators are installed. In addition to the generator panels, the board has six feeder panels and a lighting panel. The lighting panel has several circuits not only for the power house, but also for the car houses, and the grounds surrounding the power house.

BOILERS.

The boiler room is to be equipped with four 300 h. p. Stirling boilers with Murphy automatic stokers. The coal is fed from the coal hopper through chutes delivering to the hoppers of the furnace, and in these chutes are placed weighing scales. There is, therefore, no handling of the coal. The breeching is No. 8 B. W. G., of rectangular section, It is covered with magna-bestos and supported independently of the boiler walls.

The boilers are to have independent pump governors and Reliance water columns.

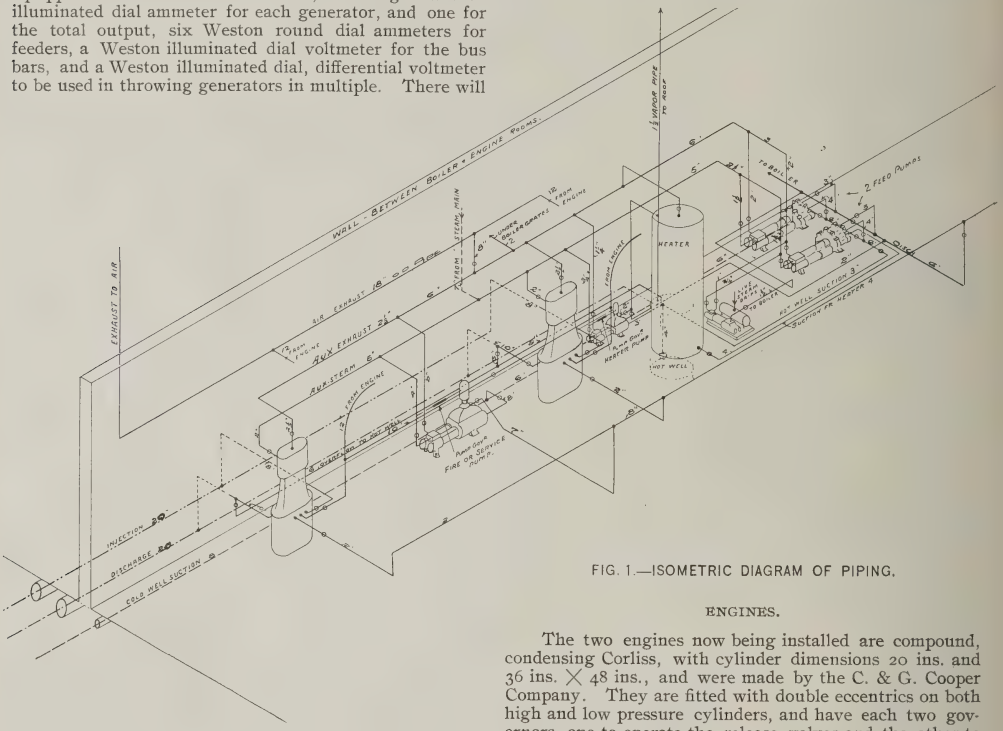


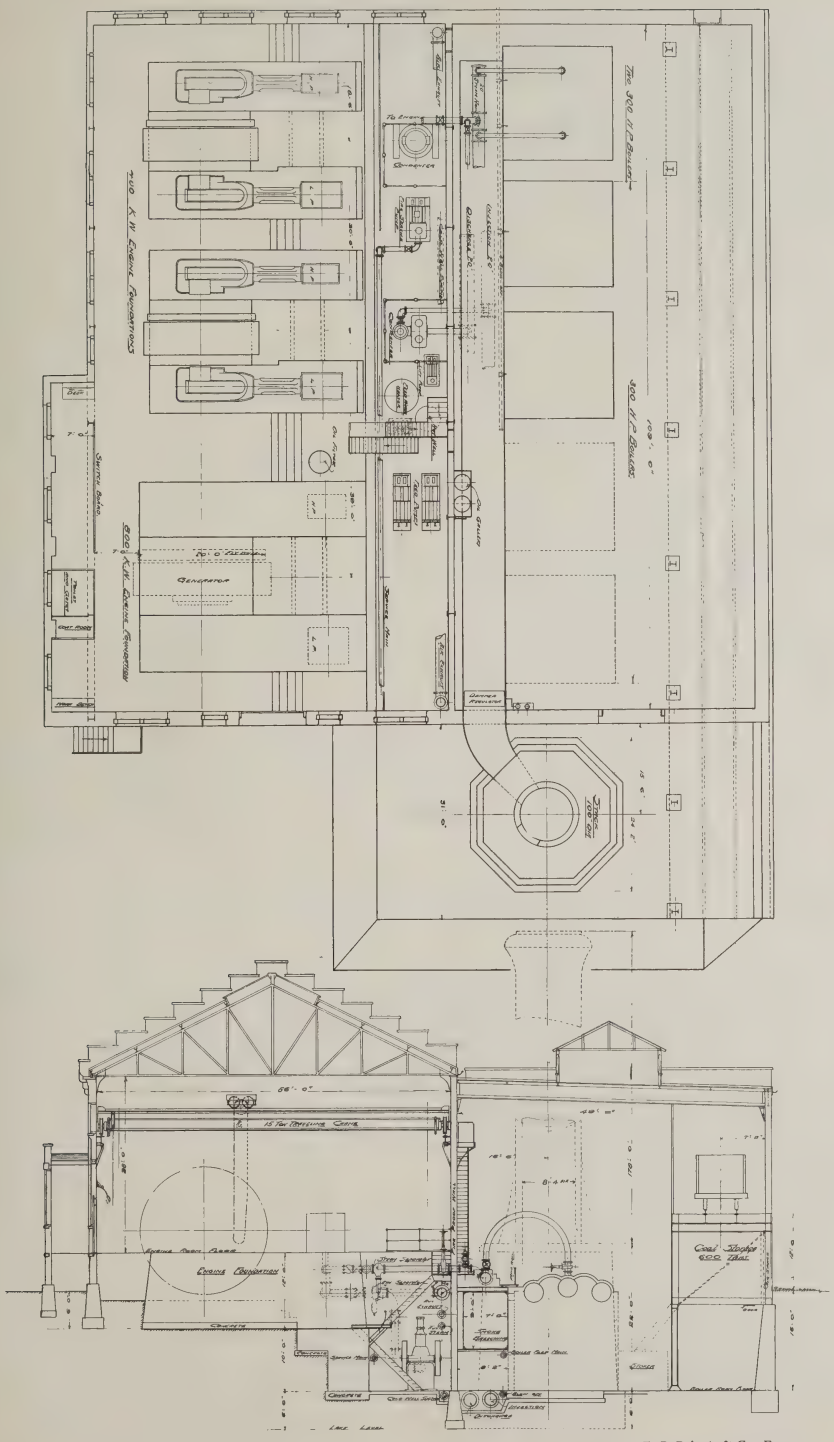
FIG. 1.—ISOMETRIC DIAGRAM OF PIPING.

ENGINES.

The two engines now being installed are compound, condensing Corliss, with cylinder dimensions 20 ins. and 36 ins. × 48 ins., and were made by the C. & G. Cooper Company. They are fitted with double eccentrics on both high and low pressure cylinders, and have each two governors, one to operate the release valves and the other to release a weight which operates a butterfly valve, cutting off the steam whenever the engine increases speed more than the predetermined amount. This weight is also arranged to actuate in its fall a magnetic circuit breaker in the main circuit of the generator. As the steam pipes are all below the floor, stands are provided to operate the main steam valves and their by-pass valves. The engine piping is arranged so that the exhaust may go either to the condensers or to the atmosphere through a Blake relief valve. By means of a reducing valve on the low pressure cylinder one or both cylinders can be run by live steam independently.

There is a complete piping system for both cylinder oil and engine oil fed with oil from tanks in the boiler room. A Musgrove column is used in connection with the sight feed lubricators for the cylinders; hand pumps are also provided. By means of a small hand pump the butterfly valve can be lubricated when desired.

Each engine is fitted with a full complement of gages mounted on an enameled slate board. There is also a main gage board, which has, in addition to the usual instruments, a Bristol recording gage.



E. P. Roberts & Co., Engineers.

FIG. 2.—PLAN AND CROSS SECTION OF POWER STATION—LORAIN & CLEVELAND ELECTRIC RAILWAY.

AUXILIARY APPARATUS.

Two Blake twin vertical condensers are used, each of sufficient size to maintain at a moderate speed a high vacuum in one engine, and at a higher speed a fair vacuum in both engines. It is intended that, normally, each condenser shall operate in connection with one engine, but a cross connection makes it possible for either condenser to be connected to both engines. The two feed pumps are Blake outside packed plunger pumps, and there is also a Blake low service pump to pump water from the hot well to the heater and a Blake pump also for the fire and water

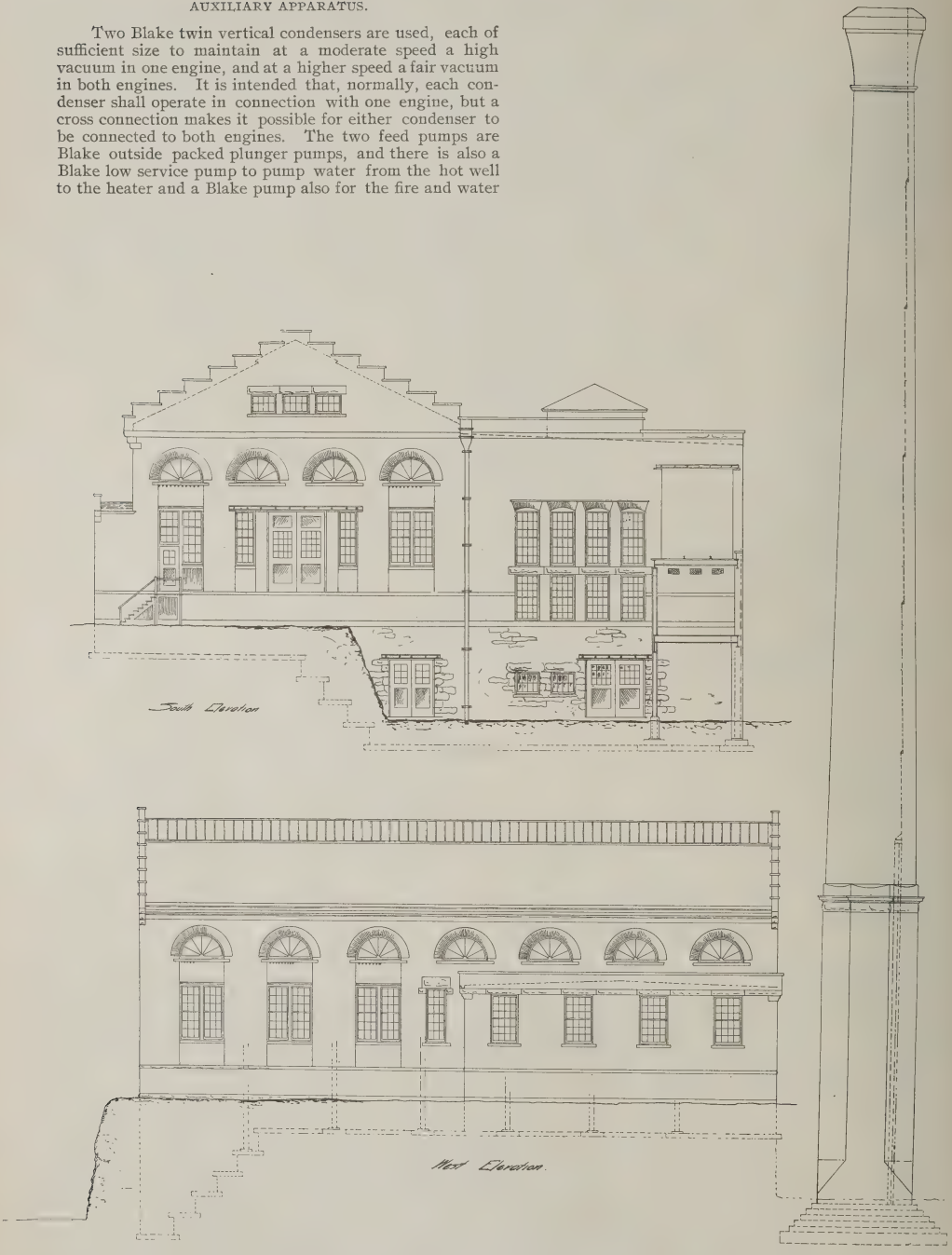


FIG. 3.—SOUTH AND WEST ELEVATIONS—LORAIN & CLEVELAND ELECTRIC RAILWAY.

works service, to pump to a 50,000 gal. tank, located near the car houses. These pumps are so interconnected that the disconnection of one to repair or pack it will not interfere with the continuous operation of the plant. The pumps are large enough to provide for the future growth of the plant to the extent necessary to operate one 800 k. w. generator. All the pumps are controlled by pump governors.

The feedwater heater is the open type and of sufficient capacity for future growth. The Cochrane live steam and exhaust steam separators are used.

PIPING.

The high pressure piping is all extra heavy flanged, tongued and grooved and fitted with copper gaskets. It is covered with Keasbey & Mattison's magnesia sectional covering. The low pressure pipe is standard pipe covered with magna-bestos. The valves are Crane, extra heavy, bronze seated, and all the larger ones being by-passed. Angle and globe valves are Jenkins. Fig. 1 is an isometric diagram of the piping in the pump and condenser pit.

The necessary atmospheric exhaust pipe, exhaust head and relief valves are installed.

The intake and overflow pipes are 20 ins. and of cast iron. The intake draws water from the cold well outside of the building, and the overflow discharges into the lake. The pipe supplying the tank has a separate line to the cold well, and can be used to supply water to the feed pumps when so desired. Water for priming is obtained from the line running to the tank. The service tank, as before stated, has a 50,000 gal. capacity and is supplied by an 8 in. pipe from the power house, reduced to 6 ins. and 4 ins. at the car houses.

Three Ludlow two nozzle hydrants are used in this pipe system. The tank has an automatic float which controls the pump governor, and the tank can be cut out of service if, in case of fire, it is desired to do so.

BUILDING.

The building is of a substantial character, and fireproof throughout. The boiler room floor is cement, and the engine room floor cement, supported by hollow arch tile sustained by steel beams.

Large openings are left in the engine room floor over the condensers. Through these lead stairs for passing from the boiler room floor to the engine room. There are galleries also over the boilers and along the piping in the pump pit.

A 15 ton traveling crane is to be installed in time for the use of the machinery contractors. It is being built by the Cleveland Punch & Shear Works, and will have two 8 ton trolleys each fitted with triplex blocks. All motions will be controlled from the engine room floor. This crane will have cut gearing and roller bearings, insuring the greatest possible ease of handling. The span is 54 ft. 6 ins. center to center of rails.

Bids were taken both on brick and steel stacks 200 ft. high and 100 ins. clear diameter. A brick stack was decided upon.

OFFICERS AND CONTRACTORS.

The officers of the company are: B. Mahler, president; E. G. Tillottson, vice-president; E. W. Moore, treasurer; Jas. C. Hoge, secretary; F. W. Coen, assistant secretary; Chas. W. Wason, consulting engineer.

The chief engineer is A. P. Ruggles, and the principal assistant engineer is E. H. Arnold. The mechanical and electrical engineers for the power house are E. P. Roberts & Company. The architect is J. N. Richardson.

The design of the iron and steel work in the power house was by the Osborn Company, which also has charge of the inspection of all iron and steel for the road.

The building contractors are L. Dautel Mason, contractor; J. W. Vanderwerf, carpenter; the Forest City Wire & Iron Company, structural steel.

The piping contractors are Chafer & Becker.

Electric Railway Engineering.

THE MODIFICATIONS REQUIRED FOR BRITISH CONDITIONS.

BY ALEX. MCCALLUM.

As England, Scotland and Ireland are now on the verge of a great development of the application of electricity to tramway work it may be of interest to indicate in a collected form some of the modifications of American electric railway engineering practice which will be necessary in order to meet the requirements of the British Board of Trade and to conciliate public opinion. From what has already been done in England in electric tramway equipment it is probable that American appliances will largely be used, but even though British electric equipment firms do get a large share of the coming work, street railway men in the United States cannot fail to be interested in modifications to meet a set of conditions which are unknown in their own country.

So far as the style of boilers, engines and dynamos is concerned there need be no difference of importance between those used here in England and those employed in America. It is now clear that the Board of Trade will allow the general use of an electric pressure of 500 volts, so that there should be no difficulty as to the generating machinery. It is when we come to the question of the maximum fall of potential allowable in the line and the maximum leakage to earth in the return that novelties present themselves. In the United States there is no legal compulsory maximum of drop in voltage which must not be exceeded, but I believe the average drop really existing may be taken at about 25 volts. The British Board of Trade, however, allows a drop of only 7 volts. This means in practice that with an ordinary service of cars, with the best of feeders and with rail bonds of the highest conductivity, it will only be possible to run a line for about 4 miles away from the power station. In the case of the recently installed electric tramways at Dublin the lines go to a distance of 7½ miles from the main power house, and it was found necessary to provide two sub-stations in order to meet the Board of Trade regulation. There is no doubt that this is very hard on the tramway companies, but there is no way of getting out of it.

The regulation as to leakage to earth is equally severe. The current passing from an independent earth connection through an indicator to the generator must not at any time exceed 2 amps. per mile of single tramway line or 5 per cent of the total current output of the station. That means that 95 per cent of the current has to come back by the rails and the supplementary return feeders. In many American roads, I believe, something like 60 or 70 per cent of the current comes back through the earth. The vast importance of this difference has only to be mentioned to be understood. One result will be that besides providing very heavy bonds and return feeders, engineers will also have to try to keep the rails as free from the earth as possible. How the regulation is to be rigidly complied with during snow storms is a question that does not seem very easy of solution. Various instruments have to be provided for continually testing both the outgoing and return parts of the circuit to see that the regulations are being complied with, and a record of the results of the tests has to be kept. The Board of Trade is endowed with full powers to enforce all its regulations.

In America, I believe, there is a variety of practice in the way of connecting up the trolley line more or less continuously, but in Britain both the trolley wire and the rails must be divided into half mile sections in such a way that any section or feeder can be cut out from boxes placed at half mile intervals along the line. Regarding the standard of insulation of trolley wires and feeders, the leakage current must not exceed $\frac{1}{100}$ amp. per mile of tramway. If the leakage reaches ½ amp. per mile the running of the cars must be stopped unless the leak is removed within twenty-four hours.

As to other features of the road, all feeder wires must be placed underground. Two methods of overhead construction are now rivals for favor, the one being that common in America, namely side poles and span wires, and the other that which is in use in Bristol and in South Staffordshire. On the latter plan there is one row of side poles with bracket arms, and the trolley wire is suspended from brackets not above the center of the track, but considerably over to one side. The trolley pole is hinged horizontally as well as vertically, so that it can follow the wire though the distance of the wire from the car varies. There is thus a minimizing of the number of overhead wires, especially at curves. The method works very well, but it is said that the trolley jumps the wire more frequently than when the usual American method is employed. The advantages, however, of having no span wires and only one row of poles are very great. Where span wires are used the Siemens bar trolley is looked on with considerable favor.

Regarding track construction it is, I think, generally admitted that the average British track is more substantial than the average American one. For electric haulage the standard construction for horse lines will not be departed from except that the rails will in all cases be very heavy. On existing English steam tramways, however, exceedingly heavy rails have for long been used, and even on some horse lines we have rails of 80 lbs. and 90 lbs. per yard. Accordingly we may look forward, in the case of all electric lines working under city conditions, to steel grooved girder rail of about 90 lbs. per yard laid direct on a 6 in. or 7 in. concrete foundation and tied to gage by light iron tie rods through the webs. The paving blocks will, as usual, be laid absolutely flush with the top surface of the rail both on the inside and the outside. As to long rails, I think there will soon be a large demand for these when the companies begin to realize how serious is the joint question when electric traction is employed. I heard recently that there is no rolling mill in Britain at present sufficiently commodious to roll 60 ft. rails, but if the demand for them arises that can easily be remedied. In view of the Board of Trade requirements a small fortune will have to be sunk in copper rail bonds and in return feeders. Finally on this branch of the matter, nothing is more certain than this, that to ensure the rapid spread of electric traction the greatest possible care will have to be taken by the tramway companies to procure an overhead construction which will be as little objectionable as possible in appearance and an ornamental type of pole which may also carry the electric or gas lamps for lighting the streets.

The next point is the cars and their speed. Within the past few months the Board of Trade has introduced a new regulation for electric tramways, providing that the car speed must not exceed 8 miles an hour in any street. This was pretty well understood before, but now it is made explicit, and means are also taken to enforce it. Some of the electric lines recently built have been running cars at much higher speeds, but now an automatic device in the shape of a centrifugal governor has to be fitted to each electric car, and this apparatus, whenever the speed rises above 10 miles an hour, opens a switch and cuts off the current. The motorman will thus not have the ball at his foot as he has in America. According to British ideas this is quite right too. Further, it is right because the Board of Trade has an absolute check on the speed of cables on cable tramways, and what is sauce for the goose is sauce for the gander.

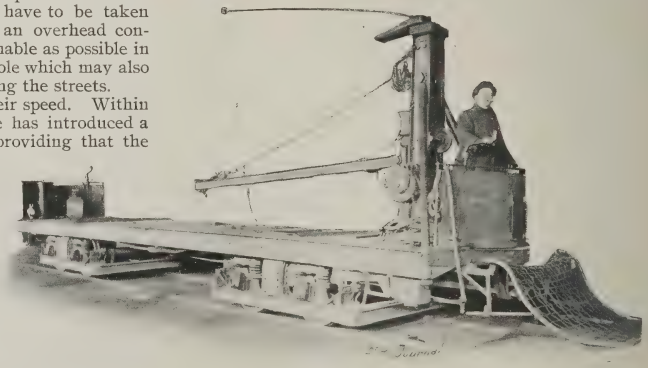
In view of this restriction of speed it will be manifest that the American type of car motor would be wholly unsuitable for English conditions. The motors must be wound for a slower speed, and as a matter of fact they require 50 per cent more turns of wire upon them than the American motors. The British Thomson-Houston Company has produced a machine of this class, and the English electrical firms turn out motors of the kind required. The weight of the motors is about the same as that of those used on American street cars, but they are considerably more expensive.

The Board of Trade also insists on the use of an emergency brake. This is provided for by a modification of the controller, whereby, if the hand brake fails to act, the driver can make the motor stop the car by acting as a generator.

Taking it over all, it is calculated that the effect of the Board of Trade regulations will be to increase the initial cost of electric equipment as compared with America by from 30 to 40 per cent, on long lines at any rate. As the car speed will only be half that usual in America, double the number of cars will be required to give the same frequency of service. In spite of these things the supporters of electric traction here believe that profits can be made. They rely largely on the fact that wages are so much lower here than in America. Coal also is cheaper than in most American cities. As to half-penny and penny fares for short distances, general experience shows that the receipts per car mile are on the average quite as high as in America, despite the uniform five cent fare. The short distance travel is immense, and is profitable. Altogether, it will be seen that a little experimenting, shaking down and settling will soon lead to an established standard practice. Readers may now, however, be better able to appreciate not only the new problems presented by British conditions, but also a statement I have frequently made in the past, namely, that cable traction has a much wider field (in proportion to the whole of the tramway lines in Britain) before it than it has in America. Electric equipment is dearer than in the States; cable equipment is cheaper than in America, and—so it is maintained on this side of the water—better.

Rail Car for Track Construction.

The Brooklyn Heights Railroad Company has in use a special platform car built for conveying rails from one part of the system to another. A view of this car is shown herewith. As will be seen, it is extremely strong and heavy and was built entirely of steel, by the Maryland Steel Company. Its carrying capacity is 40 tons and it has been found very useful in taking rails from the lighters and distributing them along the places where construction is being carried on.



CAR FOR CARRYING RAILS—BROOKLYN.

The New Orleans Traction Company has just decided to erect a handsome two story brick office building on its property at the corner of Magazine and Pleasant Streets. The headquarters of the company will be moved from Canal Street to the new building.

Subway Explosion in Boston.

Owing to a bad leakage of gas into one of the subway excavations in Boston, a serious explosion occurred at the corner of Tremont and Boylston Streets, on Mar. 4, about noon. This corner, which is one of the busiest places in Boston, is passed during the daytime by an almost continual line of electric cars. One of these, belonging to the West End Street Railway Company, was completely destroyed, and others with a number of adjacent vehicles were badly damaged. Six persons were killed outright and fifty were injured.

Power Station Burned at Philadelphia.

A disastrous fire occurred in Philadelphia, Mar. 3, by which the power station of the Union Traction Company at Thirteenth and Mount Vernon Streets was destroyed. The station was equipped with five Westinghouse Kodak units of 600 h. p. each, and three Westinghouse generators of 2000 h. p. each, driven by Wetherill-Corliss engines. The fire is said to have been caused by careless handling of the traveling crane. In operating the crane from one end of the room to the other the iron hook was allowed to trail across the field armature of one of the generators, causing a short circuit. The melting metal set on fire the oil soaked floor, which was wood, and the fire quickly spread to the rest of the building.

Street and Other Railways in Greece.

By Nicholas D. Sourmely.

As it is for the first time that this country, whose antique fame and glory are well known and cherished by every person of education throughout the civilized world, is brought through your valuable journal to the notice of your readers, and inasmuch as very little is known in the United States about its trade, industry, street and other railways, it will not be out of place, I think, to give here some particulars on these subjects.

The Kingdom of Greece has now a population of over 2,500,000, and there are about 6,000,000 Greeks inhabiting the Turkish Empire, Egypt and the Levant. The population of Greece is increasing rapidly by the continuous immigration of Greeks.

Athens, the capital of Greece, in whose center are to be found the grand monuments of her ancient glory and splendor, has close upon 150,000 inhabitants. It is the seat of the Government, and carries on a large import business from all parts of the world excepting the United States. Athens can justly boast of having the finest public buildings in the world, such as the National Academy, the National Library, the University, the National Polytechnic and museums, etc., all of them built and endowed by various Greek patriots. It is a noteworthy characteristic of this ancient race that whenever a Greek becomes rich he is sure to spend large sums of money in endowing his country with some institution or work of general utility. The family of Zappas have spent several millions for the erection of a magnificent marble building of adequate design and proportions, in which the Olympian games are held every four years.

The port of Athens is Piræus, a growing city of nearly 50,000 inhabitants, distant by rail about half an hour. The harbor accommodation is great, lighters are abundant, and every facility can be found for rapidly loading and unloading and coaling steamers at cheap rates. Most of the European steamship lines make regular calls at this port, and it has become a regular station for the naval squadrons in the Mediterranean waters of all the European powers. Piræus has become the center of the Greek industry and trade, and gradually but surely it is concentrating the transit trade of the Levant, becoming the most important distributing center for the Turkish Empire, Egypt, etc. Piræus possesses the finest flour mills, cotton mills, woolen mills, engineering works, shipbuilding yards, etc., in the Levant, giving permanent work to several thousands of workmen, the government of the country granting every possible facility, exemptions, etc., for their development and welfare. Other towns of importance are Patras, Volo, Syra, Kalamata, Corfu, etc.

The province of Thessaly is playing a most important part in the import trade as it produces large quantities of wheat, corn, etc.

For about nine years now Greece has suffered from a serious financial crisis, brought about by the heavy expenditure on public works, etc., the various governments borrowing heavily and at comparatively high rates of interest. The national debt of Greece may be stated to be about $120,000,000. The large amount of paper currency issued caused gold and silver to rise at a terrific rate, with serious consequences to the nation generally, the import trade suffering most severely. The credit of the country received a severe but unjust blow by the temporary suspension of the payment of the interest on the national debt, pending the negotiations for the reduction of the same to a reasonable rate. To this the German bondholders brought the greatest obstacle to an amicable and satisfactory arrangement.

This crisis caused several capitalists in Greece to invest heavily in manufacturing and other concerns with marked success; labor is extremely cheap, the average price of the best Cardiff coal is about $4 per ton of 2240 lbs., and the Government wisely helps manufacturers by raising the import dues, and by allowing raw materials to be imported free of duty. By such means and encouragement, there are now established, working full time and yielding handsome profits, a good number of industrial establishments all over the country.

The United States Ambassador in Athens is the Hon. Eben. Alexander, the very best and cleverest diplomat the United States have ever sent out here. I say the very best and most suitable, because to his personal influence and tact is due the feeling of sympathy created here for his country, and if at the present time there has sprung up a demand for American goods, it is due exclusively to him. As it may easily be conceived, it is far from easy for the Greek importers who have business relations of long standing with British and Belgian manufacturers, to make a trial of American goods and "notions." The distance between the two countries is so great, the means and cost of communication so difficult, the terms and conditions of American firms so different from those granted by "John Bull," that it must be a matter of congratulation and pride to Mr. Alexander that he has succeeded in the successful importation of his country's products in Greece. A good start has been made; follow it up closely and success is certain to result. American goods can be offered at cheaper prices and their quality will favorably compare with that of even German goods. One thing is wanted to secure for American goods a permanent and profitable footing on these important markets—a regular monthly steamship line plying between New York via Liverpool to Piræus, at cheap rates.

From a political point of view, Greece, during the last few months, has been in a fever of enthusiasm on the annexation of the great and beautiful island of Crete. This island has about 300,000 inhabitants, nine-tenths of whom are Greeks. The island is extremely fertile and yields various agricultural and other products to a yearly value exceeding $10,000,000, and this will be doubled as soon as peace and quiet allow the inhabitants to cultivate their lands. Your readers will doubtless have read that last month the united European fleets bombarded the Christian camp outside the port of Cania and killed many persons. The correspondent of the London *Daily News* wired to his paper that the sight was horrible, and add to this that the Turks were allowed to fire on the Christians at the same time! The Greek flag was struck down twice, and twice it was raised in defiance by the Greeks who kept their stand during all the time the fleets bombarded them. The European nations have been moved, the indignation of the people of England, France and Italy has been aroused. The vote of sympathy of the United States Congress and Senate was very much appreciated in this country.

Coming now to the question of street and other railways, I have to say that there is a good field for American contractors, locomotive and rolling stock builders and others to transact much business in Greece. At the present moment the following lines are in the market: The municipality of Patras, a town of nearly 500,000 inhabitants, wants to build a tramway of a total length of about 18 miles, horse, steam or electric traction.

Another line proposed is that from Athens to Vouliagmeni, a length of about 14 miles.

Another line is from Kalamata to the seaside, a length of about 4 miles; all good paying little contracts. The Government lends valuable help for such work by granting exceptional concessions such as freedom from all import and all other dues, and every other possible facility. There is one important consideration to be held in view for such works out here; labor is abundant and extremely cheap; for example, the usual railroad diggers and workmen are paid on an average fifty to sixty cents per working day of eleven hours, engine drivers, seventy cents to $1, engineers, draughtsmen, etc., a little over $1. The internal cost of transportation is cheap, and in fact we have so many facilities that it is really a pleasure to undertake such contracts in Greece.

Athens has a Belgian-Greek Tramways Company with extensions to New and Old Phalerum (the summer resort of Athens). Within the city and the suburbs the tramways use horse traction. To Phalerum and Piræus they use locomotives of Krausse & Company, of Leipsig. Their nominal capital is 2,200,000 fr., divided in shares of 500 fr. each. The chief offices are at Brussels and the official title is the "Cie. des Tramways d'Athènes et Extensions." Its franchise gives this company the right to build and work 42 kilometers of line (30 in. gauge), but they have constructed and are actually working lines about 30 kilometers in all.

At Piræus we have a tram line from the railway station to the custom house, a short distance of less than a mile, worked and owned by the Athens-Piræus Railway Company.

The Piræus-Athens Railway (length 10 kilometers) is justly considered the best paying line in Greece. The locomotives in use are of English and Belgian make. The chief engineer is an Englishman, Mr. Simmonds, a clever railway engineer, who served for many years in the famous Cornwall Works of Tangyes Ltd., Birmingham, and other eminent British builders. Other important roads are the Piræus-Athens-Peloponnesus Railway, the Thessalian Railway, the Attica Railway, the Northeastern Railway and the Pyrgos-Katakolos Railway. With the exception of the Athens-Piræus Railway, which uses English locomotives and rolling stock, all the railway companies employ locomotives of French, German or Belgian make.

SCIENCE · ENGINEERING · INVENTION ·

Railway Motor Testing in Schenectady.

The trend taken by the electric railway industry in the direction of the field hitherto occupied exclusively by the steam locomotive, as evinced by the recent developments on the New York, New Haven & Hartford and Baltimore & Ohio railroads, has caused the General Electric Company to provide itself with its own special line of track upon which to carry out electric traction experiments. The line of track built by the General Electric Company, lies between the works at Schenectady and the Erie Canal. It has been laid upon the canal bank, is 6700 ft. long, and is of the regulation New York Central Railroad construction, the service rails being standard rails 85 lbs. to the yard. The track is laid from the side of Building No. 7, and crossing the River Road rises on a grade of 4 per cent to the level of the canal bank. The first section of the line is a tangent 2415 ft. long; the second a series of short tangents and curves 1635 ft. long and the third another tangent 2730 ft. in length.

Running beside the track on the far side from the canal are two conductor rails. They are 30 lb. rails, set on 8 in. ash blocks treated with bergtheer in vacuum pans and thoroughly impregnated. Two sets have been laid for the purpose of experiment with alternating multiphase currents. For direct current experiments the two are connected in multiple. Both service and conductor rails are bonded with No. 0000 copper bonds. The line is divided into three working sections, each controlled by its own switch.

The experiments made so far have been carried on for the purpose of developing motors and systems of operation for elevated and surface steam roads. For a locomotive a special eight wheeled car is used. This resembles a regular passenger coach so constructed as to give an unobstructed access to the two motor trucks. The weight of this coach-locomotive equipped is about 30 tons empty. It is divided into three sections, a driving and testing department in front, a passenger division in the center and a rear compartment in which are carried the air pump, tools, etc.

FIG. 1.—END VIEW OF MOTOR CAR AND TRAIN.

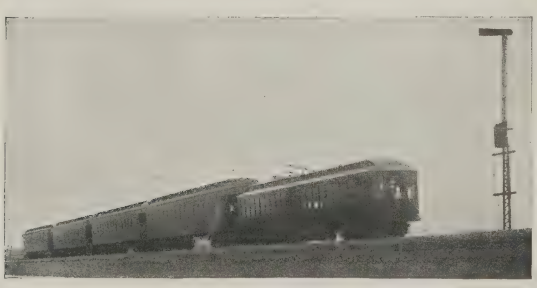


FIG. 2.—ELECTRIC TRAIN AT HIGH SPEED.

The equipment of the forward compartment consists of a skeleton wooden switchboard carrying the ammeters, voltmeters, wattmeters, etc., to test the motor equipment which may be under experiment at any stated time. In addition the switchboard is fitted with the necessary quick-break switches, magnetic blow-out, fuse boxes, automatic circuit breakers, etc. The controller is set in front of the right forward front window, through which the driving engineer has an unobstructed view of the track in front. To his right is the valve handle of the air brake, and in front of him is an ammeter. The resistances are suspended from beneath the central compartment.

In the test during which the photographs from which the illustrations were made, the equipment of the car consisted of four G. E. 2000 motors, one to each axle, motion being communicated to the wheels through steel gears and pinions. The forward truck was equipped with a special speed recorder. The controller used was a K 16 series parallel controller.

The contact shoe is a flat piece of cast iron with the ends slightly curved. It is fastened to the truck by two loose links and an iron casting which is bolted to the bolster. This method of suspension keeps the shoe continuously in contact with the surface of the conductor rail as it allows it to conform immediately to any inequalities which may occur in the latter.

The air for the brakes and whistle, one of which is set at each end of the car, is furnished by a vertical, direct connected air pump, operated by a motor controlled automatically. This automatic action is brought about by the balancing of the pressure in the air tanks against the power of a spiral spring. The

FIG. 3.—MOTOR CAR DRAWING FREIGHT CARS.

spring is coiled in a cylinder furnished with a piston, the upper end of which is a switch in a magnetic blow-out device. As soon as the pressure in the main tank falls below the desired pounds per square inch the spring forces up the piston until its upper end is in contact at the switch. Contact being made, the motor circuit is closed and the air pump motor starts. As soon as the pressure rises to normal the piston is forced back, the circuit is broken and the motor stops, any arc at the point of rupture of contact being immediately extinguished in the magnetic field of the blow-out device.

The first test made with the motor equipment, the total drawbar pull of which is about 15,000 lbs., consisted in the hauling of three flat New York Central and one flat Lake Shore freight cars each loaded with pigs of iron. This load, about 121 tons dead weight, was easily handled by the locomotive, and the records as to speed and power required showed most gratifying results. The flat cars were then switched back into the works.

The locomotive was then coupled to four New York Central standard passenger coaches, making with the motor car a train of 130 tons. The controller was in charge of Chief Engineer W. B. Potter, and S. H. Libby acted as conductor. Several interesting runs were made with this train up and down the track, with equally encouraging results.

Fig. 2 is made from a snap shot photograph taken during the latter test as the train was rushing past the first semaphore at a speed of about 40 miles an hour. Fig. 1, made with the train at rest, shows the construction of the track, the method of laying the conductor rails and the semaphore with its switchbox.

Car for German Interurban Railway.

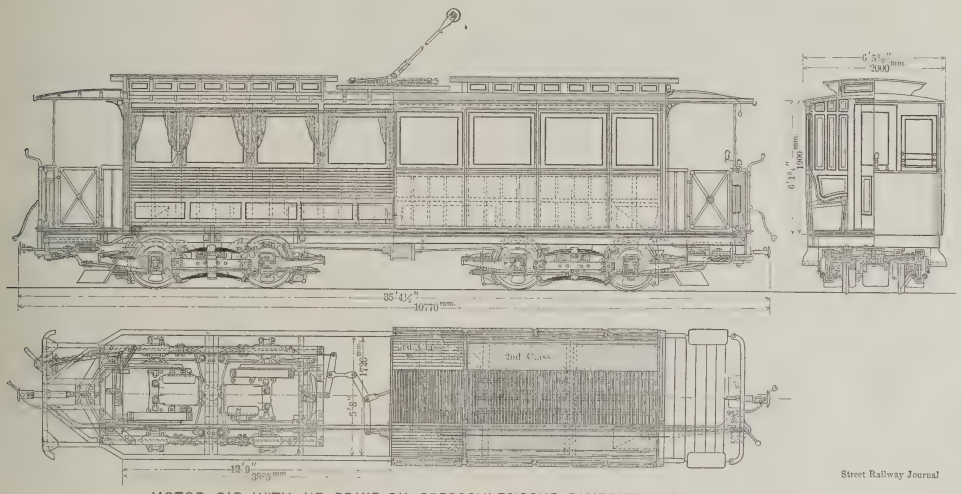
The accompanying engraving shows side and end elevations and sections of one of the electric motor cars which will be run on the Oberschlesische Dampfstrassenbahn system in Prussia. This has been a steam road, but is rapidly being electrified. Thirty motor cars and fifty trail cars will be put into immediate service. The motors with which these cars will be equipped will be of the Walker make and the brakes will be of the Standard Air-Brake type, As will be noticed, there are compartments for both second and third class passengers. The "Standard" air brake was specified for the entire installation in view of the satisfactory results which had attended the use of this brake on the Grosse Leipziger Strassenbohn in Leipzig, Germany. On the latter road over 300 Standard brake equipments are in use. Full details of the motor to be used on this car were published in the January issue.

The Oberschlesische is a road of extremely narrow gauge, the track having a width of but 30 ins. In order to furnish adequate power, motors will be placed on each axle, that is, four to a car, these motors being of a specially narrow type. There was no room therefore on the axles or the car for axle type compressor. On this account the gearless motor driven compressor will be used.

The hand brake staff is retained in addition to the air brake, and will operate in conjunction therewith if required. The brake rigging however is arranged to secure uniform pressure alike on all the wheels, and the train when filled will weigh over 50 tons. The steepest grade along the road is 5 per cent and cars will maintain an average speed of 16 miles per hour. The motor compressor furnished in this installation occupies a space of 16 ins. × 24 ins. × 18 ins.

The Trenton Trolley Wagon.

Those who inspected the exhibit of Trenton trolley wagons made at the St. Louis convention by the manufacturers, McCardell, West & Company, were struck by the compactness, rigidity and completeness of the wagon for the work intended. The wagon has been on the market for about three years and is meeting with increased use, the companies which are employing it now being a very large number and including prominent railway corporations in all sections of the country. The tower is raised and lowered by a wrought iron chain passing over revolving sheaves fitted on sliding bearings and winding on a wrought iron cylinder secured under the sills of the body. The cylinder is revolved by a compound gear by means of which the tower can be quickly and easily elevated by one man. The compound gear is fitted with a ratchet and brake by means of which the tower can be quickly lowered and stopped at any point with men on the platform. The revolving platform at the top of the tower is lightly yet strongly made. It is secured at the center of the tower by a heavy wrought iron center bolt passing through an iron transom plate fastened to a strong framework of wood and iron. Stout iron rollers are let in and secured to the lower surface of the framework of the platform. These rollers pass over the upper surface of a large flat iron circle firmly secured to the top of the tower. The platform can be set firmly in any position desired. When not in use the upper section of the tower wagon can be lowered, the platform extended in line with the body, and the guard rails on the platform folded, making a compact, well balanced wagon which can be driven rapidly, without danger of upsetting.



Street Railway Journal

MOTOR CAR WITH AIR BRAKE ON OBERSCHLESISCHE DAMPFSTRASSENBAHN, GERMANY.

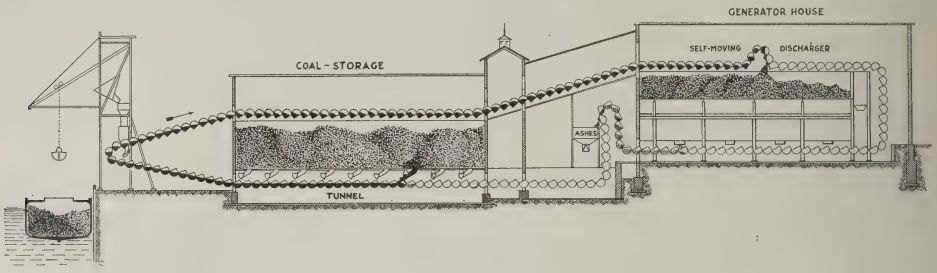
Ticket Punches.

The cancelation of tickets and the punching of transfers seems to the ordinary person unacquainted with the details of street railway operation a trivial part of the service. Practical managers, however, could assure any such person that this belief is not founded upon fact, but that the punch occupies an important function in the service. A great deal of time has been spent upon perfecting this appliance for the uses to which it is put, and the ingenuity displayed in many of its features is striking.

For ordinary transfer work no preservation of the pieces punched from the tickets is required, and for this work the chief aims sought in the punch are durability, variety of punch characters and non-clogging qualities. The R. Woodman Manufacturing & Supply Company, whose punches are well known throughout this country, manufactures a large number of different patterns of punch marks, one of its circulars illustrating 444 and this could be increased probably almost indefinitely. Where the company desires to keep and retain all punchings made from the tickets the punch is fitted with a receiver. This protects the companies from fraud and imposition as it is a well known fact that in many cases the punchings are collected and placed back in the tickets and then punched over again, defrauding the railroad companies of numerous fares. Woodman punches are in use by many of the largest railway companies in this country, such as the West End Railway Company of Boston, which has purchased more than 3500 of them; the Lynn & Boston Railway Company; every road in Baltimore; the Paterson (N. J.) Railway Company; Milwaukee Street Railway Company and others.

Large Coal and Ash Handling Plant.

Those who have to deal with the handling of coal and ashes in power houses, will be interested in the conveying system recently installed at the works of the Equitable Gas Light Company, New York. The coal, which is broken anthracite, is unloaded from barges in the East River by a clam-shell hoist, weighed and delivered to the conveyor, which deposits it either into the storage building, or into an overhead steel bin of 100 tons capacity in the generator house. The conveyor returns beneath the floor of the generator house, where it receives ashes. These are dumped outside the building and the conveyor continues through a tunnel under the coal



A COMPLETE COAL HANDLING PLANT.

house, from which coal is drawn through twelve gates. These are pivoted cut-off gates, operated by the buckets in such a way that each bucket draws its proper load.

The conveyor, which is 714 ft. long, consists of a series of overlapping steel buckets held between two strands of chain, in which, at intervals of 2 ft., small self-oiling rollers are mounted. The buckets are not loosely hung on trunnions, as in other continuous conveyors, but are rigidly fastened to the chains. A hood forming the top of the bucket limits the amount of material loaded into each and enables the bucket to carry its load on the vertical lift and while inverted on the top run. The self-oiling rollers actually perform the function their name implies, that is, they oil themselves. At one point in the track the rollers pass over an oil pan. Small scoops attached to the hubs of the rollers pick up a quantity of oil, which, passing into the chambered interior, lubricates the rollers and the joints of the chain in a thorough manner. This enforced lubrication, which is a new idea in machinery of this class, insures a durable and easy running conveyor, the tension on the chains being remarkably low in spite of the devious route which the conveyor takes.

The gas generators in this plant are arranged for broken coal, and it is important to reduce breakage to a minimum and to remove all pieces smaller than stove size. The transfer of coal from the buckets to the storage bin is designed with reference to this requirement. A movable carriage, traveling on tracks over the bin, contains a screen and is provided with guide wheels, which tilt the buckets into the discharging positions. The coal is poured over the screen bars and while the lumps pass into the bin beneath, the screenings are chuted into a screw conveyor, which carries them to a separate pocket.

In the sides of the steel bin are a number of gates operated from the floor beneath. These discharge the coal into weighing hoppers of 2 tons capacity each, one on each side, which are hung by trolleys from overhead tracks running parallel to the bin. These are provided with chutes which deliver coal directly into the mouths of the generators. This arrangement makes the entire volume of the coal bins available for any one pair of generators, as is often desirable when the plant is running light, and by dispensing with frequent stopping and starting of the conveyor machinery, reduces attendance to a minimum. This machinery was designed and erected by The Link-Belt Engineering Company, and includes other novel features.

Extensive Engine Works Near New York.

In probably no other portion of the equipment of an electric railway does careful construction count for so much as in the engines. The economy of the engine, its durability and the general satisfaction which it will give in service, may be said to depend in a geometrical ratio upon two factors—good original design and careful workmanship. Any variation from the best practice in either of these two points will be sure to tell sooner or later, usually sooner. As to the relative value of these two factors, good design and good workmanship, it is rather hard to say which is the more important. If forced to choose, however, most engineers would decide that good workmanship is more necessary for good service than excellent design, and would prefer a well built engine to a well designed engine if the latter were poorly built. For this reason an inspection of the methods of construction employed by any engine builder is particularly interesting to steam users, and probably there is no better way of determining the relative value of different engines than by a trip through the shops in which they are manufactured, and by a careful inspection of the processes employed.

Fortunately for those steam users who visit New York, and who are contemplating the employment of Ball & Wood engines, a visit to the works of that company is extremely easy. The works are located in Elizabethport, one-half hour's ride from New York. The property adjoins that of the Singer Manufacturing Company, and is 200 ft. × 900 ft. in extent. The main building is the machine shop, a corner of which is shown in the accompanying engraving. The other buildings are the paint shop, boiler rooms, nickel plating and forging departments, etc. The plant is of recent construction throughout and the facilities for shipping are excellent. In evidence of this it can be stated that an engine can be loaded complete with boxes, wheels, etc., on a flat car in eight minutes. The tracks of the Central Railroad of New Jersey run alongside the works, one track extending into the machine shop, greatly facilitating the shipping.

In the machine shop the small tools are under the galleries, and the large ones in the open center, where the electric traveling crane can handle the heavy castings. New tools are constantly being added, and it is the policy of the company to leave nothing undone that will increase the usefulness of the plant or add to the efficiency of the machines produced. The shop is equipped for running night and day, and is at present operating the full time of twenty-four hours.

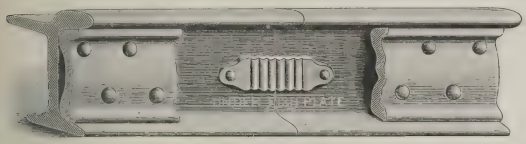
One of the most interesting departments of the establishment is the testing room. Every machine before being shipped is assembled and driven under load to make sure that every part has been well constructed, and the speed regulation is perfect. The method of testing the governor regulation is by the electric tachometer, a description of which was published in the last issue of the STREET RAILWAY JOURNAL. This machine was designed by engineers of the Ball & Wood Company, especially for testing the speed of their engines and is used by them exclusively. It furnishes as sensitive and as perfect a test of speed regulation as could be conceived, and by it the most minute variations in speed can be visually determined. No machine is considered perfect unless it regulates within one-sixth of 1 per cent between abrupt changes of no load and full load. This regulation, which would have been considered impossible a few years ago, can be absolutely secured by means of the flywheel which is characteristic of the Ball & Wood engines. The demand for these engines has compelled the company to build them in all of the various forms which are used in electric railway lighting work. These include the simple and compound horizontal engines, and both the tandem and cross type and vertical engines of all sizes.

MAIN BUILDING—BALL & WOOD WORKS.

New Rail Bond.

The accompanying engravings show a new duplex rail bond which has just been placed on the market by the New York Electrical Works.

The present tendency in rail bonding seems largely toward their application underneath the fish plates. With the protection to the bonds themselves which this method affords, the additional advantage is secured in the "Duplex" of reduction to a minimum of the amount of material and cost of the copper conductors required for a specified capacity.



SIDE AND END VIEWS OF RAIL WITH BOND.

The device as applied consists of two metallic conductors—preferably of copper—so formed that their corresponding ends are adapted to enter a single hole in the rail at its opposite sides or faces. The terminals of these conductors being of tubular or eyelet form, an important result may be obtained, namely, the clinching, with a single rivet, of two bonds placed at opposite faces of the rail. This accomplishes double bonding (i.e., double conductivity) with but one rivet hole in each end of the adjoining rails.

The conductors are interchangeable, therefore do not require to be selected in pairs. They are made of either drop forged or of new process pure cast copper. A slightly modified form is furnished for use as a single bond.

An Electric Feedwater Purifier.

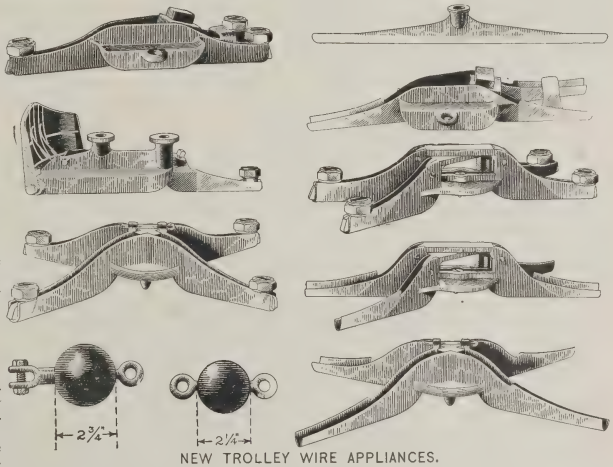
The employment of electricity for the purification of the feedwater used in boilers is rapidly increasing. Although electric purifiers were introduced among steam users only a few years ago, their success has been remarkable and they have received the strongest indorsements from prominent steam engineers and users. A number of railway and lighting corporations have adopted this method of rendering impure feedwater fit for boiler use, among them the Winchester Avenue Railway Company, of New Haven, Conn., the Troy (N. Y.) City Railway Company, the New York & Brooklyn Bridge Corporation, the Gloucester (Mass.) Electric Light Company, the North River Electric Light & Power Company, of New York City, and the Hannibal (Mo.) Electric Street Railway Company. In the New York power station of the cable railway of the New York & Brooklyn Bridge 1395 h. p. of purifiers have been in use for nearly two years with such satisfactory results that additional orders to the extent of 1780 h. p. have recently been placed for them.

PURIFIER AND DISKS.

The construction of the electric purifier, illustrated herewith, and manufactured by the Curtis-Hull Manufacturing Company, is simple in the extreme. The water is passed through the cylinder illustrated which is filled with alternate disks of copper and zinc of the forms shown at the right. The size of the purifiers for different horse powers varies with the local conditions and the character of the feedwater, but for ordinary conditions a 200 h. p. purifier would measure 8½ ins. in diameter by 39 ins. in length and a 650 h. p. purifier would measure 12 ins. in diameter by 62 ins. in length. The action of the current generated by these disks is such that the impurities in the water have no tendency to scale on the boiler tubes, but are precipitated to the bottom of the boiler whence they can be blown off. The theory of the action of the purifier is that the formation of scale in a steam boiler by impure water is mainly dependent upon the presence in the water of calcium sulphate (plaster of Paris). This acts as a cement and joins together the calcium carbonates, silica, organic matter, etc., contained in the water, thereby forming the scale found on the boiler tubes. The currents induced in the electric purifier by the copper and zinc subject this calcium sulphate to electrical action and to the action of the decomposing zinc. This in the presence of sodium chloride results in either changing the calcium sulphate, which is insoluble, to calcium chloride which is soluble, or to a form in which the power to cement is lost. The other foreign matter in the water therefore is allowed to settle without scaling on the tubes. Of course, in time the zinc disks will have to be renewed. The Curtis-Hull Manufacturing Company was also the manufacturer of the electric feedwater purifiers in the plant of the Syracuse Rapid Transit Railway Company, described in our last issue.

New Trolley Wire Appliances.

New designs in trolley wire appliances have recently been perfected by the General Electric Company. The frogs and crossings are all characterized by a perfectly straight under run to allow of the passage of the trolley wheel under all strains up to the actual strength of the trolley wire. In drawbridge frogs, in order to meet variations due to the expansion and contraction in long bridges, both the length and range of movement of the spring contacts have been increased. The right angle and adjustable crossings are little susceptible to injury under conditions of ordinary practice. In both the tongues are the same as in the frogs, the lips folding over the wire. They may thus be held in place without solder until the final position is determined.



NEW TROLLEY WIRE APPLIANCES.

To meet cases in which it is desired to avoid soldering, a line of frogs and crossings has been designed, known as form "G." They are similar in construction to the form "F," first mentioned, with this difference, however, instead of the lips and tongue to be soldered over the wire, screw clamps are used. The wire is held securely to the tongues by the pressure of the screw clamp. This type of frogs and crossing is peculiarly adapted for cases in which simplicity, ease of installation and satisfactory operation are factors of importance.

The ordinary plain ear, form "H" will be peculiarly acceptable to roads using the G. E. cap and cone, and bell insulators, as it is suitable for use with either. It is made with long lips extending the entire length of the ear. These may be fitted around the wire for temporary use without solder. For span and guy work, where a small strain insulator is particularly desired, the General Electric Company makes one with an outside diameter of the ball of 2¼ ins. It is capable of standing a strain of 1 ton with ample factor of safety.

The Roxborough, Chestnut Hill & Norristown Railway Company, of Philadelphia, Pa., will establish a 40 acre park at Perkiomen Turnpike and Hallowell Avenue, about 3 miles from Norristown, to be called Plymouth Park. A handsome casino of colonial style is now under construction, and there is to be a lake of fresh water covering about 2 acres. The usual excursion park amusements, such as caroussels, swings, a music stand, baseball grounds, tennis courts, and probably a scenic railway will be installed.

Toggle-Clamp Feed Wire Insulator.

The present methods for fastening the feed cables to their insulators consist principally of wire bindings, screw-caps or grooves with metallic fingers, which may be hammered over on the wire. Each of these methods has its disadvantages and requires time for a proper fastening of the wire, besides involving an additional expense and some injury to the insulating covering, when for such reasons, as in moving the cable or in taking up of slack it becomes necessary to detach the wire from the insulators. Any improvement which will facilitate the attachment of cables and do away with loose parts will constitute an immediate advance toward greater economy in construction by increasing the efficiency of the lineman and adding to the life of the insulating covering of the cables.

TOGGLE-CLAMP.

The automatic fastening furnished by the "H. W. J." toggle-clamp feed wire insulator introduces the improvements desired. As its name indicates, the principle of the fastening is based upon the multiplying action of toggle levers. The jaws are 3 ins. long and are hinged at the sides; upon the insertion of the cable they tend to come closer together under the weight of the wire; and the greater the downward pressure the greater will be the clamping action. The utility of the principle as applied to a feed wire fastening is apparent. The jaws are readily spread by an upward movement requiring little effort on the part of the lineman, whose labor consists entirely in raising the wire and dropping it into the jaws. The attachment is instantaneous and the clasp upon the wire so powerful as to prevent the possibility of slipping. Notwithstanding the powerful clamping action of the jaws, the wire may be readily detached from the insulator by an upward lift, which causes the jaws to spread and loosen their grip.

The "H. W. J." toggle-clamp insulator is placed upon the market by the H. W. Johns Manufacturing Company in the belief that its simplicity, effectiveness and labor saving and economical features will prove of interest to all electric railroads and engineers.

Cross Arms for Iron Poles.

In supporting heavy railway feeders on iron poles, it is desirable to have cross arms that are strong, light and neat in design. Fig. 1 shows a cross arm made of malleable iron. This arm is designed for the heaviest feeder work. It is made in halves, clamped together on the pole by means of four bolts. The cross section of the arm is I shaped and the distribution of the material is so proportioned as to properly handle the strains put upon it. The pin holes are cored for 1½ in. wood pins. Two pin and six pin arms are similar in design to the four pin shown in the illustration.

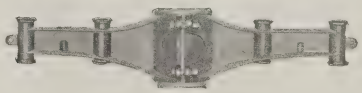
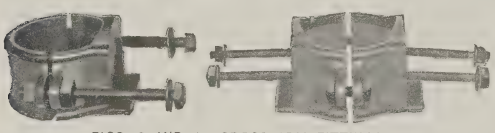


FIG. 1.—IRON CROSS ARM.

FIG. 2.—WOODEN CROSS ARM.



FIGS. 3 AND 4.—CROSS ARM FITTINGS.

Fig. 2 illustrates a new design of wood cross arm for iron poles. This arm is made of a standard wood cross arm and a special malleable iron fitting for attaching the wood arm to the iron pole. The clamping surface of the fitting is large, and when clamped in position it is a rigid support for the wood arm bolted to it.

For ordinary work, the single cross arm with single fittings (Fig. 3) is sufficient to support the feeders properly without the use of braces. On very heavy work or curves, end junction and corner poles, the double fitting (Fig. 4) for two cross arms should be used and properly bolted together through spacing blocks in the ordinary method. The use of the wood cross arm is very desirable on account of its lightness and especially on account of the insulation it affords to any of the feeders that may be down on the arm resulting from a broken tie wire. The Creaghead Engineering Company manufactures these arms in many sizes and lengths. This company's pole brackets, pole fittings and line material of all kinds have met with great favor among practical railway men.

New Type of Hanger.

The accompanying cuts show views of a trolley wire hanger for straight line suspension, and two different styles of insulated bolts used with it. This style of hanger is manufactured by the Ohio Brass Company, and is designated as the Type D to distinguish it from the other forms of hangers of a similar kind which this company has placed on the market in the past. The Type D hangers are made in all the various forms required for the different styles of suspensions. The bodies, which are of malleable iron, are made as light as is consistent with the strength required, but ample allowance has been made in their design so that they will support with perfect safety the heaviest trolley wires now in use. The castings being machined to a standard size admit using the Type D and D–W bolts, which are shown herewith, interchangeably so that the different styles of bars and clamps can be assembled with the various forms of hangers. These bolts are in duplicate of each other, except that their projecting metal ends are made differently, being of such a design as to permit attaching the corresponding types of ears and clamps to them. The Type D bolt is threaded externally on the end and can be used with all the various styles of ears and clamps that are provided with the usual form of boss tapped for ⅝ in. stud. The end of the Type D–W bolt is cone shaped and threaded internally to receive the stud bolt with which the Type D–W clamp is equipped. This style is similar in every respect to the well known Type W trolley clamp, with the exception that the stud bolt is made shorter in length, so as to admit using with it the Type D–W bolt.

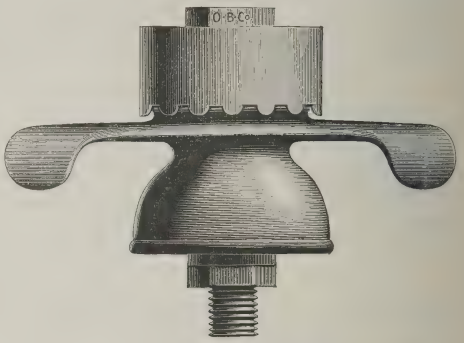
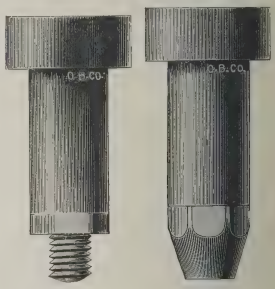


FIG. 1.—TYPE D STRAIGHT LINE HANGER, WITH CLINCH CAP.



FIGS. 2 AND 3.—BOLTS.

In finish of detail and general character of workmanship these appliances are up to the standard of the Ohio Brass Company. It is not necessary to describe in detail their minor points of merit, as they show for themselves in the finished article. It may not be amiss to say, however, that new and improved methods in the making and handling of the patterns and in the machining of the castings have been used, which has resulted in bringing the Type D hangers to a degree of perfection never before equaled in this class of material. The particular features which appeal strongest to the users of them are the hanger cap and insulated bolts, all of which are supplied with hexagonal nuts of the same diameter, and in consequence one size of wrench fits them interchangeably. The style of wrench which is supplied for use with these is 5 ins. in length, stamped out of steel and open at one end, the jaws being of the proper size to allow them to fit easily over the nuts. It will be apparent to any one who has had any experience with overhead construction material that the purpose of these nuts is to provide a means for screwing the respective articles on which they are placed quickly and securely into position.

The hanger cap, as will be seen from Fig. 1, is also made with a series of lugs around its lower edge, the object of these being to hold the cap securely in position on the hanger body, thus preventing it from unscrewing and backing off. This is done by bending some of the points, preferably any two which are opposite each

other inwardly over the shoulder formed on the hanger body beneath the threaded part and tightly against it. This style of cap, on account of the way in which it is handled and the service which it gives has been designated as the "clinch cap, and as it obviates the trouble which has been experienced in the past from the cap becoming loosened from the hanger body and falling off, it will undoubtedly meet with favor. The Ohio Brass Company reports that although this style of hanger has been on the market but a very short time, yet the sales of it have been surprisingly large, and since the first of the year the company has received orders for them, aggregating more than 9000.

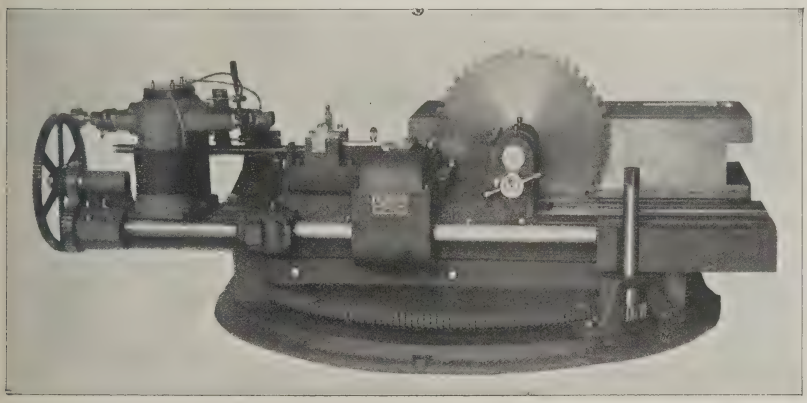
An Outside Paint.

Professor Spennrath, director of the Technical School of Aix-la-Chapelle, lately won the $2,000 prize offered by the Society for the Advancement of the Industrial Arts for the best essay on "Protective Paints." The prize was not won simply by theoretical demonstrations, although the professor furnished scientific reasons also, but by most carefully conducted practical experiments with various pigments and oils, covering several years' time. The results demonstrated that a properly made paint of graphite and boiled linseed oil is the most suitable for protecting structural ironwork, roofs, etc., exposed to the destructive agencies of heat, cold, storms, etc.

Cold Metal Sawing Machine.

This machine, which is illustrated herewith, has been specially designed by the Q. & C. Company for structural iron workers, track layers and others who handle beams, channels, etc., in limited space; it is also suitable for general work and has a very large capacity as compared with other saws at the same price. Among the improvements incorporated in this machine are increased feeding speeds, prolonged life of saw blades and lateral adjustment of saw blades. The feeding mechanism has been much improved and any change in speed can be made without stopping the machine. The saw carriage is provided with quick return by means of rack and pinion; all bearings are adjustable to compensate for wear, and the machine throughout is made of the best material; the saw arbor is of Jessop's steel and the worm wheel of Phosphor bronze engaging with a steel worm. The machine is equipped with a motor and has a circular base. The company also furnishes this machine on a stationary base with tight and loose pulleys for belt power.

The Bryant saws are now being widely used by street railway companies; among those that have ordered the style illustrated are the Citizens' Street Railway Company, of St. Louis, the Metropolitan Company, of Kansas City, the Chicago City Railway Company and the West End, of Boston.



COLD METAL SAWING MACHINE.

LEE HUTCHINS, secretary and treasurer of the Washington & Great Falls Electric Railway Company, Washington, D. C., is one of the chief promoters of the Washington, Westminster & Gettysburg Railroad Company, and others who are interested are George Colton Smith, of Wilkesbarre, Pa.; Herbert Shriver, of Union Mills, Md.; Wm. B. Thomas and J. H. Cunningham, of Westminster, Md.; John A. Shaw, of Littlestown, Pa., and H. A. Cady, of Washington. The distance of the surveyed route is 73 miles, and passes through Rockville, Latonsville, Westminster, Union Mills, Littlestown and many other towns. Four power houses will be built along the line. Within thirty days the organization will be completed, all the stock subscribed, officers elected and active work begun.

A Continuous Rail Frog.

The "continuous rail frog" shown in the cuts is something in the line of track improvement recently put on the market by the Terre Haute Car & Manufacturing Company. It is the invention of John Delane and John F. Blue, both of Terre Haute, Ind., and is fully covered by letters patent.

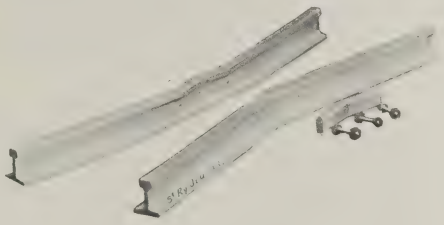


FIG. 1.—PARTS OF FROG.

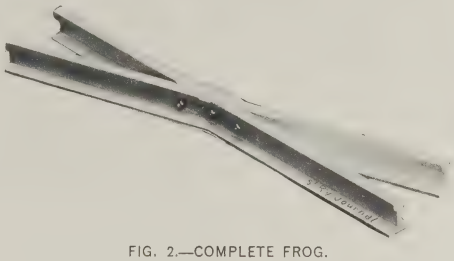


FIG. 2.—COMPLETE FROG.

Fig. 1 shows the construction of the frog. The two pieces of rail are bent to the desired angles, the flanges are machined to come together, the wrought iron divider is inserted in the joint between the webs of the two rails and the entire frog is then bolted together. The balls of the rails are then milled to permit the passage of the flange of the wheel, the completed frog having the appearance shown in Fig. 2.

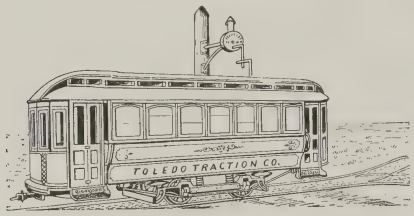
The extreme simplicity of this frog is apparent from the cuts. Instead of weakening the track at the point where placed, this frog actually strengthens it, the web of both rails carrying the load. The switch point, being a part of the rail itself, does not require the support of a plate and concrete foundation, and it is impossible for it to go down. In the old form of frog the point wears down below the rail and the guard rail, but with this the wear is no greater on the point than on any part of the rail. In this frog, the pounding of the car at the point is obviated, removing at once a source of annoyance and expense, as renewals of points are not necessary.

The simple construction also lessens the first cost of the frog and materially reduces the labor of applying it. In the manufacture of this frog, the rails used can be of any desired length, as it is obvious that the rail can be bent at any point.

THE Wellston, Creve Coeur & St. Charles Electric Railway Company, St. Louis, Mo., has about completed arrangements with the St. Charles & St. Louis Bridge Company for the use of a bridge which it will build across the Missouri River and has made surveys and secured rights of way for its projected lines from the city limits of St. Louis near Wellston to St. Charles with a branch line to Creve Coeur Lake. Among those interested are J. B. C. Lucas, Robt. Schencke, F. A. Thompson, Thomas T. Lucas, Charles P. Damon, G. R. Wise, J.H Chambers, J. H. Bobb and E. T. Thomas.

A New Electric Signaling System.

The necessity of block signals has been impressed upon steam railroads by many disastrous accidents from collisions, but owing to the much slower speed at which street railways have been operating, the use of block systems on these roads has never reached the extent that it has gained on steam lines. With the increase however in the rate of speed, the necessity of a block signal system is increasing, especially on single track lines where cars pass each other at turnouts at stated intervals. Without a system of this kind the motorman of a car going in one direction never knows exactly whether he need wait at one turnout to pass the car approaching him or whether he will have time to reach the second turnout. A



SIGNALING DEVICE.

new electric signal system has recently been brought out by the Saddler Electric Switch & Signal Company. By means of it the signals are worked automatically by a contact rod on the top of the car. The signal can be operated without stopping the car.

The signal box is located on a pole near the track, as shown in the accompanying engraving, and is fitted with a short projecting arm. This is struck by a pin or ratchet on the top of the car and is then driven to one side in the direction in which the car is advancing. This action throws into electrical connection the trolley wire and the projecting arm of the next box ahead which is located at the far end of the block.

A box containing a lamp is carried on the front platform of car, either overhead or upon the sash in front of the motorman, and the binding posts upon the top of the box are connected with the contact pin upon the top of the car, and with the gearing beneath the car, thus grounding that side of the box. If now a car has passed the box at one turnout and has driven the arm to one side, the arm will return to its former position, but the connection between the trolley wire at that box and the projecting arm at the next will be made and will thus remain. If now a car should attempt to leave the switch ahead, as shown in the cut, its contact pin upon the top of the car will rub against the pendant end of the projecting arm, thus allowing the current to flow through the photophone box, ringing the bell within the box, and causing the lamp to burn for a short time. After the car has run through the block to its exit at the next switch, its pin will evidently strike the arm of the box there in the opposite direction from that in which the connection was made at the last box. This action will cut the circuit at the last box left, or at the entrance of the block and thus throw the arm of the box at the turnout ahead out of circuit.

It thus happens that the car throws on the connection at one end of the block and throws off the same connection at the other end of the block; so that no attention is required on the part of any one, nor is the current grounded, nor is the lamp burning except at the instant of giving the signal. It is also true that should a car leave a switch, thus setting the contact box in communication with the arm at the next switch ahead, and should for any purpose be compelled to back into the switch again, the contact will be broken, thus allowing the car ahead to leave the switch ahead and come on. The apparatus will not get out of repair, and is easily erected, the four wires for the signal box being numbered so that the connections may be made by an intelligent person.

The system is in use on the lines of the Toledo Traction Company, the Toledo & Maumee Valley Railway Company, and the Toledo, Bowling Green & Fremont Railway Company, and is giving very good satisfaction.

New Railway at Oshkosh.

The Citizens' Traction Company is the title of a new corporation organized several months ago to build an electric railway in Oshkosh. The charter was secured about three years ago by J. K. Tillotson, but no steps were taken, on account of the continued business depression, to build the road until 1896, when Mr. Tillotson succeeded in interesting in the enterprise O. U. Von Schrader and G. J. Kobusch, of St. Louis, the latter being president of the St. Louis Car Company. The officers elected were Mr. Kobusch, president; Mr. Von Schrader, treasurer; and Mr. Tillotson, secretary. The company after its incorporation proceeded immediately to build the line and has now nearly completed its road, has built its power house and car house, has placed 11 miles of poles, graded 8 miles of roadbed, distributed its ties and just purchased its rails. It has the hearty and enthusiastic support of the citizens of Oshkosh, who have subscribed $25,000 as a direct bonus to show their appreciation of the work of the company. Without solicitation from the company, the business men have also petitioned the City Council to grant the company the right to double track the main street.

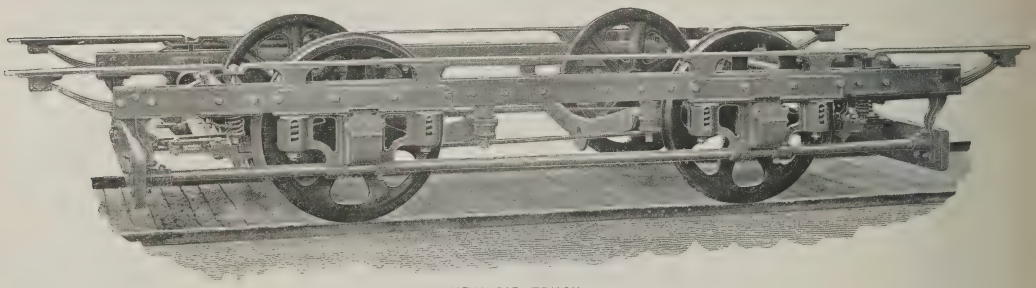
Franchises have also been secured for a considerable suburban system which will probably be operated by a separate company. The franchises include connecting links between eight or nine towns with a total population of 75,600, in the immediate neighborhood of Oshkosh.

New Car Truck.

The accompanying illustration shows the Barney & Smith Car Company's latest design of motor truck for single truck cars. It is known as the company's class "G" truck.

The prominent features of this truck are its excellent riding qualities, small number of parts to get out of order—hence the economy of repairs—and its unusually long spring base, which with a wheel base of 6 ft. 6 ins. is 15 ft. 6 ins. for body support. The peculiar combination of the pedestal spiral springs, with an elliptic spring over the journal box and with the half elliptic adjusting springs at either end of the wheel beams, imparts to the car a remarkable smoothness of motion. An important feature of this truck and one, too, of very great merit, is the ease of adjusting the end springs to accommodate the varying loads of car bodies having ends of different weights.

This end is accomplished by means of an adjusting bolt at the inner end of each end spring, which enables the end of the spring beam to be raised or lowered to suit the different requirements, thus always carrying the car body level and not pitched down or up at one end.



NEW CAR TRUCK.

To remove wheels and axles from the truck, all that is necessary is to remove the nuts from the two bolts shown under the journal boxes. This permits the small cross bar immediately beneath the journal box to be removed, thus allowing the wheels, axles and boxes to drop down.

This truck has been examined by many experts in electric truck matters and has received the highest praise.

A CERTIFICATE of the incorporation of the Washington, Westminster & Gettysburg Railroad Company (Annapolis, Md.) has been filed for record in the executive department. The incorporators are William B. Thomas, James A. C. Bond, Charles T. Reifsnider, T. Herbert Shriver, John A. Shorb, George Colton Smith, James B. Colegrove, John H. Cunningham, David Cowan, Jr., Stewart Roberts, John F. Reifsnider, Milton Shaffer, Edwin J. Lawyer. The road is to run through Montgomery, Howard, Frederick and Carroll Counties, with a branch from Sandy Spring or Laytonsville to Frederick. The capital stock is $100,000.

Improved Combination Car, California Style.

Theform of combination car illustrated herewith is especially interesting because of its rapidly increasing popularity. The design originated on the Pacific coast of the United States, the first car of the kind having been used on the cable roads of San Francisco. The type was eminently suited to the mild climate when riding outside was comfortable at nearly at all seasons of the year. It became so popular as to be almost universally adopted on the Pacific slope. While practically open it makes provision to give its passengers protection in case of wind, rain or a sudden change of temperature, at the same time the body furnishes ample shelter at all times for invalids or those who are delicate.

IMPROVED COMBINATION CAR.

These cars at once stepped into favor with smokers because they are well accommodated without inconvenience or complaint from other passengers. Those who had objections to open cars were perfectly comfortable in the closed body, while in the warmest weather ample ventilation could be secured. These cars were not only favorites with the traveling public, but with the railway men as well. They were inexpensive as compared with double deck cars of a similar capacity, and were able to make much better time than the latter because of greater ease of loading and unloading. While extensively used in the West there was one feature which kept them out of the East. This was the extreme distance of the step from the ground and the great height of the riser from the sill to the floor. This feature made these cars in their original form slow in picking up and dropping passengers.

The car illustrated, designed and built by the J. G. Brill Company, entirely obviates this difficulty by bringing the platforms down as low as those of an ordinary closed car. A car of the style shown can not only be loaded and unloaded at terminals very quickly, but can pick up and put down passengers with the greatest rapidity. With this single difficulty removed the popularity of these cars will undoubtedly become as great in the East as the West. The improvement has been made by cutting off the sills at the body instead of allowing them to run through. The platforms are then brought down to a proper level, that of a closed car. The body, however, remains sufficiently high to admit the use of a 30 or 33 in. wheel and a 21-E truck.

The construction by which this very desirable end is accomplished is quite simple. Two angle irons extend the whole length of the car body and platforms. The side sills rest upon them and they are offset at the ends of the body so as to take the platform timbers. The long flange of the angle iron is placed upon the outside, giving ample space for springs, wheels, etc., without raising the body. In the engraving one of these angle irons is shown under the car like a bent sill. These irons entirely relieve the body from the strains set up by the long platforms which are often heavily loaded. As shown in the engraving, the closed body of the car has a seating capacity for eighteen persons and the platforms twenty. The standing room on the platforms is enormous, a point which managers will appreciate.

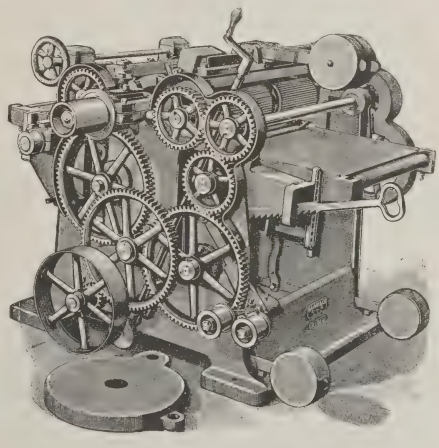
On the platforms there are two cross seats placed back to back with a bulkhead between them. The latter is fitted with both sash and blinds. These together with the curtains, which come down all the way to the floor, enable the platforms to be entirely enclosed at a moment's notice. The round end seat panels enables this to be done quickly and with ease. The rounded corners, while increasing the strength of the metal panel, prevent the curtains from sticking or wearing on the seat end. The passengers can in this way be protected against sudden storm or unpleasant changes of weather. In the engraving the curtains are shown drawn down on the further side of one of the platforms and the steps folded. The dimensions of the car shown in the illustration are 13 ft. 6 ins. length of body. Platforms 7 ft. 9 ins. over all. Total length of car over buffers 29 ft. This type of car packs very compactly for foreign shipment without the necessity for "knocking down" entirely. When skilled labor for erection is obtained with difficulty this is a point of considerable advantage.

In this car an improvement has been made in the operation of the windows. Instead of dropping into pockets behind the seats they are made to rise 3½ ins. This improvement was suggested by Col. N. H. Heft, electrical engineer of the New York, New Haven & Hartford Railroad. It is found that 3½ ins. is about as much as can be given with comfort to passengers. With the high speeds of modern electric cars greater lifts produce drafts which become annoying and uncomfortable. When the platform curtains are raised, the bulk head sash dropped and the windows of the body raised, a practically open car is obtained.

The Eureka maximum traction truck lends itself to use with this style of car in a very advantageous manner. By placing the pony wheel under the platform a great distance between the truck centers can be obtained, ample space retained for reaching the motors, while the platforms still remain low, even with 33 in. wheels. This combination gives great carrying capacity, a high tractive force, the ability to pass around short curves with ease while retaining all of the other advantages of this type. Double trucks greatly decrease the wear and tear on the roadbed, a further advantage not to be overlooked.

New Heavy Double Cylinder Surfacer.

The demand for a heavy surfacer with a short bed, capable of planing smoothly all kinds of lumber, has led to the introduction by J. A. Fay & Company, of the machine shown in the accompanying



DOUBLE CYLINDER SURFACER.

engraving. Two sizes are made to plane on both sides up to 26 ins. and 30 ins. wide, 10 ins. thick, and they will plane two pieces at once up to 12 ins. wide, though varying in thickness. This is a very desirable machine for use in the manufacture of sash, doors, and other parts of a car.

The frame is very heavy, with plate sides and girts, and supports a bed or platen that is gibbed to planed ways, and is adjustable vertically, for variations in thickness to be planed, by means of heavy, square thread screws. The end of the bed is arranged to swing around for ready access to the lower cylinder for purposes of sharpening and adjustment.

The upper cylinder has journals 9 ins. × 2¼ ins., and is belted on both ends. The lower cylinder journals are 8 ins. × 2¼ ins., and is single belted. Both cylinders, with their journals, are made from a solid steel forging of fine quality, and are slotted on all four faces. One pair of knives is furnished with each cylinder. The lower cylinder is carried in a heavy frame, and is adjustable independently of the bed, and a tightener is furnished to take up the belt when changing for different thicknesses.

The feed-rolls are four in number, 7 ins. in diameter, driven by powerful gearing. The feeding rolls are weighted and the delivery rolls have spring pressure. The regular feed sent with the machine is 37 ft. per minute, but this may be changed if desired. The feeding roll and bar before the upper cylinder are divided into two sections, so that two pieces of material may be planed simultaneously though varying in thickness. They are heavily weighted and will raise independently or together. The pressure bar under the lower cylinder adjusts itself to the finished surface of the board. The pressure bar over the lower cylinder has an independent vertical adjustment, and swings out of the way to give access to the cylinder.

Changeable Electric Headlights.

Electric headlights possess so many advantages over the oil headlights that they are being used extensively on electric roads. Some objections were originally brought against electric headlights, due to poor construction and design, but these, it is claimed, have been entirely overcome in the modern headlights. The accompanying engravings show the Syracuse changeable electric headlight which has achieved remarkable success during the time

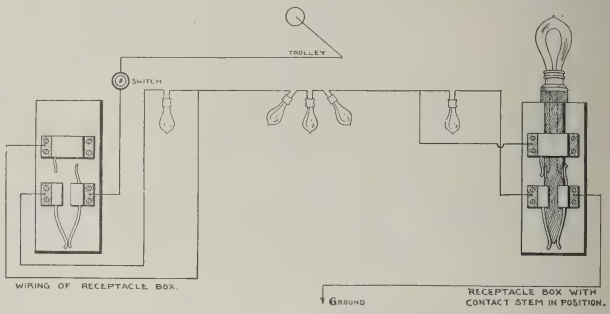


FIG. 1.—PLAN OF HEADLIGHT WIRING FOR FIVE LIGHT CAR.

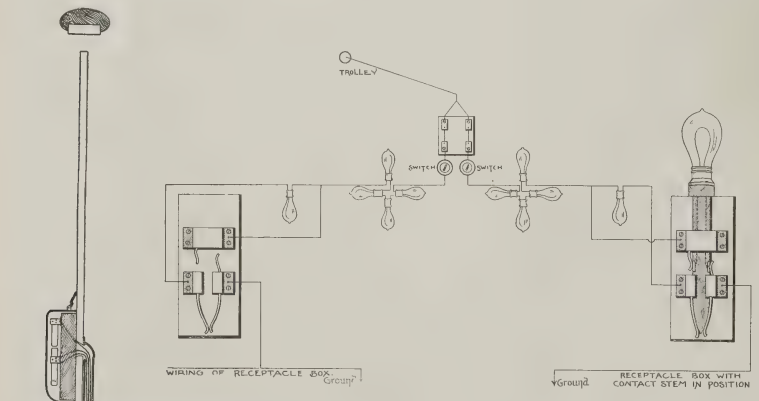


FIG. 2.—PLAN OF HEADLIGHT WIRING FOR TEN LIGHT CAR.

FIG. 3.—PLATFORM WIRING.

ELECTRIC HEADLIGHT.

n which it has been on the market and which possesses a number of important advantages.

The wiring of a changeable electric headlight for a five light car is shown in Fig. 1. No switch is necessary when the headlight is put in service. It is simply slipped into a small receptacle bolted to the front of either dash. Doing this automatically cuts one lamp out of the car circuit and its place is taken by the lamp in the headlight. The same results are secured in a ten light car with slightly different wiring as shown in Fig. 2. When the end of the run is reached the headlight is simply transferred to a receptacle at the other end of the car, all the connections being made automatically.

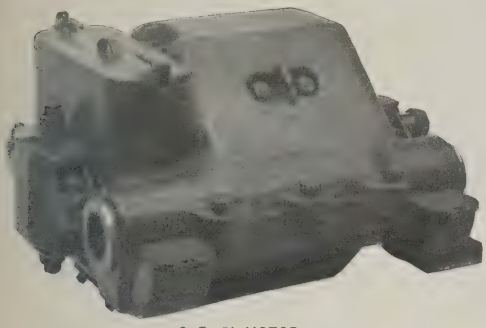
A feature of the system is the fact that only one headlight lamp is necessary for each car. No holes have to be cut in the dashboard except a few small ¼ in. holes for the bolts which hold the receptacle in position. In this way the same headlights can be used for summer and winter equipment, it being only necessary to equip each end of the car with receptacles. The latter are of cast iron, 10 ins. high by 4 ins. wide, and are fitted with a hinged cover which boiled in paraffine to make it thoroughly waterproof, is firmly attached to the steel jacket. At the top of the contact stem is the socket, which can be of any make desired. The headlight is raised by means of a strong sheet steel handle which is attached to the top of the steel jacket.

The Syracuse changeable electric headlight is manufactured by the Crouse-Hinds Electric Company.

An effort is being made by the principal owners of the San Jose & Santa Clara Railroad Company, San Jose, Cal., and some of the heaviest creditors of the San Jose Railroad Company, now in the hands of receivers, to bring about a consolidation of all interests and form a new corporation, and operate all the street railways of San Jose and vicinity under one management and from one power station. The new corporation will have a capital of $1,000,000 and issue new bonds to the amount of $500,000 to take the place of the old bonds and to pay for the properties.

G. E. 51 Railway Motor for Heavy Railway Service.

Steam *versus* electricity is a popular subject of debate of engineering societies at the present time, and the actual substitution of electricity for steam as a motive power on suburban and elevated roads is assuming large proportions. Already suburban branches of steam roads and two elevated roads are operated entirely by electricity and the General Electric Company, in anticipation of this new phase of electric railway work, has designed and developed,



G. E. 51 MOTOR.

and is to-day prepared to furnish every kind of apparatus for the complete electrical equipment of suburban railways now using steam.

The G. E. 51 railway motor has been especially designed for high speed suburban and elevated railway work. It has a capacity of 80 h. p., rated according to the standard basis of a rise of 75 degs. Centigrade above the temperature of the surrounding air after a run of one hour at rated load.

A large number of gear reduction combinations may be used to afford a wide range of speed and tractive effort. For high speed work a gear reduction of 1 to 1.74 is used, and at the present time trains of 25 to 30 tons equipped with two G. E. 51 motors having this gear reduction, are operated at speeds of from 45 to 50 miles an hour with success.

The G. E. 51 motor may be readily adapted to slow speed work, snow plows, freight locomotives and the like, by the use of larger gear reductions, and the electric brake may be satisfactorily added to the G. E. 51 motor equipments. On the standard gage track, however, the brake and motor cannot be mounted on one axle and it is advisable, therefore, to have double truck cars for the brake equipment, the motors being placed on one truck and the electric brakes on the other. With special dished wheels, however, the brakes may be mounted on the same axle as the motor. The G. E. 51, two motor equipment with the electric brake includes the B 7 brake controller and without electric brakes the ordinary K 13 controller. Both of these controllers involve all the well known features of the K type and occupy but a small space on the car platforms.

In general appearance the G. E. 51 motor resembles the G. E. 1000. The field frame is two steel castings parted horizontally, but extended to the back to envelop the car axle. A large opening is provided, allowing easy access to the motor for the adjustment of the brushes and the inspection of the interior. The motor, when closed, is dustproof and waterproof. For the removal of any foreign substance that may become lodged in the bottom of the motor a handhole is provided in the bottom of the frame at the commutator end with a cover bolted on the outside.

An important and novel feature of the G. E. 51 motor appears in the bearings. The large size axle bearings are lubricated by the use of oil, and wool waste is packed in the oil reservoir underneath. The armature bearings are lubricated in like manner and all the bearings are essentially similar to those designed for steam railroad service according to Master Car Builders' specifications. A special feature of the armature bearing is the adjustment, the armature being raised and lowered by set screws at the top and bottom of the armature bearings. The range of axle diameters for which the motors may be fitted is from 4 ins. to 5 ins.

The armature construction is the standard adopted in all the G. E. motors. It is of the drum wound, iron clad type, with machine wound interchangeable armature coils. The slots in the core are sufficiently large to permit through insulation of the coils, and the insulating materials used are selected only after exhaustive tests have been made with every lot of wire, paper, cloth and tape used in their manufacture. The completed armature is compact, strong, durable and able to withstand the severest strains of regular service.

The commutator is manufactured from the best hard drawn Lake copper, the segments being 1¼ ins. in depth to allow of considerable wear before refilling is necessary. There is a groove encircling the commutator near end of leads to facilitate their removal. The large diameter and length of the commutator ensures rapid radiation of any heat. The brush holders are of the standard type, each holder containing two brushes, and to prevent ridges forming on the commutator, these are staggered.

New Works for an Important Company.

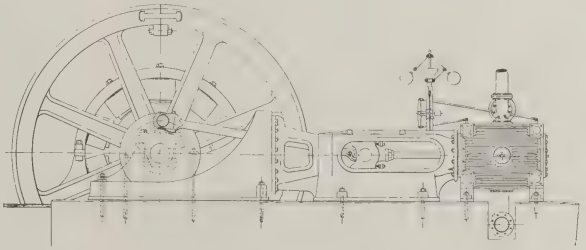
The Sterling Supply & Manufacturing Company, of New York, has recently moved its works to much more extensive quarters in the Lexington Building, 141-155 East Twenty-fifth Street, New York. This is the building recently erected by the Metropolitan Street Railway Company, and the steam plant for operating the Lexington Avenue cable system of that company is on the ground floor. The rest of the building is devoted to light manufacturing purposes. It was especially built with this end in view, and is well arranged for such use. The Sterling Supply & Manufacturing Company will occupy the third floor, where from 14,000 sq. ft. to 16,000 sq. ft. have been secured, and where from 100 to 150 men will be employed. Power will be furnished by the company's own electric motor, which will operate countershafting extending through the different departments. Here will be conducted the manufacture of registers, fenders, sand boxes, brakes, insulators, etc., in all of which lines the company reports a large increase of business. The insulator department is a new branch of the company's business, but promises to be very extensive. The facilities for receiving and shipping goods are perfect, as the building contains five elevators, one of which is large enough to receive a full loaded truck with team. In this way the shipping facilities from any department of the company's works are just as good as if they were all on the ground floor. The growth of this company's business from comparatively small beginnings has been remarkable, and its increasing business has compelled the company several times to move to larger and more extensive quarters. In its present location, however, the company expects to have a permanent home, as future extensions to its works can be secured without moving.

The "Heavy Duty" St. Louis Corliss Engine.

The accompanying engraving shows a 400 h. p., heavy duty St. Louis Corliss engine direct connected to a 250 k. w. generator. This engine has been built by the St. Louis Iron & Machine Works especially for heavy service, such as electric street railways, rolling mills, mining and blast furnaces. It combines great strength, constant regulation under wide range of load, economy of operation, and the ability to operate continuously upon enormous overload.

The main frame and guide frame are made especially heavy, and the guides are bored to a circle their full length, with special machinery to insure being parallel. The main pillow block is extra long and large, giving a large wearing surface for the shaft journal.

The valve gear is of the standard hook type releasing gear, and is operated by double eccentrics and double wrist plates, which give movement to the steam and exhaust valves independent of each other. With this new form of movement it is possible to cut off the admission of the steam to the cylinder at any point in the



HEAVY DUTY ST. LOUIS CORLISS ENGINE.

stroke between zero and three-quarters, and still obtain a constant compression with the independent exhaust valves. This is an important feature in electric power work or, in fact, in any service where the extremes of load are large and sudden. The valves are either single or double ported, according to the type of engine and the speed at which it will run.

The governor is the centrifugal heavy ball type, of special design, and is provided with a weighted lever for changing the speed of the engine, if necessary; also with an oil dash pot to prevent chasing, and an automatic safety stop.

The crosshead and crank are of open hearth steel of 60,000 lbs. tensile strength per square inch. The crosshead has taper adjustable shoes, lined with anti-friction metal. The main shaft is of selected wrought iron, and has extra long journals.

Latest Walker Practice in Electric Railway Apparatus.

The Walker Company, has recently brought out a new motor which is known as the 3 A. It has a capacity of 30 h. p. and contains several specific improvements that are entirely new in the electric railway art. Besides this the general design of the motor has been improved and its lines are now much more graceful and substantial despite the fact that its predecessors were models in this respect. A general view of the motor is the subject of Fig. 1. It will be seen that the side arms of the suspension have been made much more massive, but they are cored out hollow, and hence combine lightness with rigidity. The suspension device has but four parts. The bearing on the car axle is of babbitt and is carefully scraped. This suspension frame carries all the grease cups, and grease and oil are not allowed on any part of the motor itself. The grease cups have been made much larger. The motor bearings are entirely outside the case and all refuse lubricant falls on the ground and cannot enter the motor. The pinion bearing is 8 ins. in length instead of six as on other makes and this additional bearing surface notably increases the life of the bearing. This can be seen in Fig. 2. The stresses on the pinion bearing are much more severe than those on its mate, and the Walker Company has been the first to appreciate and provide for this necessity.

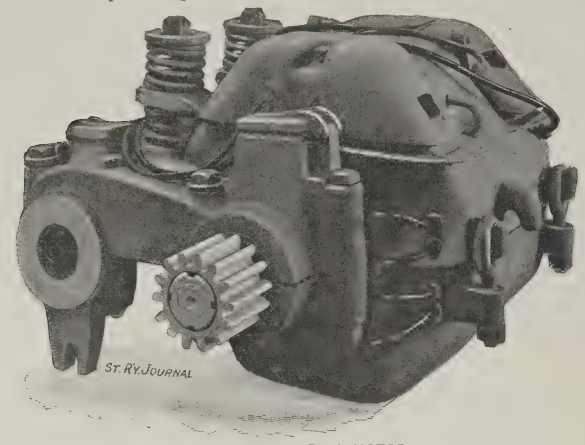
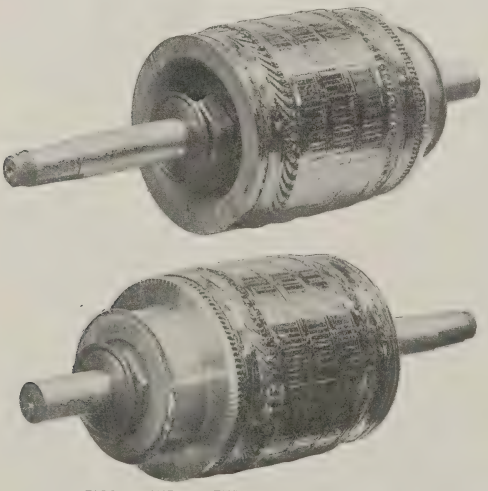


FIG. 1.—TYPE 3A MOTOR.



FIGS. 2 AND 3.—END VIEWS OF ARMATURE.

Of the principle of the suspension it is necessary to say but little, as it has been fully illustrated and described in these columns. It is sufficient to call attention to the fact that the rigid connection which keeps the gears in mesh does not in any way interfere with the motion of the motor as it moves under the vibrating influence of the car. To rigidly arrest such motion means pounding and the motor therefore is limited in its play by springs which absorb the jar. The arrangement also adapts the field to turn under sudden and severe torque. Thus, when the armature is momentarily blocked by inertia and severe grade the torque reacts on the field and compresses the suspension springs thus taking the strain off the gears. With ordinary suspension the teeth often snap from suddenly applied torque and in any event the life of the teeth is much shortened.

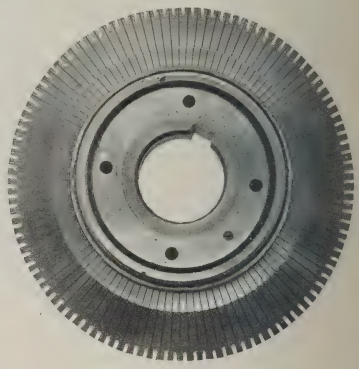


FIG. 4.—COMMUTATOR.

The field of the motor is wound of a size larger wire than any other makes of equal capacity. The field coils are rectangula both in shape and in section, and thus no special tools are necessary in making repairs on them. There are four field coils in all, each pole being salient, and thus the field is perfectly symmetrical. The effect of this is to minimize sparking and avoid unequal distribution of work in the armature winding. The advantage of a four field winding are beginning to be appreciated and used more generally. The field coils are thoroughly soaked in a fire and water proof compound, and thus rendered impervious to heat or moisture. The motor casing has apertures at both ends of the armature in its upper half. Thus either end of the armature can be inspected without opening the motor. This is an exclusive advantage of the Walker motor, and quite an important one. These lids are provided with ventilating holes that keep the armature materially cooler in seasons of overload. The holes are so designed as to render it impossible for dust or moisture to enter. The familiar eyebolt hinge which permits the tightening of the magnetic joint between the case halves is retained. The new case is octagonal in shape whereas the old one was cylindrical.

FIG. 5.—NEW TROLLEY.

The armature has also been materially improved. The barrel system of winding is used, but the coil has been improved so that it is now so short that the completed armature is fully as short as the ar-

mature using connectors passing over the ends. In fact one of the new armatures can operate in the old field, thus conclusively proving that its length has not been increased. The great advantage of the barrel winding is the ease with which its coils may be slipped on, the small proportion of dead wire, and the fact that the principal band wires can be placed outside the clearance where they are neither limited as to size nor heated to melting the soldered joints by eddy currents. Further than that, they cannot in this secure position be cut by the rubbing of the armature against the pole pieces which would perhaps happen if the bearings were neglected. This is quite a common accident on other motors.

A serious objection to the ordinary barrel winding which renders it worthless for a railway motor, has been successfully overcome in the Walker winding. The cylindrical extension formed by the end connectors is very susceptible to damage and is a great harborer of dirt and moisture on its interior. The Walker coils are protected by an oil, dirt and damage proof iron armor formed by extending the end casting so as to support and contain the ends of the coils. This may be seen by consulting Fig. 2.

The slots in this armature are quite wide as they contain two coils side by side. The teeth are long enough to admit of a strip of wood being wedged in above the coils which effectually protects them when the armature is rolled over the floor. Fig. 3 gives a better idea of the commutator and of the armature.

The commutator is very large and has 108 bars and thus the voltage per bar is very low. The lugs are brought out equal to the armature diameter. The mica collar, preventing flashing on to the shaft, has been enlarged and improved. The regular process of forming the commutator under enormous pressure is used, and all the squeeze and give is taken out of the commutator insulation so that subsequent sinking of the bars is an impossibility. A general view of the commutator is shown in Fig. 4. The armature coils are of stranded wire and it is practically impossible to break them by repeated bending. There are no joints in the winding except at the commutator lugs.

The maximum efficiency of the motor is 89 per cent—an extremely high figure for such a motor—and the efficiency curve is remarkably flat.

Besides the motor the new trolley is a recent production. It has been perfected mechanically and is now ready for market. Fig. 5 is perhaps a better detailed view than any yet published.

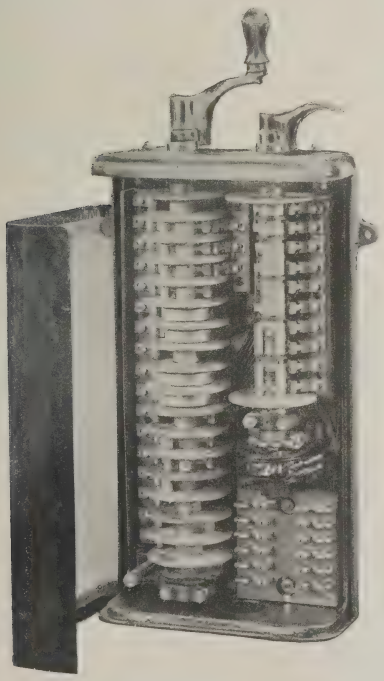


FIG. 6.—NEW CONTROLLER TYPE J.

In Fig. 6 is shown a new controller, the type J. This differs from type E in that it has but a single cylinder for both breaking and controlling contacts. It involves the same principle and has absolutely no arcs at its controlling contacts. It is of great mechanical simplicity and bids fair to become very popular.

The new rheostat shown in Fig. 7 is very ingenious and is cheap both in first cost and maintenance. As will be seen, it is composed of a large number of small sections which can admit of any subdivision in the controller connections that may be found desirable. They consist simply of asbestos ribbon, wound with an iron ribbon into a spiral, and they are therefore practically fireproof. These sections are secured together with a single bolt, and thus a resistance of any size desired can be built up. Each section is provided with substantial screw contacts so that it is not only possible, but

FIG. 7.—NEW RHEOSTAT.

easy, to remove and replace a burned out section or to modify the connection at pleasure. The rheostat is substantially housed in a cylindrical sheet iron covering.

Medbery Insulating Material.

The use of the Medbery material for insulating purposes, in electric railway work, dates back some six years. Because of its high insulating and weatherproof qualities, as well as on account of its strength, the material has met with general adoption. During the time that this material has been on the market it has been subjected to the most severe tests of weather and climatic conditions under actual service. So far as insulation was concerned, the early styles of insulating material were all that could be desired, but still in certain cases they lacked sufficient strength to be long wearing under the trying conditions of line service. It was also found that many of these earlier styles of insulators, while showing good results in testing, were unable to stand the severe changes of heat, cold, rain, snow, etc. Attention was immediately given by the company to correcting these defects by special processes and satisfactory results were obtained. The Medbery material is now claimed to be of such an extraordinary degree of hardness as to withstand the most severe service.

To determine the strength of this material a test was made recently of a 2½ in. globe strain by Professor Morton, of the Stevens Institute. This test showed that the insulator had a tensile strength of 6700 lbs., or rather at this strain the composition did not give way, but the metal part broke on the outside. The results of an efficiency test made by the same expert show that after the composition had been soaked in water for twenty-four hours it had a resistance of 350,000 megohms. The Fiberite Company has also had several pieces submerged in water for four years and eight months, during which time they have not absorbed 2 per cent of moisture. This test would be more severe than 1000 years' exposure out of doors.

So far as climatic conditions are concerned the material has been in use in Montreal, Ottawa, St. John, N. B.; Minnesota and Wisconsin about four years, subjected to the severest cold without developing a single defect that has been reported. The material has also been exposed for long periods to the moist climate of the Pacific Coast, to that in Texas, South America, Great Britain and Germany, with no development of trouble. Among the companies that have employed the material largely in their work are the Brooklyn Heights Railroad Company, Nassau Railway Company, Union Railway Company of Providence, R. I., and the Union Traction Company of Philadelphia, Pa. The Fiberite Company is also supplying material to roads in Buffalo, Cleveland, Detroit, Chicago, St. Louis, San Francisco, and many of the large cities of the country.

A STATEMENT was widely published in the daily press last month that Superintendent Passmore, of the Reading (Pa.) & Southwestern Street Railway Company, had issued an order directing all conductors and motormen to remove mustaches and beards, and appear on their cars clean shaven after Apr. 1. Mr. Passmore writes that the report is false and has caused him considerable annoyance. All that the company asks of its men is that they present a tidy appearance and perform their duties faithfully. If they do that the company is satisfied.

A FRANCHISE for the building of an electric railway in Xenia, O., has been granted to John P. Martin.

Bonding Rails without Disturbing the Pavement.

The recently discovered elastic copper is used by Thomas A. Edison and Harold P. Brown in a new form of rail bond called the E C A (elastic copper amalgam.) The form shown in the accompanying cuts is especially designed for rebonding girder rails without disturbing the pavement. A large electro-magnet whose pole pieces fit the head of the rail, is used to hold the drill to its work and to support a hardened steel template with a pair of intersecting holes. These holes are bored in the tram at the end of each rail so that one is in each and so that they enter $\frac{5}{16}$ in. into the upper edge of the angle plate, as shown in Fig. 1. The terminals are made of the Edison elastic copper, welded to flexible copper conducting strips which are bent into shape of a U. These terminals are cylinders with one side flattened. Their surfaces are covered with the Edison flexible solder which serves to make a perfect electrical contact and prevent rusting.

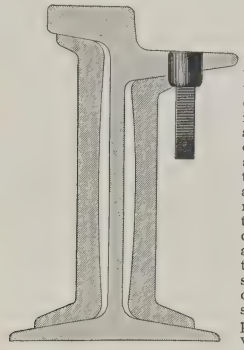


FIG. 1.—SECTION OF RAIL, SHOWING BOND.

After the holes in the rails are amalgamated, the U-shaped portion of the bond is passed through the slot connecting the holes, and the terminals driven home, their flattened sides coming together with $\frac{1}{32}$ in. compression. This establishes two paths for the current, one through the U, which is heavy enough for the maximum current, and the other directly across the terminals. The elasticity of the copper maintains the latter contact even when the rails have slackened apart $\frac{1}{32}$ in. The terminals are driven below the surface of the tram and the steel is burred over to retain them in place.

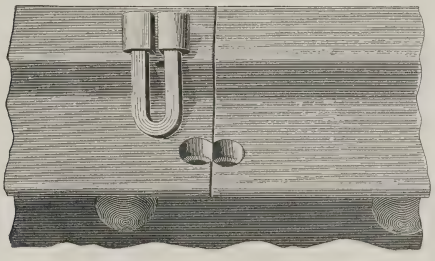


FIG. 2.—BOND READY FOR INSULATION.

The wear of wagon wheels, of course, tends to increase the bur and keep the terminals down. The edge of the angle plate also shares in carrying the current. Fig 2 shows the bond ready for service and Fig. 3 is a section of rail and angle plate showing position of bond. Tests of a number of different rail bonds were made in February by a Franklin Institute Committee, and the C E A bond was found to carry 1500 amps. with but .018 volts loss, the temperature of the bond being practically the same as the rail. The rails were then slackened $\frac{1}{32}$ in. without increasing the drop, proving the elasticity of the copper. The angle plates were then entirely removed, the rails separated ½ in. and the same current passed through the U. The drop was still less than one-half that of the best of the ordinary copper bonds and its temperature below 110 degs., while the copper bonds of same section varied from 200 to 496 degs. with same current. It is stated that a considerable part of the new work in New York City will be done with E C A bonds.

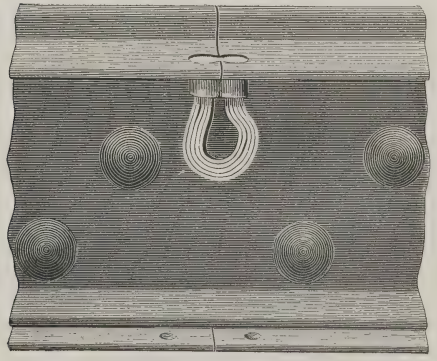


FIG. 3.—BOND IN PLACE.

Many roads with an old stock of copper bonds on hand are following the suggestion of G. W. Knox of the Chicago City Railroad and applying Edison amalgamation and flexible solder to the bond terminals, thus cutting the resistance down to one-third and preventing corrosion.

The Cattori Series System of Distribution for Electric Railways.

Capt. M. V. G. Cattori, a prominent European engineer, has completed the equipment of an electric railway system about 3000 ft. in length using the series method of distribution, at the Villa Borghese near Rome. The line is divided into two sections, one equipped with a conduit and one with a surface system using the rails as conductors.

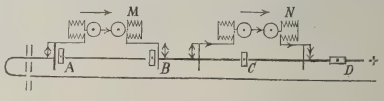
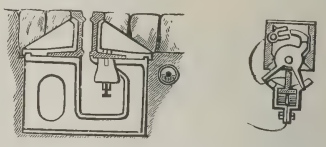


FIG. 1.—ARRANGEMENT OF WIRING.

For the underground system two conductors are used, making a complete electric circuit. One of these is divided up into a number of sections of equal length and the ends of these sections are joined by a special circuit breaker which in its normal state remains shut. The length of each of these sections is slightly less than that of a car. The car carries at each end a plow which runs on the conductor in the conduit and the forward one successively opens, and the rear plow closes the different breakers, at the same time making contact with the conductor. It is evident that should the distance between the two plows be greater than that between the circuit breakers the current will have to pass through the motor as shown in Fig. 1, where M and N represent two consecutive positions of the electric car. In one case the plows span two circuit breakers and in the other case one. The diagram shown is that for a single track line, in which the return wire is a continuous conductor. If the line be doubled tracked, only one conductor is carried in each conduit and these two are in series with each other, both being divided up into sections.



FIGS. 2 AND 3.—CONDUIT AND CIRCUIT BREAKER.

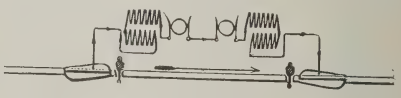


FIG. 4.—DIAGRAM OF SYSTEM.

In the installation at Villa Borghese, the conduit is laid at the side of the track under one rail as shown in Fig. 2. The conductor is in the form of an inverted T. The circuit breaker is of two bronze plates fitted on ebonite and is shown in Fig. 3. Fig. 4 is a diagrammatic view of the system.

The same system somewhat modified in detail is applicable to the use of the rails as conductors. In this case the rails have, of course, to be insulated from each other. The wheels also have to be insulated from each other.

Compressed Air Motors in New York.

The fact that two compressed air motor cars belonging to the American Air Power Company have been in operation for some time in New York City, is known to the readers of the STREET RAILWAY JOURNAL through articles in former issues. In the last issue of "Compressed Air" a report of their operation is given by E. E. Pettee, engineer of the American Air Power Company. The following statements are taken from this report :

The 125th Street line of the Third Avenue Railroad extends across town from the North River to the Harlem River, the length of the tracks being 10,854 ft., making the round trip 4.11 miles, over which cable cars are operated at intervals of 2½ minutes. Air cars were substituted for two of these cable cars, the schedule calling for nineteen round trips each, of 79.09 miles per car; for a daily service of 156.18 miles besides 1.14 miles of switching to and from the car house and street tracks, making the total distance covered daily, 157.32 miles. Each car runs from 12.50 to 16.67 miles on a single charge of air.

During a portion of the time, only single service was performed, as at present, so that the total average mileage per day from Aug. 3 to Mar. 3, was 125.16 miles, the total distance covered, 23,030.5 miles, and the total number of passengers carried, 137,386. The cars have operated every week day, but are not run Sundays.

The grade from Fort Lee Ferry east to the Boulevard is 1.96 per cent, while at the New York Central Railroad tunnel crossing, the maximum grade is 7.7 per cent for a short distance.

In the following statement of operating expenses, the coal and water items include all that has been used at the compressing plant during this period, and the labor account includes, in addition to the operating employes, a night watchman, record keeper, and also switchman for a portion of the time. It must also be borne in mind that the fires are kept under boilers for twenty-four hours, although the compressor only runs seven hours daily.

Actual average cost per car mile for entire period—seven months—125.16 miles per day.

Coal	$.0563
Water	.0103
Oil and waste	.0013
Power plant labor	.1261
Conductor and motorman	.0608
Repairs car equipment	.0038
	$.2586

Average present cost per car mile, with one car service performed—78.09 miles per day.

Coal	$.0675
Water	.0113
Oil and waste	.0017
Power plant labor	.0833
Conductor and motorman	.0608
Repairs, car equipment	.0038
	$.2284

Average present cost per car mile, with two car service—156.18 miles per day.

Coal	$.0433
Water	.0103
Oil and waste	.0013
Power plant labor	.0833
Conductor and motorman	.0608
Repairs	.0028
	$.2018

If the proportion of labor actually utilized in this service is considered, the expense would only amount to $0.1791 per car mile at present.

The present number of employes is six, besides conductors and motormen.

The reason for the present cost of operation being lower than the average for entire period is that the number of employes has been reduced as well as the air consumption by the car. The number of employes at present is, however, sufficient to operate a fifteen car service, so that the proportion of labor charges per car mile is still very high.

At a recent conference of several engineers, who investigated the cost of operating the American Air Power Company's system in behalf of a street railway now operating a large number of cars at intervals of one minute, it was determined after careful examination and agreed that for the items above enumerated, the cost per car mile would in no event exceed $0.085, and that with a large equipment of cars in service, like that performed on 125th Street, the cost would only be $0.0756 for the same items now costing $0.2018, while operating the two car service. This would make the total operating expense of such a road about twelve cents per car mile.

The average consumption of free air per car mile for the seven months' service of air cars on 125th Street, has been 477.7 cu. ft. During the severe snow storm of Dec. 16, 1896, the cars performed the schedule service with promptness and regularity, carrying 20 per cent more passengers and using 22 per cent more power than the day previous. In comparing results with an electric road in this vicinity, it appears that with 33 per cent less service than the day previous, the load on the power plant was about 80 per cent greater.

During the last week, the average consumption of free air per car mile was only 414 cu. ft., and many of the trips were made on considerably less than 400 cu. ft.

The actual cost of compressing air to 2500 pressure per square inch, and storing for use in a modern air compressing plant operating with condensing engines, including coal at $2.75 per ton, water, at $1 per thousand cubic feet, oil and waste, the removal of ashes, labor, repairs and maintenance of power plant, depreciation, and interest on cost of entire power plant, including buildings, for compressing plants of the following capacities, based on the consumption of 2½ lbs. of coal per hour, per horse power for twenty hours per day, is estimated as follows :

Cost per 1000 cu. ft. of free air compressed to 2500 lbs. pressure per square inch.

STATION CAPACITY.

500 cu. ft. per minute	$0.0675
1000 " "	.0571
2000 " "	.0469
3000 " "	.0419
4000 " "	.0394
5000 " "	.0375
6000 " "	.0359
7000 " "	.0342
8000 " "	.0326
9000 " "	.0312
10000 " "	.0300

The process of operating the compressed air system on 125th Street, is as follows:

The air is first compressed by a steam actuated air compressor, which is compounded in three stages from which the air passes through a cooler and dryer and is accumulated in a nest of Mannesmann steel flasks which are all connected in multiple by a series of headers or manifolds, in which stop valves are placed for controlling and confining the air to be stored at a maximum pressure of 2500 lbs. per square inch. A pipe leads from this air storage to the car house charging stand, placed alongside the track, which consists of a copper pipe in three sections, having a controlling valve and flexible joints and a charging nozzle at the end. All the joints and the nozzle are self packing so that no leakage has occurred in the seven months' service. After the car has been connected by inserting the nozzle in a pipe at the side of the car track, the charging valve is opened and contents of the station storage flasks admitted until the desired pressure—2000 lbs. per square inch—is registered by the car storage gage. When the charging valve is closed and a small bleeding valve in the charging pipe opened, permitting the high pressure air in the short length of pipe to escape, at the same time a check valve in the car piping closes automatically preventing any escape of air, after which the nozzle is removed and the car ready for another 17 miles' service. The entire time occupied, including connecting and disconnecting in actual daily service, takes less than two minutes, and has been done in less than one minute in numerous trials.

At the same time the car is being charged with air, another nozzle is introduced to the heater connection, and live steam from the boilers is admitted, until the temperature registered is about 300 degs. F.

The air storage reservoirs on these cars have a capacity of 51 cu. ft., sufficient to run the car 18 to 20 miles continuously, or from 14 to 17 miles, making the stops incident to ordinary street railway service. A larger capacity could readily be installed on the car, giving it ample power to run 20 miles with a reserve. The reservoirs consist of seamless steel flasks capable of standing a pressure of double that used without reaching the elastic limit of the metal and with no possibility of leakage. They are 9 ins. in diameter and of varying lengths adapted to their location under the seats and the car floor. Between the flasks and the motor is placed a small tank containing 6 cu. ft. of water which is heated as before described. The tank is jacketed with non-conducting material, preventing external radiation. This provides not only against loss of heat, but also against any perceptible rise in the surrounding atmosphere, so that no discomfort can arise from it.

Numerous trials have proved that the application of heat as employed in this system enables the cars to run nearly double the distance that cold air will carry them.

In operation, the compressed air, after passing through a reducing valve and being lowered to 150 lbs. to the square inch (the working pressure), circulates freely through the hot water, and a mixture of heated air and vaporized water passes to the motors, working expansively, the terminal pressure being so low as to cause no sound in exhausting the air.

The motor mechanism consists of two simple, link-motion reciprocating engines having cylinders 7 ins. in diameter and 14 in. stroke, with valves cutting off at from $\frac{1}{10}$ to $\frac{1}{6}$, and applying the power by connecting and parallel rods direct to the crank pins of the drive wheels, which are four in number, 26 ins. in diameter running on a wheel base of 7½ ft. Upon this four wheeled truck rests the entire weight of the car and mechanism, evenly distributed upon elliptic springs, enabling the car to pass smoothly over bad track and crossings.

The mechanical features of the motors are substantially identical with those of a steam locomotive, minus fire box and boiler.

The car is fitted with specially designed air brakes of sufficient power, with the high pressure air always at command, to set the wheels instantly if desired, by a single wrist movement of the motorman.

STREET RAILWAY NEWS

Annual Convention of the Texas Street Railway Association.

The annual convention of the Texas Street Railway Association was held in Austin, Tex., Mar. 17–18. The following companies were represented: the Laredo Electric & Railway Company, the Austin Dam & Suburban Railway Company, the Austin Rapid Transit Railway Company, the Elm Street line of Dallas, the Dallas Rapid Transit, the Ft. Worth City Railway Company, the Houston City Electric Street Railway Company, the San Antonio Street Railway Company, and the San Antonio Edison Company. The meeting was called to order by C. F. Drake, vice-president, who after a short address introduced Mayor Hancock, of Austin, who welcomed the delegates to Austin. The convention then proceeded to business and the appointment of committees was then made:

On Resolutions: G. B. Hendricks, of Ft. Worth, chairman; H. C. Chase, of Houston and J. D. Chiles, Austin.

Constitution and By-Laws: H. C. Chase, chairman; C. F. Yaeger, of Laredo, and C. L. Wakefield, of Dallas.

Topics for Next Meeting: Geo. D. Hartson, of Dallas, chairman; R. S. Wakefield and D. D. Willis, of San Antonio.

Membership: A. H. Hayward, of Houston, chairman; D. D. Willis and B. M. Hammond, of San Antonio, and Henry Garrett, of Dallas, and J. K. Urie, of Galveston.

Legislation: F. E. Scovill, of Austin, chairman; I. H. Evans, Austin; W. H. Weiss, San Antonio; Julius Runge, Galveston; C. L. Wakefield, Dallas.

The last named three committees were by motion made permanent.

Invitation was extended by the Austin Club to all the delegates, and by the Austin Dam & Suburban and the Austin Rapid Transit roads to inspect their lines. The meeting then adjourned until 2:30.

At the afternoon meeting a resolution was introduced and passed condemning the purposes of a bill before the Texas legislature affecting the control of street railway companies by the municipal authorities. The Committee on Resolutions made its report on the death of Colonel Sinclair, and the following resolutions were adopted:

Resolved: That in the death of our honored and esteemed president we have lost a valued guide and counselor, a worthy citizen, a true and tried friend and co-worker, who was so intimately associated with us that we experience a sense of personal loss in his sudden taking off in the very fruition of his career.

Resolved: That we extend to his bereaved family our sincere condolence and sympathy in this their time of mourning.

Resolved: That a copy hereof be transmitted to the family, and also a memorial page be suitably inscribed upon our records.

The convention then proceeded to the discussion of subject, "Uniform Rate of Wages and Number of Hours Worked."

It was developed that in the main 12½ cents per hour was paid. Several roads had the three men to two car swing system. A few had long hour days, with third or fifth day off; in the latter case, the wages were from $40 to $55 per month. There seemed to be no uniformity as to the number of men worked in barn or repair shops.

Discussion was had on the life of pinions and gears. The next question was "Legislation, State and Municipal."

This was opened by a few impromptu remarks by C. L. Wakefield, in the course of which he said that the Association should be careful that its vigorous action and remarks on legislation should not be such as to suggest the idea to the general public that there is more in the matter than there really is, that many legislators introduced anti-corporation bills because they did not feel that personal sense of responsibility, or fear doing a personal wrong, as they would were the parties individuals, instead of corporations. He said further that the members should try to live as closely to public men as possible, frankly stating their position, and frankly admitting that there may be wrongs done by corporations, which ought to be stopped, and that their efforts will be directed that way.

Mr. Yaeger asked if there was a law enabling municipalities to pass ordinances fixing a penalty for interfering with wires, cutting them, stealing power, etc. As nearly as the members could tell, there was no such a bill. Mr. Hendricks moved that the Committee on Legislation prepare a bill covering the point in controversy, and report to the convention during its present session.

The pass question among city officials was then taken up, and very generally discussed. Most of the roads, it was found, were very liberal in this regard. The question of passes to newspapers was taken up also under this discussion. With only three exceptions, it appeared that the newspapers gave full value for all passes they received, in the way of advertising entertainments, etc.; and it also generally had the effect of making them get both sides of a story in case of an accident. It was found that in every case policemen and firemen are passed on their badges; the means of passing were discussed, and with two exceptions, a coupon ticket was used; and this in two cases, bore on each side the stamped name of the holder.

THURSDAY, MAR. 18.

The meeting was called to order at 10 A.M. The Committee on Topics for the next meeting, reported as follows: 1. "Power Construction." 2. "Overhead Construction." 3. "Construction and Maintenance of Car Bodies." 4. "Brakes." 5. "Discipline of Employes." 6. "Rail Joints." 7. "Methods of Increasing Traffic." On recommendation of the Committee the list was left open, and afterwards the committee was made permanent for further suggestions.

The Committee on Bylaws recommended an increase in dues to $10 per annum, which was passed.

The next question discussed was "Accidents: Their Liability and How to Prevent."

This subject was treated in a paper by R. S. Wakefield, of San Antonio, who stated that in view of the general carelessness of the public the greatest care should be taken by the motormen. They should especially be careful about relying too much upon gongs to clear the track as all persons cannot hear well. He also recommended the infliction of some penalty for every accident, either a "lay off" or a cash fine.

During the discussion on this point which followed, C. L. Wakefield said: "An ordinary wagon or buggy in this country makes more noise than a street car. Therefore the man that is in the buggy cannot hear the car, and it is not safe for the motorman to attempt to pass until he knows he has the attention of the driver." He also advised, in towns that were not too large to make it impossible, a close acquaintance with all possible jurors, so that, although they might not be friendly, some of the prejudice might be obviated.

Mr. Willis, of San Antonio, on the subject of accidents, said that he made it a rule to get on the ground as soon as possible, and interview personally outside witnesses immediately, and get both sides of the case; and if the accident was serious, to get a photographer, and have a picture taken as nearly as possible giving the place where the accident occurred and the position of wagons, cars, etc. He also recommended having prompt measurements made by the civil engineer, and getting ready for a law suit. If there seemed to be a possibility of settlement, he advised the prompt settlement with the cash in hand displayed to the plaintiff, but if there were no possibility of a settlement to pay no attention to it. Mr. Hendricks advised fighting every case in which the company was not to blame, as the reputation for so doing would deter a great many from bringing suit.

Mr. Chase considered no accident as excusable when a car was going in the same direction as the vehicle. A motorman ought never to form the opinion that a wagon is not going to cross the track in front of him. He advised settlement for small damages at once.

Mr. Hartson, of Dallas, cited a case where suit was brought when, he believed, no accident had occurred. Such a case had come up also in Dallas on another road, in which considerable damages were obtained.

Mr. Scovill, of Austin, instanced a case in St. Paul, where in a collision there were seventy-four passengers on the car, and 122 suits were brought against the company.

"Amusements" was the next subject, upon which a paper was read by the secretary for J. K. Urie, of Galveston, who was not present. Mr. Urie stated that as a general proposition the amusement feature was an important one for the larger sized towns and cities, but that the all important question was whether the added cost more than made up for the profit from the extra travel. His experience showed

that ten persons will go to a free show to one that will attend where any admission fee is charged, even though the charge be merely a nominal one. He recommended the location of a proposed pleasure resort near a body of water if possible, and advised enclosing the resort and admitting only those who could show a car ticket, to keep out those who had reached the park without using the cars.

This paper was followed by discussion, in which Mr. Hendricks said that he had had success with balloon ascensions, one in particular. The same success had attended the roads represented by C. L. Wakefield and H. C. Chase, in this regard. The value of popular price theatre shows was discussed, and it was found that they did not pay the street railways. Base ball was conceded to be a good thing, but rather expensive, in that the base ball people generally demanded considerable assistance. It was suggested by Mr. Drake that each member of the association furnish the secretary a list of the attractions he found good, the terms on which they are secured, and the measure of his success. A motion covering this was carried.

The next subject discussed was upon "How to Obviate Public Prejudice Against Corporations." In his paper on this subject, Geo. B. Hendricks of Fort Worth, recommended the adoption by companies of the most liberal treatment of the public possible, and especially the enforcement of the rules of politeness in all dealings of all the employes of the railway company with passengers and public.

The following nominations were then made:

The president for the years 1897-98, Carl F. Drake; vice-president, A. H. Hayward; secretary, C. L. Wakefield.

Both Fort Worth and San Antonio were put in nomination for the next place of meeting, San Antonio winning by one vote.

The meeting then adjourned until 1.30 at which time the members took the proposed trip up the lake above the Austin dam. The Austin dam is a magnificent piece of stone work, and stands about 65 ft. high. There was about 3 ft. of water running over it, making a beautiful cascade. The lake above the dam extends up the river 27 miles. The water power is considerable, and the city, which owns the dam, has an electric light and power plant and water works all operated from this water power. The cost of the dam was $1,500,000, and although it has been in operation but a short time it has already gone far toward paying interest and sinking fund. Ex-Mayor McDonald, who was largely instrumental in the construction of the dam, was with the party. A trip was made 8 miles up the lake, and proved a genuine surprise to most of the party. The lake is enclosed in ranges of beautiful large hills, or small mountains, covered with cedar, broken in many places by canyons and inlets. At Fish Pond House a stop was made; here are large private grounds belonging to the Austin Fish Club. The dam is reached from the city by a fine system of street railways, operating cars by power furnished by the city from the water power. On the lake is a large steamer whose capacity is 1500 to 2000 people.

The convention was called to order for the night session at 8 P.M., when Col. Barnard was heard on the question of joint track legislation. The next subject discussed was "How to Make Street Railway Employes Honest." Mr. Wakefield suggested that to get them honest was better than to attempt to make them honest. Mr. Drake suggested that a wrong hypothesis was held by the majority of the street railway and steam railway managers, by starting out with the idea that all men are dishonest. He believed that the majority of men (provided they are below the rank of manager or superintendent) are honest. Mr. Hartson keeps a record of each trip, using it as a check on the motormen.

After a general discussion the subject of the repair shop was taken up. One member advised the use of all copper and brass in the manufacture of new bearings made. Rawhide pinions were found in some cases to have lasted from five to eight months, and in other cases were not found to be entirely satisfactory. Mr. Hendricks, of Ft. Worth, said that after his brass bearings wear down he fills them with babbitt, and finds this course very satisfactory.

Mr. Scovill explained a scheme that he had seen at the National Convention at St. Louis, of fitting the axle with a pipe clamped to the motor; this made a long bearing which was fitted with a lubricating device. It was represented to him there that the amount of oil used was less than in the old way, and the bearings lasted a great deal longer. R. S. Wakefield's experience with Magnolia metal bearings had not been satisfactory.

Trolley wheels were found at last from three to six months. Car wheels in some cases cost fifty cents to press on, fifty cents to press off, and $1 a wheel to have the wheel bored. In other cases the charge was $1.30 for boring, and in some cases seventy-five cents each way for pressing. There seemed to be no uniformity in the length of the life of the wheels.

On the question of brakes, the general opinion seemed to be that a brake to be successful and cheaply operated must apply its force directly in a horizontal line to the center of the axle. The question of double trucks *vs.* single trucks was here brought up, and Mr. Chiles entered into an extended discussion, holding that the double truck was far superior in every way.

After a vote of thanks to the several street railway companies in Austin for the hospitality extended the delegates, the convention adjourned.

Street Railway Accountants' Convention at Cleveland.

In response to a request sent to the street railways of the United States and Canada, that the officers in charge of their accounting departments should be sent to Cleveland in order to take steps towards the formation of an association of street railway accountants, between thirty and forty representatives of various roads gathered at the Hollenden Hotel, Cleveland, on Mar. 23. The meeting was called to order by H. H. Windsor, editor of the *Street Railway Review*, to whom is due much of the credit for taking the initiative in calling the accountants together. Morris W. Hall, secretary of the Camden & Suburban Railway Company, was elected temporary chairman and W.B.Brockway, auditor of the Toledo,Bowling Green & Fremont Railway Company, was elected temporary secretary. The meeting then proceeded to business and on the two days of the convention the following papers were read:

"From Horse to Electric Accounts" by H. L. Wilson; "Suggestions for a Standard System of Accounts," by C. N. Duffy; "Monthly Closing of Accounts," by Dana Stevens; "Transfer Tickets," by Frank R. Greene; "The Relation of Accountants to Managers and Employes," by P. V. Burington; "A Simple System of Interurban Accounts," by W. B. Brockway; "Naming and Standardizing Apparatus," by J. P. E. Clark, and "Depreciation," by H. C. McJilton.

These papers will be found on pages 217 to 222 of this issue.

A committee on organization and a nominating committee were appointed early in the session. In the second day's session the committee on organization reported a constitution which was, after some discussion, adopted. The committee on nominations reported the following list of officers who were unanimously elected: president, H. L. Wilson, auditor West End Street Railway Company, Boston, Mass.; first vice-president, C. N. Duffy, secretary and treasurer Citizens' Street Railway Company, and Cass Avenue & Fair Grounds Railway Company, St. Louis, Mo.; second vice-president, J. F. Calderwood, secretary and auditor Twin City Rapid Transit Company, Minneapolis, Minn.; third vice-president, C. B. Reavis, secretary Augusta Railway & Electric Company, Augusta, Ga.; secretary and treasurer, W. B. Brockway, auditor Toledo, Bowling Green & Fremont Railway Company, Toledo, O. An executive committee of the five officers named, together with Dana Stevens, accountant for receiver Belt Railway Company, Washington, D. C.; W. S. Dimmick, superintendent Omaha & Council Bluffs Railway and Bridge Company, Council Bluffs, Ia.; E. R. L. Tighe, accountant Brooklyn Rapid Transit Company, Brooklyn, N. Y.; W. G. Ross, comptroller Montreal Street Railway Company, Montreal, Can., was elected.

A committee was also appointed to present at the next meeting of the association, to be held at Niagara Falls in October, a suggestion for a standard classification of operating expenses. This committee consists of C. N. Duffy, J. F. Calderwood and Wm. F. Ham. The new officers were installed and the business meeting adjourned until October with an exchange of hearty congratulations on the inception of what is believed will be a valuable and well considered effort towards a higher standard in street railway accounting.

The following gentlemen were present at the convention:

Morris W. Hall, secretary the Camden & Suburban Railway Company, Camden, N. J.
M. C. Lytle, Wadsworth, O.
W. W. Herrick, adjuster Cleveland Electric Railway Company, Cleveland, O.
Frank R. Greene, secretary Chicago City Railway Company.
A. F. Walker, Allentown & Lehigh Valley Traction Company, Allentown, Pa.
William F. Ham, secretary Nassau Electric Railroad Company, 268 Twenty-third Street, Brooklyn, N. Y.
D. A. Keister, auditor for the Marion City Railway Company, Marion, Ind.
W. B. Brockway, auditor Toledo, Bowling Green & Fremont Railway, Toledo, O.
F. S. Borton, secretary Akron, Bedford & Cleveland Railroad Company; Cleveland, Painesville & Eastern Railroad Company, Cleveland, O.
F. E. Smith, auditor Lynn & Boston Railroad, Lynn, Mass.
Chas. L. Wight, auditor the Toledo Traction Company, Toledo, O.
J. F. Calderwood, auditor Twin City Rapid Transit Company, Minneapolis Street Railway Company, Minneapolis, Minn.; the St. Paul City Railway Company, St. Paul, Minn.
E. S. Doud, secretary Lehigh Traction Company, Hazleton, Pa.
H. C. McJilton, secretary The Baltimore Traction Company, Baltimore, Md.
Wm. R. Avery, auditor Cincinnati Street Railway Company, Cincinnati, O.
P. V. Burlington, secretary The Columbus Street Railway Company, Columbus, O.
W. G. Ross, comptroller Montreal Street Railway Company, Montreal, Can.
J. M. Smith, comptroller Toronto Railway Company, Toronto, Ont.
A. L. Linn, Jr., bookeeper Cleveland Electric Railway Company, Cleveland, O.
A. T. Walter, secretary and treasurer Allentown & Lehigh Valley Traction Company, Allentown, Pa.
Dana Stevens, accountant Belt Railway Company, Eckington & Soldiers' Home Railway Company, Maryland & Worthington Railway Company, Washington, D. C.
C. B. Reavis, secretary and auditor Angusta Railway & Electric Company, Augusta, Ga.
E. D. Hibbs, auditor Consolidated Traction Company, Jersey City.
John Ehrhardt, assistant secretary Cleveland City Railway Company, Cleveland, O.
F. T. Pomeroy, general manager and treasurer Cleveland, Berea & Elyria Railway, Cleveland, O.

H. J. Davies, assistant secretary and treasurer Cleveland Electric Railway Company, Cleveland, O.
W. G. McDole, auditor Cleveland Electric Railway Company, Cleveland, O.
E. R. L. Tighe, accountant Brooklyn Rapid Transit Company, Brooklyn, N. Y.
Walter M. Barnaby, chief accountant Brooklyn Heights Railway Company, Brooklyn, N. Y.
C. N. Duffy, secretary and treasurer Citizens' Railway Company, St. Louis, Mo.
Robert V. McCullough, cashier Southern Electric Railway Company, St. Louis, Mo.
H. L. Wilson, auditor West End Street Railway Company, Boston, Mass.
W. S. Dimmock, general superintendent Omaha & Council Bluffs Railway & Bridge Company, Council Bluffs, Ia.
Edward E. Higgins, STREET RAILWAY JOURNAL, New York.
Henry H. Windsor, *Street Railway Review*, Chicago.
T. E. Crossman, official stenographer, Brooklyn, N. Y.

Notes from England.

(*From Our London Correspondent.*)

A deputation from the Town Council of Sheffield has visited several towns both in England and on the Continent, and has inspected all the systems of mechanical power for tramways which are in use. The members came to the conclusion that the trolley wire method has the fewest disadvantages and the most advantages, and they recommend its adoption experimentally on two lines in their city. The report has been adopted and the Town Council hopes in the future to work all the tramway lines in the city, as the company has been bought out.

Arrangements are on foot for an extension of the electric tramway system in Coventry to a distance of about 6½ miles. The company promoting this scheme hopes to be able to buy up the existing electric lines in Coventry. It seems eminently fitting that a city which is identified with the development of another branch of locomotion, namely, the bicycle, should be provided with a good tramway system. Industrially Coventry has a great future, for the bicycle and bicycle tire trades are centered in it. The street railways there are in for a good time, despite the fact that bicycles are used by a larger proportion of the population than in any other town on earth.

Electric traction is now in prospect for a large number of towns in England. In the present session of Parliament an exceptionally large number of schemes are brought forward for electrifying existing horse and steam lines. In some cases the companies are to undertake the work on their own account, but in many instances the present British tendency of municipalization is prominent, and the town councils seek either to buy up and work the tramways themselves, or to buy them and lease them to the companies.

The British Thomson-Houston Company is successful in its operations. Besides having equipped the Dublin and Bristol electric tramways it is contracting for the cars on the Birmingham electric lines, where it is proposed to substitute conduit electric tramways for the steam lines now in use. The company is also about to equip electric tramways at Cork and at Clontarf in Ireland.

Dick, Kerr & Company, Limited, who despite their success with the construction of cable tramways have recently formed an electric department of their business, have already secured a contract for the building and equipment of the Dover Corporation electric tramways. Hitherto there have been no street lines at all in Dover. The new tramways will occupy about 3 miles of street length, of which only a small portion will be double track. Dick, Kerr & Company occupy such a prominent position in tramway track construction in this country that their success in getting this contract is not surprising and they have recently secured the services of a most competent electric railway engineer in the person of Mr. Rutherford from Canada, so that there can be no question of their success in the new branch of their business. They have already done a good deal of work in providing and laying the permanent way of electric lines.

Apropos of the same firm, I believe that their contract for the installation of cable traction for the whole of the tramways in Edinburgh is making rapid progress. It will probably be completed about the end of this year. The installation extends to about 15½ miles of street, or 31 miles reckoned by single track, and will be the largest thing in the way of cable haulage in the Old World.

It might be thought that we have had quite enough of mountain railways in Switzerland, but the Jungfrau line, now in the course of construction, when completed three or four years hence, will be a noted addition. Electricity, generated from abundant natural supplies of water, will be the motive power, and the maximum gradient is to be 1 in 4—in American phraseology, 25 per cent. The last part of the ascent to the mountain top will be in an elevator, also worked by electric power. The line will be circuitous and mostly in tunnel in the sides of the mountain. Its total length will be 7⅝ miles, and the rise in this distance is 6900 ft. The rack system will be used, as ordinary adhesion would be useless on such grades.

It will perhaps be yet shown that one of the most formidable rivals, under British conditions, to electricity for tramway purposes will be the Serpollet steam engine. I do not know yet how it will "pan out" financially, but at all events it seems undisputed that it has this advantage over all other steam locomotives that full steam is raised practically instantaneously with lighting the fire.

The Dublin Tramway Company has just passed the twenty-fifth year of its existence, and is in a prosperous condition. Special congratulations are due to Wm. Anderson, the secretary and manager, who has been connected all along with the company and who has been largely instrumental in bringing it to the position it now enjoys. He is, I believe, not unknown on your side of the "herring pond."

The despair of the British tramway reformer is London. In the States you know what the difficulties are in advancing in such a place as New York. Multiply that by ten and you have some idea of the state of London. The larger the town the more is the obstruction to improvement in the means of local transportation. Add to that Cockney conservatism. The only gleam of hope at present of improvement in methods of tramway traction is the fact that an agreement has been concluded between the London County Council on the one hand and the North Metropolitan Tramways Company (the largest concern of the kind in London) and the London Street Tramways Company on the other, for the sale of the lines of these two companies to the Council and the lease of the whole undertaking to the North Metropolitan Company for a limited period under onerous rental and maintenance conditions. There is a provision for the introduction of mechanical power, but whether it will result in anything is doubtful. One thing is certain, the London County Council is opposed tooth and nail to erection of poles and overhead wires in the streets, and if any mechanical power is adopted it will be either a conduit system, cable or electric, or an independent system such as gas or oil motors. Many of the North Metropolitan lines are eminently suited for cable traction, and if it were introduced there is no doubt it would be a great financial success.

Foreign Notes.

Algiers, Algeria.—It is proposed to connect the city of Algiers with its suburbs by an electric tramway. M. Dalaize is the promoter of the project.

Argentine Republic.—A concession has just been granted for the construction and working, during a period of twenty years, of an electric railway in the town of Concordia.

Auckland, New Zealand.—Special advices to the Journal are to the effect that the motive power of the street railways in Auckland is to be changed from horses to electricity in the near future.

Barcelona, Spain.—The report of the directors of the Barcelona Tramway Company (Limited), for the past year, states that in anticipation of the projected change of traction, the directors have spent £6022 in the purchase of land, and further expenditure is anticipated in the current year. The company has definitely decided upon adopting the overhead electric traction system as soon as the necessary municipal permission can be obtained.

Bergamo, Italy.—A line of tramways is projected between Bergamo and Sarnico, the extreme southern end of Iseo Lake. The plans have been laid out by the engineers, Luigi Conti and Ernesto Caffi. The projected line is to be 30 kilometres in length.

Bergen, Norway.—An electric railway will shortly be introduced in this city by a German company.

Bordeaux, France.—The Municipality of Bordeaux has appointed a committee to inquire generally into the question of electric traction.

Cairo, Egypt.—It is reported that the Egyptian Government has just authorized the Cairo Tramway Company to build a line as far as the Pyramids, and in a short time it is expected that this line will be completed.

THE recently established electric tramways in the city of Cairo are a great success, and notwithstanding the very low rates, which are someting less than 1d. for a distance of 3 miles, they are being worked at a profit. The electric lighting is also being extended.

Christiania, Norway.—An electric railway, forming practically an extension of the Christiania Elektriske Sporvei Selskale to a summer resort on the summit of a mountain near by, is now building. The capital of the company is equivalent to $200,000, and the road is 5 kilometers in length. The managing director is A. Tenzer-Krugh.

THE Christiania Elektriske Sporvei Selskale is to be double tracked, and additions are to be made in its car equipment.

Corunna, Spain.—A concession for an electric railway has been granted by the local authorities and is now submitted for ultimate approval by the Government to be built in Corunna.

Funchal, Madeira.—The concession for an electric tramway line from Funchal to Camara de Lobos is shortly to be offered for sale to the highest bidder.

Hanover, Germany.—The Street Railway Company of Hanover contemplates an extension of about 62 miles of line during a comparatively short period of time, the first 37 miles to be built in 1897. All these extensions will be operated with the overhead electric system, in connection with accumulators, with which all the cars will be equipped for service. In portions of the city these new lines will also be used for freight traffic, and new freight cars are building for that purpose. 110 accumulator cars are now in course of construction, all to be finished by Aug. 1897.

Kingstown, Ireland.—The Board of Commissioners will petition the Board of Trade that the electric tramway company be allowed to increase the speed of its cars to 12 miles an hour.

Leghorn, Italy.—Messrs. Schuckert & Company, of Nuremburg, Germany, are making good progress with the construction of the electric tramways at Leghorn. The plant at the generating station will comprise three 330 h. p. engines and dynamos, steam being supplied by a battery of Babcock & Wilcox boilers. The lines are to be completed by June 1 next.

Mexico.—The manufacturers of the United States, in common with other business men and capitalists of the country, now are devoting a great deal of attention to the subject of trade with Mexico. The STREET RAILWAY JOURNAL is doing all in its power to further the interests of American manufacturers in the premises, and is meeting with very satisfactory results. In its effort to secure information concerning the street railways of Mexico, it has been very materially aided by Charles G. Worden, of the *Two Republics*, the oldest daily American newspaper published in the city of Mexico, This newspaper, established in 1867, is answering free of charge any and all inquiries addressed to it pertaining to the resources, advantages and opportunities of Mexico.

Monte Carlo, Monaco.—By recent ordinance the establishment of a line of electric tramways in the principality of Monaco has been declared necessary.

Mustapha, Algeria.—By decree of Jan. 20, 1897, the establishment in the department of Algiers, of a line of tramways by mechanical traction between Algiers and Mustapha has been authorized. The French Thomson-Houston Company, of Paris, has secured the concession for the line, which will probably be operated by trolley.

Nicaragua.—Frank H. Davis, formerly of New York, and now manager of the Ribas Tramway, has recently obtained a concession from the Government from Lake Nicaragua to the Atlantic Coast, and a concession has also been offered to him for an electric railway in Managua, a town of 17,000 inhabitants. A guarantee of $3000 in gold is required by the Government from any company proposing to build a road in this city, this sum to be returned to the company on the completion of the road. It is possible that such a road will be exempt from taxation.

Para, Brazil.—The state of Para contemplates granting a concession for a railway line from Para to Pinhiera, a distance of about 8 miles.

Paris, France.—The omnibus lines within the boundary of Paris have lately been notified that in accordance with the existing contracts, they are to submit at once their plans for the transformation of their service into tramways, under penalty of forfeiting their concession.

Porto Rico, West Indies.—A number of railways and tramways are projected and being built on this island. A short narrow gauge road from Mayaguez to Lares, some 30 miles long, is being built by the firm of Bravo & Company, of Mayaguez, who is also president of the street railway company of that city. Another narrow gauge road is contemplated from Arecibo to Lares, and the firm of Roses & Company, of Arecibo, is interested. Still another narrow gauge road is contemplated from Ponce to the interior of the island.

THE minister of Ultrama has recently advertised for sale concessions for short roads in various part of the island, with an offer of subsidies and privileges for ninety-nine years.

Rheims, France.—The City Council is investigating electric traction with a view of compelling the local street railway company to adopt it.

Santiago, Chili.—It is stated that the Chilian Congress has authorized the construction of an electric railway from Santiago to San Bernardo.

Seoul, Korea.—A railway about twenty-six miles in length, connecting Seoul, the capital of Korea, with Chemulpo (Jinsem) will in all probability be begun this spring. The enterprise is in the hands of American capitalists. The Korean government has granted another railway concession to a French company. Other concessions are sought by other foreign companies, but so far without success.

Southampton, England.—The tramways company is reconstructing some of its lines. In view of the probable introduction, before long, of electric traction, the track will be doubled wherever possible.

Sydney, Australia.—Important extensions of the Government cable and electric railway systems are contemplated.

Tashkent, Caucasia.—A Franco-Russian Company has been organized under the management of General Annenkoff, Edouard Emfain, Brussels, and Edouard Denis, Paris, for the construction of a line of tramways at Tashkent, Asiatic Russia. The capital stock is 1,760,000 francs, all subscribed.

York, England.—The York Tramways Company is proposing the early introduction of electric traction on its lines.

Paper Covered Cables for Underground Conduits.

While paper has been used quite as long as rubber for insulating electric wires, it has never been used to any great extent until recently, and it has been the popular idea until within the last five or six years that rubber was the only practical insulator for underground work. Many power distributing companies even now will have no other. Telephone companies were among the first to recognize the merits of paper insulation; to-day the specifications of the Bell Telephone Company call for paper and paper exclusively.

But while it is generally conceded that paper is the best and cheapest insulation for telephone work, there are many rival claims as to the respective merits of rubber and paper for use in power transmission. The manufacturer of paper insulation claims that not only is it fully as good an insulator and from 25 to 30 per cent cheaper than rubber, but it is better in a number of ways. In street railway work where the cable is so often overloaded, a hot conductor is liable to reduce a rubber covering to a viscous state and gradually settle down towards the bottom of the lead conduit, pushing the soft rubber up into the position formerly occupied by the conductor and leaving the conductor uninsulated. With paper insulation it is, of course, impossible for anything of this kind to occur; should the conductor become red hot, it could do nothing more than carbonize the inside layers. Even if the cable is of sufficient cross section to make overloading impossible, it is believed that in time the rubber will gradually allow a settlement of the conductor to the lower side.

With rubber it is difficult in many of the processes used to place the conductor concentrically. In pressing the soft rubber about it the conductor falls more or less to one side and, of course, the value of the insulation depends upon the thickness of the rubber at the thinnest point. In covering with paper the insulation is wound on in strips and there is no opportunity for the copper to get out of center.

The above, it must be understood, are the arguments advanced by the manufacturer of paper insulated conductors. On the other hand, it is claimed for rubber that it has already stood the test of years; there are rubber covered feeders in use to-day that were laid twelve and fifteen years ago. While paper may last as long, it has not yet been tested for a greater period than three or four years for heavy current transmission. The lead covering is easily punctured, and in actual practice punctures are often made that are not discovered; if the insulation is of rubber, then the puncture makes little or no difference, but if it is of paper, moisture will be absorbed even in a concrete conduit, which at once causes a leak.

It is also stated that when the lead covering is destroyed by electrolysis or otherwise, the rubber will still act as an insulator. The fact is, however, that when the lead covering is broken it can be but a very short time with any insulation until the cable will have to be taken up.

The strongest argument presented by the manufacturers of rubber cables, however, is that dealing with the relative flexibility of rubber and paper, the latter is hard and inelastic and a sharp bend will break the insulation. With a cable covered with good rubber a fault of this kind is not likely to develop.

Personals.

Mr. H. M. Littell and Mrs. Littell sailed for Europe last month on a pleasure trip.

Mr. John A. Brill sailed for Europe Mar. 31. He will be gone for several months, and will combine business and pleasure.

Mr. H. J. Somerset, until recently electrical engineer of the Winnepeg (Man.) Electric Railway Company, has been appointed superintendent of that road to fill the vacancy caused by the retirement of George H. Campbell.

Mr. R. K. Bryers has been appointed superintendent of trucks, of the Brooklyn Heights Railroad Company. William H. Blood has been appointed superintendent of the Eastern division of the same company; *vice* R. K. Bryers transferred.

Mr. Jules De Burlet, Minister of State of Brussels, and brother of Mr. Pierre De Burlet, general manager of the Société Des Tramways Bruxellois, died Mar. 1. Mr. Jules De Burlet was formerly Belgium Minister Plenipotentiary to Portugal, and held other high offices under the Government.

Mr. Charles B. Reaves, accountant of the Augusta Railway Company of Augusta, Ga., was presented last month a handsome Masonic charm, by the employes of the company as a testimonial of the high esteem in which he is held by them. The presentation was made by Col. D. B. Dyer.

Mr. T. M. Burt, manager of the Berlin & Waterloo Street Railway Company, of Berlin, Ont., severed his connection with that company Mar. 1. Mr. Burt has been prominently identified with a number of street railway enterprises in Ontario, is progressive and has had an extended experience as a street railway manager. Mr. T. E. McLelan succeeded him in his official capacity with the Berlin & Waterloo Railway Company.

Mr. E. W. Goss, superintendent of the Middletown Street Railway Company, of Middletown, Conn., and of the Portland Street Railway Company, of Portland, Conn., has also been recently appointed superintendent of the Middletown & Portland Bridge Company. This company is the owner of a highway bridge across the Connecticut River, 1300 ft. long. It has a draw of 450 ft. oper-

ated by four G. E. 800 motors. This is said to be the longest highway draw in the world.

Prof. E. P. Roberts, of Cleveland, who has just been elected president of the Alumni Association of Stevens Institute of Technology at the recent celebration of its twenty-fifth anniversary—an honor of which any man may well be proud—was a graduate of its class of '77, and has had a varied and interesting professional experience since his graduation. His first work was in a machine shop, after which he became successively superintendent of a machine shop in Newark, N. J.; assistant to Hiram S. Maxim; assistant to Edward Weston; assistant to William Stanley; engineer of the Brush-Swan Rocky Mountain Company; superintendent and manager of the Brush-Swan Electric Lighting Company, of Cheyenne; associate professor of electrical engineering at Cornell University, in charge of electric light and power station designing; superintendent and general manager of the Swan Lamp Manufacturing Company, of Cleveland, and finally, at present, independent consulting engineer for railway and lighting plants in Cleveland. Mr. Roberts is also president of the Correspondence School of Technology, at Cleveland, and is a member of several engineering societies.

Mr. Benjamin Frick has accepted the position of manager of the New York office of the National Water Tube Boiler Company, of New Brunswick, N. J., and will have his headquarters at 26 Cortlandt Street, New York. Mr. Frick has been prominently identified with a large number of important electric railway enterprises, and is still interested in a number of companies of this character. He is well known in the street railway fraternity, and is regarded with high esteem by all who know him. He is a native of Philadelphia, where he was born in July, 1860. His first connection with electric railroading was in 1893, when he became identified with E. W. Clark & Company, of that city, and was appointed assistant manager of the Lynn & Boston Railroad Company, in which that firm of bankers was interested. He remained with that road until March, 1894, when he went to Brooklyn as treasurer and afterwards secretary of the Atlantic Avenue Railroad Company, of that city. He severed his connection with that company at the time of its consolidation with the Nassau Railroad Company. Mr. Frick acted for a year as secretary of the New York State Street Railway Association, and expects to keep an active interest in the various railroad enterprises in which he is engaged, in addition to his duties in connection with the National Water Tube Boiler Company.

Mr. James More, Jr., M. Inst. C. E., M. San. Inst., F. R. M. S., whose portrait is published herewith, has been for the past fifteen years engineer for Messrs. Dick, Kerr & Company, Ltd., of London, Edinburgh and Kilmarnock, and for them has carried out the construction in Great Britain of a large number of tramways, including horse, steam, electric and cable. Mr. Moore was born and educated in Glasgow, where he served his apprenticeship as a civil engineer. While there he was engaged in carrying out sewerage, road and water works, the construction of railways and the preparation of Parliamentary and constructional drawings. Leaving Glasgow he acted as engineer upon a number of important enterprises for different contractors until 1881 when he accepted the position of engineer in the corporation with which he is now connected. Among the important tramways whose installation he has since had in charge are the two Edinburgh Northern cable routes, two cable routes in London for the London Tramway Company, and one in Matlock. In the case of the two Edinburgh routes, the Matlock and the Brixton lines, the tramway companies were represented by their consulting engineer, Mr. W. N. Colan, M. Inst. C. E., and Mr. More had the carrying out of the work of the installations, but in the case of the Streatham extension, the work was designed and carried out by him as engineer to Dick, Kerr & Company. In the case of the Douglass cable tramway in the Isle of Man., he also had general charge of the project, prepared the parliamentary plans and procured the necessary legislation. All of these routes have been both mechanical and financial successes.

JAMES MORE, JR.

Mr. More is at present engaged in converting the entire system of Edinburgh from horse to cable traction. This work is being done by the Corporation of Edinburgh, which about three years ago purchased the lines for the old tramway company and re-leased them to Messrs. Dick, Kerr & Company. This work is being carried out upon the designs of Mr. W. N. Colam, who is consulting engineer for the Edinburgh Corporation. By September next, the contractors expect to have completed 24 miles of cable track in Edinburgh. At present about 8 miles have been finished. During the winter in Scotland, it is daylight only from about 8.30 A.M. until about 4.30 P.M. This is compensated for however by the long daylight during the summer, and the contractors expect that taking the year's work, there will be at least 2 miles per month of cable track finished. This is rapid construction for Scotland, as the maximum length allowed by the authorities under construction is 400 yds. of single line, and a three minute service of horse cars has to be kept going without interruption.

AMONG THE MANUFACTURERS.

The Standard-Air Brake Company, New York, reports good business for March, and in addition to deliveries at home, secured several good orders from abroad, including one by cable for air brakes for the colonies.

The H. Channon Company, of Chicago, has recently been taking some large orders for Ajax transmission rope. One of these is an order for thirty-one 1¼ in. diameter ropes to be placed in the Spartan Mills, Spartanburg, S. C.

Macartney, McElroy & Company, of New York, have received the contract for the construction of an electric railway connecting New Palz, N. Y., with Highland on the Hudson River. Work will be commenced immediately.

The Stanwood Manufacturing Company, of Chicago, has recently equipped with Stanwood steel steps the United States battleships "Iowa," "Indiana" and "Massachusetts," the cruisers Brooklyn and New York and the Revenue Cutter No. 3.

Janney & Steinmetz, of Philadelphia, Pa., report a large demand for the miscellaneous appliances which they supply. This firm deals in trolley poles, clamps, turnbuckles, pinions, gears, etc., and is in an excellent position to care for railway trade.

Alfred G. Hathaway, of Cleveland, has recently equipped with the Murrey anti-friction brake some of the cars of the Cleveland & Elyria Railway. Mr. Hathaway does a large business in transfer tables, turn tables, etc., and is one of the best known men in the trade.

Dick, Kerr & Company, limited, of 101 Leadenhall Street, London, and Britannia Engineering Works, Kilmarnock, have inaugurated their new electrical traction department, by securing the contract for the electrical equipment of the Dover Corporation Tramways.

The Massachusetts Cordage Company, of Boston, is greatly increasing its trolley cord business. It makes a special waterproof cord that is fast becoming popular with the electric roads, and it numbers among its patrons for this cord some of the largest electric roads in the country.

The Wells & French Car Company, of Chicago, has just opened a New York office at No. 100 Broadway. The company will be represented in New York by Frederick Saxelby who will have charge of the company's office and who is thoroughly experienced in all matters relating to car construction.

Barbour-Stockwell Company, of Cambridgeport, Mass., has been appointed agent for New England, New York and vicinity for the Composite brake shoe. This shoe, as is well known, is meeting with an increasing use throughout the country. In New England its use is the rule among all the large companies in that locality.

The Ball Engine Company, of Erie, Pa., has recently installed in the Paul O. Stoneland Building, at Chicago, an additional direct connected engine and dynamo, the latter being furnished by the Jenny Electric Company, of Indianapolis. This is the third direct connected outfit furnished by the same company in this building.

Fred. H. Koretke, of New Orleans, La., manufacturer of repair parts for street railway equipments, has found at necessary, on account of a largely increased business, to enlarge his plant and to introduce much new machinery in order to fully supply the demands of the trade. He is general headquarters for the Southern States.

The youthful artist in our advertising columns, the "yellow kid," got a little farther this month in describing the merits of Dirigo, but was not able to finish his work by the time of going to press. He has promised to work hard during April however, and to have the sign, which he is painting, finished in time for the May issue of the STREET RAILWAY JOURNAL.

J. H. McGill, Chicago representative of the Ohio Brass Company, has recently secured several nice orders for type W hangers with Dirigo insulation and Walker ears. Among them are orders from Naugle, Holcomb & Company, for the Suburban Electric Railroad, in Chicago; the Milwaukee Electric Railway & Light Company, of Milwaukee, and the Waterloo & Cedar Falls Rapid Transit Company, of Waterloo, Ia.

The American Down Draft Boiler Company, of Boston, Mass., has recently issued a very attractive catalogue, giving considerable information about the down draft furnaces and boilers manufactured by this company. The company claims among other advantages for its furnaces and boilers, perfect combustion by mixing hot air with the gases of combustion before they strike the boilers and form smoke. It also claims a greatly increased circulation in the boiler.

The Standard Air-Brake Company, of New York, will make a fine exhibit at the Brussels Exposition next month. A shipment was made by this company per S. S. "Friesland" which contained full working outfits for motor and trailer air brake car, including

whistle. Undoubtedly this exhibit will attract much attention and prove of great interest to the street railway men of Europe. General Manager Wessels expects to attend the convention in June.

The American Engine Company, of Erie, Pa., has just secured the order for the entire engine equipment of the new station of the Scranton Illuminating, Heat & Power Company, to be built on the site of the old station recently destroyed by fire. The equipment will consist of six American-Ball engines, five of which will be compound and one simple. Direct connected generators will be used on four of these engines, and the station will be modern in all its appointments.

J. E. Wilson, manager of the railway department of the Pettingell-Andrews Company, of Boston, Mass., reports many good sales of gears and sand boxes with general supplies. The Pettingell-Andrews Company has now on exhibition at its store in Boston a new hand hoist for street railway emergency work. This hand hoist is geared at sixty-one and is very novel and convenient. The company is also doing a large business in trolley wheels and has some very high records in these appliances.

Modern Machinery, is the name of a new monthly journal published by the Modern Machinery Company, Ashland Block, Chicago. It contains fifty pages of closely printed matter, and is something of a departure from the usual lines of technical journalism, containing a combination of history and prophecy, interspersed now and then with a short story and a few illustrated jokes on real and fanciful inventions. The paper is of interest not merely to the technical man, but will find interested readers in other fields.

The Billings & Spencer Company, of Hartford, Conn., has recently brought suit in the United States Circuit Court, at Cleveland, O., against the Van Wagoner & Williams Hardware Company, of the latter city. The court has been asked to grant, at first, a temporary, and finally a permanent injunction to restrain the defendants from using a patent which is claimed to be owned by the complainants for manufacturing commutator bars and segments, which patent is held to be very valuable. The complainants also ask for an accounting and exemplary damages.

Smith of New York, manufacturer of car lamps and chandeliers, electric and oil headlights, etc., has recently published a large sheet showing many of the different headlights and car lights manufactured by him. The head of the firm, Charles G. Smith, has devoted a great deal of time to the manufacture of these appliances and the firm of "Smith of New York" has been established for over half a century. The folder shows a large number of forms of different oil lamps, electroliers and combination lamps arranged for electric cars with the use of a kerosene burner or candle.

The Ohio Brass Company, of Mansfield, O., reports a large and increasing demand for its line appliances for use with figure 8 trolley wire. This would seem to indicate an extensive employment of this wire for new work this season. It is, of course, rather difficult to say at present to what extent this wire will be employed this year, but that its use is becoming quite general is shown by the report of the managers of the Ohio Brass Company, that within the past year they have sold a sufficient quantity of their special devices for use with figure 8 trolley wire to put up approximately 275 miles of line.

J. W. Gorman, of Boston, Mass., who did a large business last year in the supplying of amusement attractions to street railway companies for their parks, reports that he has an exceptionally large number of high class and novel atttactions for the season of 1897. Mr. Gorman's amusements are growing in favor with street railway companies and last year he supplied entertainments for a large number of street railway companies, including those in Gloucester, Brockton, Taunton, Holyoke, Lowell, Lawrence, Northampton, Newburyport (Mass.), Concord and Manchester (N. H.), and New Haven and Norwich (Conn.).

The Garton-Daniels Electric Company, of Keokuk, Ia., is meeting with great success in the sale of its well known lightning arresters. The company has recently published several small pamphlets calling attention to the value of lightning arresters. One of these is entitled "As an Investment," and contains also a list of some of the prominent companies in this country employing the Garton arresters. These include the Chicago City Railway Company, Lindell Railway Company, Atlanta Consolidated Street Railway Company, Walker Company, Felix Singer & Company, of Berlin, Siemen Bros. of Woolwich, England, and other prominent companies and firms.

The Gold Street Car Heating Company, of New York reports an excellent business in the sale of electric heaters during the past season. This heater is well thought of by street railway men as is shown by its selection for the equipment of the new "bridal car" recently put in operation by the Midland Railway Company of Staten Island. This parlor car is probably the finest ever put in operation upon any electric railway and its equipment and furnishings were the finest that could be purchased. That the Gold Street Car Heating Company was selected to supply the electric heaters is the highest testimonial which could be given of their efficiency and the excellence of the construction.

The Consolidated Car Heating Company, of Albany, writes that a recent patent decision by Judge Coxe, involving regulating switches for electric heaters, of which some mention has been made in different papers, does not affect,in any material way, that company's heater switch. The decision covers only a minor point, the use of an indicator on the switch, "operated by the movement of the switch" and while the company thinks the decision will be reversed on appeal, the point is by no means vital, and in fact the company has used indicators on only a very small proportion of the switches which it has manufactured.

The Pearson Jack Company, of New York, is meeting with good success in the sale of the Pearson jack for replacing derailed street railway cars. The great feature of this jack is its ability to hoist and throw over at the same time. It is a handy, compact device, weighing about 30 lbs. and can therefore be easily carried in the car. It takes about three minutes to replace the worst case of derailment that can happen. The motorman and the jack do the whole thing and thus speedily clear the track and prevent loss of time, caused by breakdowns that are so annoying to the average passenger. The company has received among other recent orders one for a large consignment for Germany.

The Lombard Water Wheel Governor Company, of Boston, has closed a contract with the St. Anthony Falls Water Power Company, of Minneapolis, to furnish it with seven governors for the new plant which it is now building. These seven governors are to regulate four water wheels each, or twenty-eight water wheels in all, aggregating 10,000 h. p. The style of governor to be employed in this plant is designated by the manufacturers as type C. During the past year the Lombard Company has regulated with this type of governor over 40,000 h. p. of water wheels in the United States. On account of the magnitude of this Minneapolis plant the question of governors was very carefully looked into before the above order was placed.

The Metropolitan Electric Company, of Chicago, has taken the agency for the Syracuse rail bond. This bond utilizes the fish-plate holes and requires no drilling. It is soldered fast to the rail and the fish plate bolts reinforce the joints, making absolutely homogeneous contact during the life of the rail, and giving a surface connection between the copper and rail of ten times the cross section of the bond conductors, thus making the best possible construction. In addition to this the Syracuse bond is not only cheap in first cost, cheap to put on the rail, but is economical and will save coal bills, and is endorsed unconditionally by the best engineers. The Metropolitan Electric Company has just issued circulars describing fully the rail bond.

W. T. Van Dorn, manager of the Fitzgerald-Van Dorn Company, of Chicago, writes us that he is doing a large business in the sale of Van Dorn automatic drawbars for elevated, cable and electric railroads, and is very much encouraged with the outlook for the coming season. The tendency toward the use of long cars on electric railroads is resulting in an increased demand for this drawbar, and as this company builds some eight sizes it is prepared to supply couplings of any capacity. The Fitzgerald-Van Dorn Company has recently received orders from companies that at first put on common pin and lock couplings, but afterwards found that the automatic coupling was indispensable. The Van Dorn ball joint attachment is also being adopted by several large companies.

The Cahall Sales Department, of Pittsburgh, Pa., general sales agents for the Aultman & Taylor Machinery Company, of Mansfield, O., has just published one of the handsomest and most tasteful catalogues which has ever reached this office. The catalogue is, of course, descriptive of the Cahall water tube steam boilers, both the vertical and Babcock & Wilcox types. The catalogue is bound in light colored cloth with board covers, and is illustrated by a large number of fine engravings, many of which occupy full pages. The descriptions of the different types of boilers manufactured are especially complete, and the book contains the records of a number of tests made of Cahall boilers, including one combination test made at nine different intervals by different engineers for both efficiency and capacity.

The Railway Material & Tool Exhibit Company, has opened rooms in the Great Northern Building in Chicago, for the purpose of supplying facilities for the exhibition of material and appliances used by railways both steam and electric. This scheme offers to non-resident manufacturers and dealers, who do not wish to assume the expense of a local office, facilities for the continuous exhibition of their specialties. Traveling agents can make their headquarters here while in the city. An exhibit placed here must of necessity come much more prominently before railway men than if placed in a private office. Exhibits have the special supervision of the manager who devotes his time to showing them to visitors. From time to time catalogues will be issued. The location of the rooms is the best in the city with respect to both strangers and residents, and the company is receiving a large number of inquiries for space.

The McGuire Manufacturing Company, of Chicago, reports a very good business in its truck department, and says the outlook is more encouraging than it has ever been. McGuire Company is now delivering fifty of its No. 26 pivotal trucks to the Suburban Construction Company, of Chicago. Among other recent orders are orders from the following: Buffalo & Williamsville Railway Company, Williamsville, N. Y.; People's Railway Company, Dayton, O.; Chicago City Railway Company, Chicago; Frederick & Middletown Railway Company, Frederick, Md.; New Castle Electric Street Railway Company, New Castle, Pa.; Second Avenue Railway Company, Pittsburgh, Pa.; Waterloo & Cedar Falls Rapid Transit Company, Waterloo, Ia. The company's foreign trade has increased greatly the past year and it looks for a good amount of business from abroad this year. The sales of its ratchet handles are very satisfactory and these handles are now standard on a great many large roads.

The Lombard Hydraulic Brake Company, of Boston, Mass., has just issued a catalogue descriptive of its hydraulic brake, on which several articles have appeared in the STREET RAILWAY JOURNAL. The brake uses compressed air as a medium for accumulating energy. It differs from other air brakes, however, in that the air does not circulate in the cylinder which actuates the brakes in order to enter the piping from the tank to the cylinder or valves. All of these parts are continuously filled with non-freezable oil, and nothing but oil under the elastic air pressure which is in the upper part of the pressure tank. After being used the oil is automatically returned to a vacuum tank, and is then transferred by a pump to the pressure tank. The hydraulic brake is giving excellent results, and a large number of advantages are claimed for its use.

Kinsman & Knudson, is the title of a new firm recently formed by Frank E. Kinsman and A. A. Knudson with headquarters at 66 Broadway. These gentlemen are at present engaged in a series of experiments, which it is believed will materially add in the solution of the problem of electrolysis caused by using the tracks as the return circuit. In the large cities this has become one of the most trying questions with which the electric railway engineer has had to deal and its solution would be of the utmost importance both in construction and operation. Both Mr. Kinsman and Mr. Knudson are particularly well fitted for this work and the publication of the results they obtain will be awaited with great interest. The experiments are being conducted on entirely new lines and several important discoveries have thus far been made. It is believed that others will follow.

The Wakefield Rattan Company, of Boston, Mass., has issued an attractive catalogue descriptive of its car seats. A number of the illustrations are printed in colors, giving a very good idea of the completed seat and covering. Diagrams are given showing the construction of the seat which is widely used and giving excellent service. An interesting portion of the catalogue is that devoted to the Henry revolving chair now being put on the market by this company. These chairs are for street railway service and are mounted in pairs on a center support, making it much easier to keep a car clean than if fastened to the side of a car. The arrangement of the seats renders possible as large a seating capacity as with side seats or the regular reversible seats, and gives each passenger a seat by himself. At the same time it prevents a passenger from occupying more than his legitimate share of room.

The Hunt Air-Brake Company, of Pittsburgh, Pa., has been awarded the contract for ten combined motor air brake equipments for that number of 40 ft. combination and passenger cars for the Olean & Bradford Electric Railway. The contract was given by the Pierce Construction Company, of Leominster, Mass., and the cars are being built by the Wason Car Company. This line is the "Scenic" route over the mountains between Olean and Bradford and every appliance for comfort, speed and safety has been adopted. The Hunt Air-Brake Company has also received a duplicate order from the Johnson Company for combined motor equipments for the Lorain Street Railway and counts among its other March business twenty other equipments, independent of trial equipments. The Wilkesbarre & Northern Railway Company has also ordered trial equipments from the Hunt Company, and will determine later the number of cars to be equipped.

The Cutter Electrical & Manufacturing Company, of Philadelphia, installed a number of its circuit breakers in the power station of the Union Traction Company of Philadelphia, which was recently destroyed by fire. While the engines were still playing upon the flames, Charles Hewitt, the chief electrician of the Union Traction Company, placed himself in communication with the Cutter Company, and ordered for immediate delivery 165 I. T. E. circuit breakers. This order was provisional upon prompt delivery, as required by the Traction Company. Inside of twenty-four hours 116 of these circuit breakers were delivered to the Traction Company. It would seem that comment upon the merits of the I. T. E. circuit breaker, and the size of the Cutter Company's business, which would enable it to fill this order—one of the largest ever placed at one time for circuit breakers—is unnecessary. The fact that standard switchboard types were ordered, made it possible for the entire order, practically, to be filled out of stock.

The Dorner & Dutton Manufacturing Company, of Cleveland, O., states that its works were shut down for only about ten days. Since that time the works have been running regularly, and each week the company is increasing the number of its workmen, and now it has nearly its full number. The company has several small orders for trucks and some large orders for gears and pinions. H. A. Dorner, general manager of the company, has just lately returned from an Eastern trip, and had some very encouraging orders. Present indications are that business is improving. This company has also just made shipments of the following truck orders: one truck to Urbana & Champaign Electric Railway Company, four trucks to Savannah, Thunderbolt & Isle of Hope Railway Company, and four trucks to Newark Consolidated Electric Railway Company. The company has also ready for shipment three of its improved car wheel presses on three separate orders. The company's general run of orders for gears and pinions keeps up well.

The Curtis-Hull Manufacturing Company, of Hartford, Conn., manufacturer of the electric purifier recently received a letter from I. S. Spencer's Sons, who are prominent iron and brass founders and machinists, in Guilford, Conn., in regard to the operation of the Curtis-Hull electric feedwater purifier. As this manufacturing firm has used these purifiers for nearly three years their testimony as to its value is particularly interesting. It reads as follows: "The water purifier purchased of you in July, 1894, has been in constant use on our boiler ever since. We are glad to report that our boiler is nearly free from scale and the new tubes we put in a year ago last November are as clean now as at that time, which goes to show that there is no formation of new scale. It gives us great satisfaction to know that we have at last found something to prevent the trouble experienced from scale, giving such good results at a minimum cost. We fully comprehend its worth, and would not be without it for double its cost."

The Bridgeport Deoxidized Bronze & Metal Company, of Bridgeport, Conn., which has always been prominent as a manufacturer of the highest quality of Babbitt metal, decided about three years ago, to put upon the market a special grade of metal to meet all the requirements of electric railway motors. The Albany Railway was among the first to use deoxidized genuine No. 1 babbitt metal extensively. This company now reports the remarkable service of 65,000 miles on axle bearings and 43,000 miles on armature bearings of Westinghouse machines. The metal is very hard and still so tough that it will not crack even when run in a thin shell. It is, of course, a "tin" metal, and oleic acid, which is present in almost all oils and greases, will not corrode and roughen the bearing lined with it, which accounts for a cool running bearing, and by actual test a rise in temperature of less than 40 degs. in one hour continuous running It reports a large and growing trade from all over the country and has received a number of very flattering letters of recommendation.

The Electric Mutual Casualty Association, of Philadelphia, Pa., at its annual meeting last month elected the following officials for the ensuing year: president, W. B. Rockwell, Staten Island Midland Railway Company; vice-president and general attorney, Thos. B. Harned; treasurer, W. H. Clark, Bergen County Traction Company, cashier of the Quaker City National Bank; secretary, Wm. W. Wharton. In addition to the above the following were elected members of the board of directors: N. Sumner Myrick, Esq., president, Warren, Brookfield & Spencer Street Railway, Brookfield, Mass.; M. J. Wightman, electrical engineer; C. H. Stoll, president Belt Electric Line, Lexington, Ky.; Dr. H. B. Rockwell, medical director; W. S. Grant, Jr., president Geneva, Waterloo, Senaca Falls & Cayuga Lake Traction Company, Senaca Falls, N. Y. The association had an exceptionally fortunate experience in 1896. and commences the new year with a membership composed of forty of the best equipped and managed of the smaller street railways in the country, on each of which is required good physical conditions and surroundings. It bids fair to solve one of the most difficult questions street railway officials have to consider.

The Henry R. Worthington Company, of Brooklyn and New York, manufacturer of steam and electric pumping machinery, has recently received a contract from the Newport News Ship Building & Dry Dock Company, amounting to $100,000, covering pumps for the U. S. battle ships "Kearsarge," "Kentucky," and "Illinois." The same concern is also building the pumps and pumping machinary for the U. S. battle ship "Alabama," now being constructed by the Wm. Cramp & Sons Ship & Engine Building Company. The contract for the pumps for this vessel amounts to $33,000. The company has just completed and delivered the hydraulic machinery for operating the turrets on the U. S. battle ship "Iowa." It has more recently received a contract amounting to $15,000, covering the pumps required for the armored cruiser being built by the Wm. Cramp & Sons Ship & Engine Building Company, for the Japanese Government. The "Yoshi-No," another Japanese cruiser, is already fitted out with a full complement of Worthington pumps. The fact that with few exceptions all British and other foreign war vessels are equipped with these machines simply adds another testimonial to the high efficiency of the Worthington duplex steam pump.

The Standard Paint Company, of New York, the well known manufacturer of P & B paints, insulating compounds, etc., is meeting with excellent success in the sale of P & B ruberoid car roofing. This has been extensively employed for some years for the roofs of general freight, refrigerator, furniture cars, etc. It is especially adapted for car roofing, and will, it is claimed, stand more rack and wear and tear from a car than anything in the market. This material is also extremely pliable, its base being cow hair felt, thoroughly saturated with the P & B water and acid proof composition. The outer skin-like surface of the ruberoid protects this inner saturated layer, the result being that the roofing maintains its elastic properties for an indefinite time. The surface of ruberoid may be painted any desirable color with ordinary linseed oil paints. Experience has proved that it will last the life of a car. It is absolutely unaffected by the changes of temperature and is guaranteed to be free from tar or other deteriorating elements. It is very easy to apply and when once on, lies perfectly smooth and even. The P & B Company to make the trade better acquainted with this material, is mailing samples of it. The same material is also manufactured in much heavier weights for general roofing purposes.

The Q & C Company, of Chicago, is doing a large business in the sale of its different metal sawing machines. The growth and development of metal cutting by machinery has been almost phenomenal, and from an occasional use of a metal saw, this business has developed to such an extent that these machines are becoming almost indispensable. These portable rail saws are now used on nearly 150 steam railroads and about an equal number of street rail-

ways. Their value in saving labor, time and money is apparent, and many roads find it advantageous to have one of these machines on each division. Recognizing the value of facilities for doing their own work, many of the best roads are now taking up the question of large power machines for shop use, making their own frogs, crossings, switches, etc., and doing a large range of other work at greatly reduced cost. For this class of work the Q & C Company has brought out several large saws. With its new and large works at Chicago Heights, the company has never been in better position to take care of business than at the present, and while its goods are known and used abroad, as well as in the United States, its facilities are adequate for taking care of large orders for its regular stock machines, as well as getting up special designs to meet the needs of every class of trade.

The Dickson Manufacturing Company, of Scranton, Pa., has commenced the construction of a new boiler shop, 130 ft. × 225 ft. This building will have a steel framework throughout. The sides will be covered with corrugated iron and the roof with composition roofing on plank. The main boiler shop is about 52 ft. × 45 ft. Thirty feet above the ground is a runway made of substantial steel girders which carry a 30 ton power traveling crane. At one end of the main shop is a riveting tower 25 ft. × 50 ft., having a runway carrying a 20 ton crane 50 ft. above the floor level. The crane in the riveting tower runs at right angles to the one in the main shop below. Adjoining the main shop is a punch room, which is about 50 ft. wide, extending the full length of the building. Attached to to the roof trusses of this portion is a traveling crane of 5 tons capacity, which covers the whole floor surface. Adjoining the punch shop is a space for the flange fires and other furnaces, 25 ft. × 225 ft. All the main posts of the building are arranged so that jib cranes can be attached to them, and the trusses are arranged so that shafting and other machinery may be attached at convenient points. The steel work was designed and will be furnished and erected by the Berlin Iron Bridge Company, of East Berlin, Conn.

The Edward P. Allis Company, of Milwaukee, Wis., has recently received an order from the Third Avenue Railway Company for three direct coupled engines. These machines will have cylinders 26 ins. and 50 ins. × 48 ins., 20 ins. and 38 ins. × 48 ins., and 16 ins. and 30 ins. × 42 ins. The engines will be in general similar to many the company has furnished for various street railway power houses. The company has also received orders for six direct coupled engines to go in the New Waldorf Hotel. These engines are all single cylinder machines; four of them drive 250 k. w. generators and two of them 100 k. w. generators. This power plant is to be one of the most complete and elaborate ever constructed. The engines are special machines with valves and heads, and every possible refinement is being embodied in their construction. The Allis Company is also building for the Columbia University, New York City, two direct coupled engines with cylinders 20 ins. × 42 ins. This company has recently purchased the business formerly carried on by the Hercules Iron Works, the Hercules Ice Machine Co. and the Reliance Engineering Co., of Aurora, Ill., and is prepared to supply repairs on all ice and refrigerating plants erected by them as well as to figure on new machines for this purpose, and of any required size from 1 to 500 tons refrigeration.

The Rarig Engineering Company, of Columbus, O., writes that it has recently made some very heavy shipments to the West Indies, and has considerable work on hand. The business outlook is very encouraging, particularly so in the engine trade. The company is now filling orders for Stern & Silverman, Philadelphia, Pa., for their power plants, etc., for the Cincinnati & Miami Valley Traction Company's electric road between Dayton and Hamilton; 800 h. p. heavy duty Corliss engine for the Decatur Cereal Mill Company, Decatur, Ill.; the structural iron work for the King, Gilbert & Warner Company's new blast furnace located in Columbus, and numerous other contracts. The company's plant is running full time, some of the departments day and night. The new works are located just east of the city of Columbus, and are large and of the most modern type. They are equipped with electric light and power plants, hydraulic riveting plant, electric traveling cranes, steam hammers, in fact every necessary appliance for manufacturing expeditiously and in a first class manner all sizes of heavy duty Corliss engines, blast engines, haulage and hoisting engines, blast furnaces, rolling mills, mining machinery, boilers and steel chimneys, and structural iron work. The buildings are of steel and brick and are traversed by railroad tracks connecting with fifteen different roads, enabling the handling of shipments with the greatest dispatch.

The La Capital Company, of Buenos Ayres, Argentine Republic, South America, has let contracts for the materials for a power station and the necessary equipment for the power in the station, and the roadbed and cars to United States manufacturers. The Berlin Iron Bridge Company, of East Berlin, Conn., has the contract for furnishing the skeleton steelwork of the buildings and the roofs. The roof over the engine and dynamo room will be covered with corrugated iron, lined with the Berlin Company's fireproof anti-condensation roof lining. Taking into consideration the magnitude of the work and the distance it is to be shipped, it is to be considered a good recommendation for the Berlin Company's roofing. The Berlin Iron Bridge Company has also received the contract for the steel work for a new foundry to be erected by Theodore H. Colvin, of Providence, R. I. This building will be 102 ft. × 180 ft. and will be a complete and modern foundry building in every respect. The central portion, 50 ft. wide, will be served with a 20 ton traveling crane, and at distances of about 25 ft. in the length of the building will be placed 5 ton jib cranes swinging from the central portion of the building over the moulding floors in the wings, which extend along both sides of the building and are 25 ft. wide. The entire framework of this building will be steel. The roof covering is to be slate.

The General Electric Company, of New York, is doing a large business in the supply of electric apparatus for the long distance transmission of power as well as for railway service. Some of its recent contracts have been mentioned in late issues. An extract from a recent letter regarding the operation of the Fresno (Cal.) long distance transmission may be interesting to our readers. It was written by John J. Seymour, president of the San Joaquin Electric Company, operating the San Joaquin River-Fresno transmission, to the General Electric Company, which installed it. "It affords me great pleasure to write you regarding the successful operation of the long distance transmission plant installed for our company. The entire plant as furnished has been in actual practical operation for a period of several months. The 35 miles transmission has given us no trouble whatever. Our load at present consists of 145 arc lights and 5000 incandescent lights and 410 h. p. in motors, the latter including 180 h. p. for the Sperry flour mill and 75 h. p. for the city pumping plant. All of the machinery doing this work has worked with perfect success from the start. The incandescent lights have most of them been newly wired in, thus enabling us to properly balance the load, and the regulation has given us no trouble whatever. During extensive tests, it was impossible to find more than two volts variation between any lamps on the system. Lights so furnished seem to me to be better than incandescent lights usually furnished in San Francisco and other cities of the state."

The Van Wagoner & Williams Hardware Company, of Cleveland, O., and New York, N. Y., has been manufacturing drop forged commutator segments for street railway motors for about a year and a half and is building up a very successful business. It is a large manufacturing company with one of the most extensive and thoroughly equipped hardware plants in the country. The works are new and modern in equipment; everything which tends to produce superior goods at low cost has been introduced. For twenty-five years the company has enjoyed a fine reputation for the quality of its goods and honorable dealings. These facilities and the company's experience have enabled it to produce a drop forged commutator bar of superior quality. The copper is specially prepared for the company. The ordinary way of making copper rods did not produce as high a grade segment as was desired. After considerable experimenting, a rod was obtained which when treated by the drop forge pracess, produced a dense and hard wearing surface. A contract was accordingly made with one of the largest copper concerns in the country for furnishing these rods. The results so far are extremely satisfactory. Recognizing that commutator segments must also be extremely accurate, the greatest pains have been taken in making the dies and in supervising the product. The company has in its employ one of the most experienced and expert forge masters in the country. The result has been an output of segments that are extremely accurate. Several of the largest builders of motors and users of segments have expressed great satisfaction over these goods, as indicated in the following quotation from a large builder of motors: "Although we have used drop forged segments as manufactured by all other prominent producers in this country, we have been for some months, and are now using, with perfect satisfaction, those offered by the Van Wagoner & Williams Hardware Company, of Cleveland, O."

New Publications.

Wiring Tables and How to Use Them, by Thomas G. Grier. Published by Thomas G. Grier. Chicago. Seventy-five pages. Illustrated. Cloth. Price, $1.

Mr. Grier's notebooks on wiring have come to be regarded as standard. The book mentioned is written to explain how the wiring tables are compiled and the reasons for the methods used, and is consequently of an attractive character as well as a reference book. The different methods of interior wiring are illustrated and the book contains a number of wiring tables.

Trade Catalogues.

Machine Tools. Forty-four pages. Illustrated. Published by the Hilles & Jones Company, of Wilmington, Del.

Catalogue of Car Seats. Published by the Wakefield Rattan Company, Boston, Mass. Sixteen pages. Illustrated.

Brakes for Street Cars. Published by the Lombard Hydraulic Brake Company, Boston, Mass. Eight pages. Illustrated.

The St. Louis Corliss Engine. Published by the St. Louis Iron Machine Works, St. Louis, Mo. Thirty-one pages. Illustrated.

"Cahall" Water Tube Steam Boilers. Published by the Aultman & Taylor Machinery Company, Mansfield, O. Cloth. Ninety-eight pages. Illustrated.

Down Draught Steam Boilers and Attachments. Seventy-one pages. Illustrated. Published by the American Down Draught Boiler Company, of Boston, Mass.

List of Street Railway Patents.

U. S. Patents Issued Feb. 23, to Mar. 23, 1897, Inclusive.

Feb. 23.

Electric Railway System.—C. F. deRedon, New York. No. 577,450.

In an electric railway system a circuit closer comprising a permanent magnet adapted to be attracted by a device carried by a car, a lever upon which the magnet is placed, a contact plate carried by said lever and contact blocks to be engaged by said plate and having connection with the current carrying wires.

Street Railway Switch.—Anton Schmackers, Dayton, O. No. 577,454.

Consists of a shifting bar having a connection with a switch tongue, a cam lying flushed with the track and of actuating pieces carried by the car and adapted to trip the cam.

Brake Handle.—John D. Waldran, St. Louis, Mo. No. 577,470.

Has a suitable brake staff, a ratchet carried thereby having teeth placed parallel to the axis of rotation, a socket loosely passed over the ratchet and a pawl adapted to engage with the teeth of the ratchet when the handle is turned in one direction, and to be disengaged from said teeth when the handle is turned in the opposite direction.

Car Truck.—M. G. Hubbard, Jr., Chicago, Ill. No. 577,481.

The Ratchet Brake Handle.—W. A. McGuire and M. G. Hubbard, Jr., Chicago, Ill. No. 577,490.

Car Brake.—E. A. Marton, Watertown, Mass. No. 577,515.

The brake has a tubular brake beam having the brake heads secured to its opposite ends, said beam being reinforced by a solid bar placed within the same in contact with its interior surface and extending from one end to the other of said beam.

Street Car Fender.—Gustave Stademann, Philadelphia, Pa. No. 577,564.

Trolley for Electric Railways.—Herbert Gale, Bristol, Conn. No. 577,741.

Combination of the trolley pole, the forks borne by the trolley pole having ways for the trolley wheel shaft, the trolley wheel shaft hung in said ways, and the trolley wheel rotarily hung on said shaft.

Mar. 2.

Trolley Pole Controller.—L. M. Halsey. No. 577,853.

A trolley pole and jaws thereon, a trolley wheel mounted between the jaws with liberty to rise and sink therein, in combination with a spring actuated reel, a ratchet wheel on the reel shaft, and a pawl pivoted on one of said jaws with one end connected to the wheel support and the other adapted to engage or release said ratchet wheel as the trolley wheel sinks or rises.

Car Fender.—Paul Jones, Cincinnati, O. No. 578,104 to 578,106.

A car fender consisting of a scoop so pivoted as to guard the truck wheels of the car, means for holding said scoop in its elevated position, a magnet for releasing said scoop, a solenoid for depressing the outer end of the scoop, and means for closing the circuit in which said magnet and solenoid are included.

Car Fender.—Jas. E. Treat, Boston, Mass. No. 578,279.

Electric Rail Bond.—Budd J. Jones, Chicago, Ill. No. 578,304.

Has a loop shaped body, formed of a series of strands or bars, and has rivet studs secured by casting or otherwise to the ends of said body, and arranged to project laterally therefrom.

Mar. 9.

Car Fender.—Adolph J. Knauer, Philadelphia, Pa. No. 578,406.

Has a secondary fender arranged at substantially a right angle to the main fender and pivotally mounted thereto.

Life Guard for Street Cars.—George A. Parmenter, Cambridge, Mass. No. 578,497.

Safety Guard for Street Cars.—Richard F. Preusser, Washington, D. C. No. 578,522.

This guard is a combination of a net frame and the supporting frame, of a swing buffer frame having a buffer extending across to its front end, said buffer consisting of an elastic material.

Trolley Support.—Edward Blamey, Jersey City, N. J. No. 578,539.

Trolley Rope Protector.—H. M. Brooks, New Haven, Conn. No. 578,542.

The combination with the rope or cord of a trolley arm, of a shield or guard connected therewith adjacent to said trolley arm, said shield or guard being cup shaped and provided with a discharge spout at one side thereof.

Car Fender.—George Learmouth, Boston, Mass. No. 578,645.

Brake for Street Railway Cars.—J. Lessard, Cohoes, N. Y. No. 578,646.

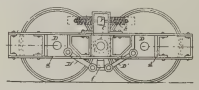
The combination with the brake shoes suspended from the car truck of a rock shaft joined beneath one side of the truck close to the inner sides of the car wheels and provided with lugs adapted to have a wedging engagement with the said brake shoes to force them against the wheels.

Street Car Brake.—B. J. Jones, Chicago, Ill. No. 578,675.

Mar. 16.

System of Motor Trucks.—James F. McElroy, Albany, N. Y. No. 578,760.

In a truck, forward and rear sets of guide wheels, a friction roller placed between them and arranged to rotate in contact there-



NO. 578,760.

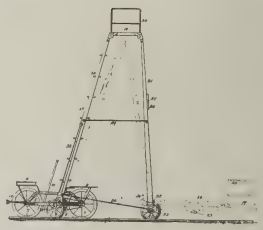
with, constant contact being maintained by the weight of the car acting on the movable bearing of the friction roller, and having a motor connected with and adapted to operate said friction roller.

Rail Bond for Electric Railways.—Thomas J. McTighe, Brooklyn, N.Y., and S. W. Childs, Natick, Mass. No. 578,829.

Consists of two metallic conductors, one on each side or face of the rail and having inwardly projecting ends and the means for drawing said ends into a single hole in the rail and securing them therein.

Trolley Repair Wagon.—William B. Woods, Wheeling, W. Va. No. 578,848.

A trolley repair wagon comprising a front truck frame and independent adjustable rear truck frame and ladder pivotally connected at the lower end to the front truck and rear supporting frame connected at its upper end to the ladder frame to fold there-



NO. 578,848.

under when the said ladder frame is lowered, and means for holding the folded ladder and supporting frame and the rear truck in a locked connection when such ladder and supporting frame are lowered thereon.

Mar. 23.

Sand Box for Electric Cars.—Morris M. Nash, Lowell, Mass. No. 579,168.

Consists of a hopper with shafts and rollers at each end thereof and having an endless band or belt passing over said rollers and provided with small buckets. It has also sprocket chains connected with the edges of the said band or belt and sprocket grooves fast with the said shafts and rollers.

Section Car Truck for Street Railways.—George E. Turner, Marion, O. No. 579,195.

Car Fender.—William Weaver, Norwalk, Conn. No. 579,372.

Trolley Support for Electric Railway Cars.—J. F. S. Branth, New York, N. Y. No. 579,380.

In a trolley or current collector for electric railway cars the combination of a support mounted upon the car roof and adapted to have a transverse rocking motion thereon and the trolley arm pivoted upon said support perpendicular to each other, one of which is horizontal and transverse to the car.

Street Car.—James A. Trimble, New York, N. Y. No. 579,458.

The car has posts or standards provided with vertical grooves combined with the sashes or panels for the sides of the car of less width than the spaces between said posts or standards, vertical strips at the side edges of said windows or panels and adapted to enter said grooves.

Electric Railway System.—George Westinghouse, Jr., Pittsburgh, Pa. No. 579,527.

A street railway built with flat rails on one side constituting electric supply, and return conductors and grooved supporting and guiding rails on the other side.

We will send copies of specifications and drawings complete of any of the above patents to any address upon receipt of fifteen cents. Give date and number of patent desired. The Street Railway Publishing Company, Havemeyer Building, New York.

DIGEST OF CONTENTS.—APRIL, 1897.

Abkürzung des Inhalts—April 1897.

"Elektrischer Strassenbahn-Betrieb in Europa". . . [*Seite* 189.]
Dies ist eine Reihe von Artikeln, direkt auf Mittheilungen gegründet, welche von den elektrischen Strassenbahn-Gesellschaften in Aachen, Versailles, Zürich, Hannover, Corentry, Brüssel, Lüttich, Birmingham, Basel, Hagen, Hamburg und Lyon erhalten wurden; eine ausführliche Beschreibung des Oberbaues, der oberirdischen Stromzuführung, Kraftstationen und Wagenausrüstung, sowie der finanziellen Erfolge, welche durch die Einführung des elektrischen Betriebs erzielt wurden.

Betrieb.

"Die finanziellen Erfolge des elektrischen- und Kabelbahnbetriebs in den Vereinigten Staaten". . . . . [*Seite* 209.]
Dies ist der erste einer Reihe von Artikeln, in welchen durch zahlreichen Tabellen die finanzielle Geschichte vieler einzelnen Strassenbahnen in Amerika während den letzten zwölf Jahren dargestellt wird, sowohl in Betracht auf den Pferdebetrieb als auf den elektrischen Betrieb. Dieser erste Artikel wird einer Erörterung der finanziellen Väernderungen gewidmet, welche in dem Strassenbahnsystem von New York, Massachusetts und Pennsylvania stattfanden.

"Ein Vergleich des amerikanischen und europäischen Radverfahrens" von P. H. Griffin. . . . . [*Seite* 215.]
Das Radfahren für elektrischen Betrieb befindet sich gegenwärtig in Europa in einem Zustande der Entwickelung, welcher demjenigen sehr ähnlich ist, der in den Vereinigten Staaten stattfand, als der elektrische Betrieb zuerst eingeführt wurde. Europäische Ingenieure bevorzugen natürlich Stahlräder, da dieselbe auf den Dampfbahnen allgemein verwendet werden. In den Vereinigten Staaten dagegen besteht von den über 200,000 Stück, welche sich im Betrieb befinden, kaum ein Prozent aus Stahlrädern. Es wird von Seiten vieler ausländischen Ingenieure angenommen, dass die Vorliebe für gusseiserne Räder in Amerika von deren Billigkeit herrührt; doch ist dies ein Irrthum. Die verhältnissmässigen Vor- und Nachtheile jeder Gattung für den elektrischen Betrieb sind ausführlich erörtert, hauptsächlich in Beziehung auf die Abnutzung der Spurkränzen, welche ein höchst bedeutender Faktor in der Dauerhaftigkeit der Räder bildet, besonders auf Bahnen, welche enge Spurrinnen besitzen.

"Schriften, welche vor der Convention der Strassenbahn-Rechenmeister gelesen wurden." . . . . . [*Seite* 217.]

Briefe und Mittheilungen von Sachverständigen.

"Ueber Doppelgestellwagen" von C. K. Durbin, Superintendent der Denver Consolidated Tramway Company, Denver, Col. . [*Seite* 223.]
Ausführliche Beschreibung einer Gattung von Wagen, welche sich in Denver sehr erfolgreich erwies. Der Wagen besteht aus einer 14 Fuss langen, geschlossenen Abtheilung, einer ebenfalls 14 Fuss langen offenen Abtheilung und 4 Fuss breiten Plattform an jedem Ende. Die geschlossene Abtheilung wird vorausgefahren.

"Ueber die Abnutzung und Erhaltung der Rädern" von J. L. Cox, Präsident der Terre Haute Car & Manufacturing Company. . [*Seite* 223.]
Die Nothwendigkeit, die für die nämliche Achse bestimmten Räder sorgfältig zu paaren und sie für die Spurweite genau abzumessen, wird erläutert.

"Ueber einen Oberbau ohne Querschwellen" von F. A. Little, Ingenieur der Detroit Railway Company, Detroit, Mich. . . [*Seite* 224.]
Mittheilungen über die Ergebnisse einer in Detroit auf Beton ohne Querschwellen, durch asphaltirten oder gepflasterten Strassen gelegten Bahn. Die Oberbau wird für gepflasterte Strassen empfohlen.

"Ueber den Stromverbrauch der elektrischen Heizer" von R. M. Douglass, Generalverwalter der Schuylkill Valley Traction Company, Norristown, Pa. . . . . [*Seite* 224].
Beschreibung von drei stattgefundenen Proben, um den Strombetrag festzustellen, welcher durch elektrische Heizung der Strassenbahnen verbraucht wird. Die Proben erwiesen, unter gewissen Umständen, dass ungefähr fünf Pferdestärke, oder von sechs bis sieben Amperen erfordert wurden.

"Betriebskosten der Kraftstationen in Brooklyn". . . [*Seite* 224.]
Ausführliche Mittheilung nebst Tabelle, welche die Kosten pro Kilowatt-Stunde, während dem Betriebsjahre 1896, der drei Kraftstationen der Brooklyn Heights Railway Company darstellt. Die Zahl der von dieser Gesellschaft betriebenen Wagen beläuft sich auf 900 bis 1100. In der ersten Kraftstation sind 4 direkt gekuppelte, 1500 Kw. starke Generatoren aufgestellt. Die zweite Station ist mit 12 durch Treibriemen gekuppelten, 500 Kw. starken Generatoren und die dritte mit 6 durch Treibriemen gekuppelten, 300 Kw. starken Generatoren ausgerüstet. Die Gesammtkosten schweben zwischen $005289 und $009588 pro Kilowatt-Stunde.

"Fastnachtverkehr in New Orleans". . . . . [*Seite* 225.]
Kurze Beschreibung des Strassenverkehrs in New Orleans während den zwei Tagen der Mardi-Gras Fastnacht.

"Fahrtkontrolle-System" . . . . . [*Seite* 225.]
Beschreibung eines in Brooklyn eingeführten Systems, um die Abgangszeit der Wagen zu kontrolliren.

"Rechtswesen" . . . . . [*Seite* 226.]

Leitartikel.

"Bemerkungen über die Behandlung der Angestellten". [*Seite* 228.]

"Organisation der amerik. Strassenbahnen-Rechenmeister". [*Seite* 228.]

"Elektrische Strassenbahnen in Europa". . . . [*Seite* 229.]
Recension über deren Bauart und Betriebsergebnissen, wie sie an einer anderen Stelle dieser Nummer dargestellt werden.

Oberbau.

"Die Lorain & Cleveland Eisenbahn". . . . [*Seite* 231.]
Beschreibung einer im Bau begriffenen Kleinbahn, deren Wagen eine Geschwindigkeit von 48 Kilometer pro Stunde erhalten werden. Hauptsächlich wird die Beschaffung der Kraftstation erläutert. Folgende Bedingungen mussten erfüllt werden: erstens sind die Schwankungen der Belastung sehr bedeutend, infolge der hohen Geschwindigkeit der Wagen und der geringen Zahl der Fahrten; manchmal übersteigen sie um 100 Prozent die normale Leistungsfähigkeit der Generatoren. Zweitens musste für eine fernere Erweiterung der Kraftstation in der nächsten Zeit, und drittens für eine fernere Erweiterung in den nächsten Jahren vorgesorgt werden.
Compoundmaschinen mit direkt gekuppelten Generatoren werden verwendet. Das Dampfrohrnetz ist derart eingerichtet, dass jede einzelne Maschine oder jeder einzelne Generator betrieben werden kann. Der Reserve-Apparat ist auch derart eingerichtet, dass falls eine Störung an irgend welchem Theile eintreten sollte, eine Unterbrechung des Betriebs nicht stattfinden würde.

"Oberbauverfahren für elektrische Strassenbahnen: für englische Verhältnisse erforderliche Aenderungen" von Alex. McCallum. . [*Seite* 235.]
Erörterungen über die in der amerikanischen Bauart der elektrischen Strassenbahnen einzuführenden Aenderungen, um den Erforderungen des englischen "Board of Trade" entgegenzusprechen und den öffentlichen Vorurtheilen vorzubeugen. Amerikanische Apparate werden voraussichtlich viel zur Verwendung kommen.
Aenderungen in Dampfmaschinen, Kesseln oder Dynamos werden nicht erforderlich. Die in England gesetzlich verordneten Bedingungen werden jedoch eine stärkere Stossverbindung, sowie etliche Aenderungen in der oberirdischen Bauart verlangen; auch wird wahrscheinlich ein stärkerer Oberbau in der Regel verlangt werden. Ergebnisse werden vermuthlich den amerikanischen gleich kommen.

"Schienenwagen für Oberbau". . . . . [*Seite* 236.]
Beschreibung eines elektrischen Wagens für die Uebertragung von Schienen von einer Stelle zur andern; die Belastungsfähigkeit des Wagens beläuft sich auf 40 Tonnen.

"Strassen- und Kleinbahnen in Griechenland". . [*Seite* 237.]
Beschreibung der Eisenbahnlage in Griechenland, mit einer kurzen Erörterung über die verschiedenen sich dort befindlichen Eisenbahnen, sowie über die ferneren Möglichkeiten für die Einführung neuer Linien.

Wissenschaft. — Baukunst. — Erfindungen.

"Versuche von elektrischen Apparaten für den Eisenbahndienst". [*Seite* 238]
Beschreibung einer neulich in Schenectady durch die "General Electric Company" gebauten Versuchsbahn, 2 Kilometer lang, woselbst Proben von elektrischen Apparaten stattfinden werden. Die neulichen Proben wurden mit einem 500 P. S. Motorwagen für leichten Eisenbahnbetrieb unternommen.

"Wagen einer Deutschen Lokalbahn". . . . . [*Seite* 239.]
Beschreibung nebst Pläne eines Modellwagens der oberschlesischen Dampf-Strassenbahn-Gesellschaft, mit elektrischen Motoren und Luftdruckbremsen ausgerüstet.

"Bedeutende Kohlen- und Aschen-Anlage". . . . [*Seite* 240.]
Beschreibung einer vor kurzer Zeit in den Werkstätten einer grossen Gasbeleuchtungs-Gesellschaft in New York eingeführten Kohlen- und Aschen-Anstalt. Der Uebertrager ist 446 Meter lang und besteht aus stahlblechernen Eimern, welche zwischen zwei Ketten laufen.

"Bedeutende Maschinenfabrik in der Nähe von New York". [*Seite* 240].
Kurze Beschreibung der Werkstätten der Ball & Wood Company in Elizabeth, N. J.

"Eine neue Schienenverbindung". . . . [*Seite* 241.]
Beschreibung einer neuen Gattung von Stossverbindung, welche unter die Stoss-Schienen eingebracht werden kann.

"Ein elektrischer Zuflusswasser-Reiniger". . . . [*Seite* 241.]
Beschreibung mit Abbildungen eines elektrischen Verfahrens, um unreines Wasser für Kesselgebrauch nutzbar zu machen. Das Zuflusswasser wird der elektrischen Wirkung ausgesetzt, indem es durch einen in den Zuflussröhren eingesetzten Cylinder geführt wird. Die Unreinlichkeiten werden dadurch in solcher Weise beeinflusst, dass sie sich nicht schuppenartig gestalten, nachdem sie mit dem Zuflusswasser in den Kessel geführt sind.

"Rolldraht-Vorrichtungen". . . . . [*Seite* 241.]
Beschreibung neuer Mustern in Rolldraht-Vorrichtungen der General Electric Company.

"Neue Klampe für Drahtisolatoren". . . . . [*Seite* 242.]

Beschreibung einer neuen Klampe, vermittelst welcher der Draht in solcher Weise befestigt ist, dass das Gewicht des Drahtes dahin gerichtet ist, die Scheeren fester zusammenzudrücken. Die Klampe ist so eingerichtet, dass das Ein- und Aushängen des Drahtes leicht geschieht.

"Kreuzungen für Eisenstangen". . . . . [*Seite* 242.]

"Drahthänger mit Koppe". . . . . [*Seite* 242.]

"Metall-Kaltsägemaschinen". . . . . [*Seite* 243.]

"Ein ununterbrochenes Herzstück". . . . . [*Seite* 243.]

Beschreibung eines Herzstückes, welches aus zu dem gewünschten Winkel gebogenen und zusammengenieteten Schienen besteht.

"Neues elektrisches Signalsystem". . . . . [*Seite* 244.]

Beschreibung eines "Block"-Systems für eingleisige elektrische Bahnen. Die "Block"-Signale werden automatisch betrieben.

"Neues Wagenuntergestell". . . . . [*Seite* 244.]

"Verbesserter Doppelwagen, Californischer Stil". . . . [*Seite* 245.]

Beschreibung eines Wagens mit geschlossener und offener Abtheilung, für milde Klimaten geeignet.

"Neue Doppelcylinder-Hobelmaschine". . . . . [*Seite* 245.]

"Versetzbare elektrische Lampen". . . . . [*Seite* 246.]

Die Lampe ist auf einem Stengel befestigt und kann von einem Ende des Wagens zum andern versetzt werden. Indem die Lampe in dem Sockel befestigt wird, ist sie automatisch mit dem Wagenstrom in Verbindung gesetzt.

"G. E. Motor für starken Eisenbahnbetrieb". . . . [*Seite* 247.]

Beschreibung eines neuen Motors von 80 P. S., welcher vor kurzem durch die "General Electric Company" eingeführt wurde.

"St. Louis Corliss Dampfmaschine für schweren Betrieb". [*Seite* 247.]

"Neuerungen in den Walker-Apparaten für elektrische Strassenbahnen. [*Seite* 248.]

Beschreibung eines neuen elektrischen Motors von 30 P. S., eines neuen Stromabnehmers und neuen Kontrolleurs, welche durch die Walker Company letzthin eingeführt wurden.

"Medbery Isolations-Material". . . . . [*Seite* 249.]

"Stossverbindung der Schienen ohne Störung des Strassenpflasters." [*Seite* 250.]

Beschreibung einer neuen Verbindung fur gelegte Schienen, ohne dass man das Pflaster zu berühren braucht.

"Cattori" System für elektrischen Strassenbahnbetrieb". . [*Seite* 250.]

Beschreibung eines neuen Systems, welches in der Umgegend von Rom eingeführt wurde.

"Luftdruckmotoren". . . . . [*Seite* 251.]

Bericht eines Ingenieurs über einen Wagen mit Luftdruckbetrieb in New York.

Mittheilungen über Strassenbahnen.

"Jährliche Versammlung des Strassenbahnen-Vereins in Texas". [*Seite* 252.]

Erörtert wurde die Frage des Bahnbetriebs.

"Convention der Strassenbahnen-Rechenmeister in Cleveland". [*Seite* 253.]

Abzug der Behandlungen während der ersten jährlichen Convention, welche am 23.—24. März in Cleveland stattfand.

"Papierisolirte Drahtseile für unterirdische Leitung". . . [*Seite* 256.]

Erläuterung der relativen Vor- und Nachtheile einer Papier- oder Gutta-Percha-Isolirung für unterirdische elektrische Leitungen.

Table des Matières—Avril 1897.

Construction des Tramways électriques en Europe . . . (Page 189.)

Série d'articles basés sur des renseignements reçus directement des directions de tramways électriques à Aix-la-Chapelle, Versailles, Zurich, Hanovre, Coventry, Bruxelles, Liège, Birmingham, Bâle, Hagen, Hambourg et Lyon, décrivant les détails caractéristiques de ces lignes au point de vue de la construction des voies, de l'arrangement des conducteurs aériens, des stations centrales et de l'installation des voitures, ainsi qu'un exposé des résultats financiers qui ont suivi l'introduction du système électrique.

Service.

Les Résultats financiers de la Traction électrique et à câble aux Etats-Unis. (Page 209.)

Cet article inaugure une série d'études dans lesquelles sera présenté, au moyen de nombreux tracés, l'historique financier d'un grand nombre de compagnies de tramways en Amérique depuis les douze dernières années, au point de vue de la traction animale et de la traction électrique. Ce premier article est consacré à la discussion des changements matériels survenus dans les systèmes de tramways de New York, Massachusetts et Pensylvanie.

Les Roues américaines comparées aux Roues européennes, par P. H. Griffin. (Page 215.)

La roue en usage sur les tramways électriques traverse en Europe une période d'évolution semblable à celle qui eut lieu aux Etats-Unis lors de l'introduction du système électrique. Toutefois, sous certains rapports, la situation est différente, la plupart des ingénieurs européens sont naturellement en faveur des roues en acier, qui sont généralement en usage sur les lignes à vapeur. Aux Etats-Unis, sur environ 200,000 roues en usage sur les tramways électriques, il ne s'en trouve qu'un pour cent construites en acier. Divers ingénieurs européens s'imaginent que ce fait est dû à ce que les roues en fer de fonte reviennent meilleur marché, tandis que cela est loin d'être le fait. L'article discute les avantages et défauts relatifs de chaque système au point de vue de son emploi sur les tramways électriques, surtout en ce qui concerne l'usure du bourrelet, qui constitue un facteur fort important dans ladurée d'une roue sur les lignes où l'on se sert de rails à gorge étroite.

Mémoires lus à la Convention des Comptables de Tramways . (*Page* 217.)

Lettres et Communications Diverses.

Les Voitures à Double Truck, par C. K. Durbin, chef du Matériel et de la Traction de la "Denver Consolidated Tramway Company" (Page 223.)

Description d'un type de voiture dont l'essai a été fait à Denver avec des résultats très satisfaisants. La voiture est divisée en deux sections: un compartiment fermé, de 14 pieds de long, et un compartiment ouvert, d'égale longueur, avec des plates-formes de 4 pieds à chaque bout. Le compartiment ouvert peut être abrité en cas d'orage à l'aide de rideaux et de fenêtres. La section fermée se trouve en avant de la voiture.

L'Usure et l'Entretien des Roues, par L. J. Cox, Président de la Terre Haute Car & Manufacturing Company . . . . . (Page 223.)

Cette lettre appelle l'attention sur la nécessité d'employer des roues de dimensions absolument pareilles pour le même essieu, et de s'assurer qu'elles correspondent exactement à l'écartement de la voie.

La Consommation de Courant par les Chauffeurs électriques, par R. M. Douglas, directeur général de la Schuylkill Valley Traction Company, Norristown, Pensylvanie . . . . . (Page 224.)

Il a été fait trois épreuves afin de déterminer la quantité de courant électrique employée pour chauffer les voitures à l'électricité; étant donné les conditions dans lesquelles les essais ont eu lieu, il a fallu environ cinq chevaux vapeur ou de cinq à six ampères.

De la Construction de Voie sans Traverses, par F. A. Little, ingénieur du Détroit Railway, Détroit Michigan . . . . . (Page 224.)

Rapport sur les résultats obtenus avec des voies construites à Détroit, sur béton, sans traverses, dans des rues pavées en pierre ou à l'asphalte. Ce mode de construction est recommandé dans ce genre de rues.

Coût des Stations centrales à Brooklyn . . . . . (Page 224.)

Cet article est accompagné d'un tableau représentant le coût par kilowatt-heure, pendant l'exercice 1896, des trois différentes stations centrales de la Brooklyn Heights Railway Company, à Brooklyn, qui emploie en service constant de 900 à 1,100 voitures. L'une des stations possède quatre générateurs directement accouplés de 1,500 kilowatts, la seconde 12 générateurs avec accouplement à courroie de 500 kilowatts, et la troisième six générateurs à courroie de 300 kilowatts. Les deux premières actionnent des machines à condensateurs, la troisième des machines sans condensateurs. Le coût total varie entre $0.005289 et $0,009588 par kilowatt-heure.

Contrôle des départs . . . . . (Page 225.)

Description d'un moyen pratique pour contrôler les départs de tramways, tel qu'il est en usage à Brooklyn.

La Nouvelle-Orléans pendant le Carnaval . . . . . (Page 225.)

Courte description de l'animation présentée par la ville pendant le Mardi-Gras.

Jurisprudence . . . . . (Page 226.)

Articles de Fond.

Organisation des Comptables de Tramways américains. . (Page 228.)

Quelques Remarques au sujet du régime des Employés . . (Page 228.)

Tramways électriques en Europe . . . . . (Page 229.)

Résumé critique du mode de construction et des résultats financiers exposés dans un autre article.

Construction.

Le Chemin de Fer "Lorain & Cleveland". . . . . (Page 231.)

Sur cette ligne de banlieue, en cours de construction, les voitures marcheront avec une vitesse moyenne de quarante kilomètres à l'heure. L'article s'occupe principalement de la station motrice. Elle avait à remplir les conditions suivantes: 1° eu égard à la vitesse élevée des voitures et au nombre restreint des départs, les fluctuations de la charge sont très prononcées, se trouvant par moment de cent pour cent au-delà de la capacité indiquée des générateurs; 2° il y a lieu de tenir compte des probabilités d'une augmentation prochaine de la station; 3° d'une augmentation ultérieure dans un avenir peu éloigné.

Des machines compound à condensation, directement accouplées aux générateurs, sont employées avec tubulure indépendante, de manière à pouvoir faire marcher soit chaque machine, soit chaque cylindre à volonté. L'appareil de réserve est également installé de façon à ce qu'un accident quelconque survenant à l'une des sections ne puisse interrompre le service.

Construction de Tramways électriques: Modifications requises pour l'Angleterre, par Alex. Mac Callum . . . . . (Page 235.)

Une revue des modifications à apporter au système américain de tramways électriques afin de l'adapter aux demandes formulées par le "Board of Trade anglais" et de concilier les exigences de l'opinion publique. D'après ce qui a été fait jusqu'ici dans cette voie, il est probable que les appareils américains seront largement employés. Il ne sera exigé aucune modification dans les machines à vapeur, chaudières ou dynamos. Toutefois, le cahier des charges du "Board of Trade" insistera sur une jointure de rails plus forte, sur certains changements dans la construction aérienne et probablement une construction de voie plus solide sera de rigueur. On croit que les profits seront à peu près les mêmes qu'en Amérique.

Wagon de transport pour la construction de voies . . . (Page 236.)

Description d'un wagon électrique pour le transport de rails d'un point à un autre ; ces wagons sont construits de manière à soutenir une charge de 40 tonnes.

Chemins de Fer et Tramways en Grèce, par W. D. Sourmely. . (Page 237.)

Description de la situation des chemins de fer en Grèce et de leur avenir.

Science — Genie — Inventions.

Essais d'appareils pour chemins de fer à Schenectady . . (Page 238.)

Description d'une voie de deux kilomètres de long qui a récemment été installée dans les usines de la General Electric Company, à Schenectady, dans le but d'établir des essais d'appareils électriques pour chemins de fer. Les essais les plus récents ont eu lieu avec des voitures motrices de 500 chevaux pour un service restreint.

Voiture-Modèle d'une Compagnie de Tramways en Allemagne. (Page 239.)

Description, accompagnée de plans, d'une voiture-modèle de la compagnie des Tramways à vapeur de la Haute Silésie, avec moteurs électriques et freins à air comprimé.

Installation d'un grand chantier de charbon et de cendres . (Page 240.)

Description d'un chantier de charbon et de cendres récemment installé dans les usines à gaz d'une grande compagnie d'éclairage de New York. Le transporteur mesure 446 mètres de longueur et consiste en une série de godets en tôle d'acier maintenus entre deux chaînes.

Fabrique importante de Machines dans les environs de New York. (Page 240.)

Courte description des ateliers de construction de la Ball et Wood Company à Elizabeth, N. J.

Nouvelle Eclisse de Rails . . . . . (Page 241.)

Description d'une nouvelle méthode d'assemblage de rails.

Purification électrique des Eaux d'Alimentation . . . . (Page 241.)

Description d'un procédé électrique avec illustrations, à l'effet de purifier les eaux d'alimentation de chaudières. L'eau impure est soumise à l'action électrique en passant à travers un cylindre inséré dans la conduite d'alimentation. Cette action exerce une telle influence sur les impuretés qu'à l'entrée de l'eau dans les chaudières, elles ne peuvent s'agglomérer et se former en croûtes.

Fournitures pour fils de trôlet. . . . . . (Page 241.)

Nouveautés en fournitures pour fils de trôlet récemment perfectionnées par la General Electric Company.

Crochet pour Isolateur de Fil de Fer . . . . . (Page 242.)

L'isolateur est pourvu d'un nouveau crochet au moyen duquel le fil de fer est tenu de telle manière que le poids du fil de fer tend à rapprocher les pinces. Il est facile d'attacher ou de détacher le fil de fer du crochet.

Procédé pour Peinture à l'extérieur . . . . . (Page 243.)

Connexion de Rails continue . . . . . (Page 243.)

Cette connexion de rails est formée de rails courbés à l'angle voulu, et assujettis à l'aide de boulons.

Machine à scier les Métaux à Froid . . . . . (Page 243.)

Nouveau procédé pour couper les traverses, caniveaux, rails, etc. Les scies et l'appareil de transmission peuvent être ajustés de toutes les manières possibles. La machine est munie d'un électro-moteur.

Un nouveau système de signal électrique. . . . . . (Page 244.)

Description d'un système à "block" pour voie simple. Les signaux à "block" fonctionnent automatiquement.

Nouveau Truck pour Tramways . . . . . (Page 244.)

Voiture double perfectionnée. . . . . . (Page 245.)

Description d'une voiture à compartiments ouverts et fermés, adaptée aux climats tempérés.

Nouvelle Machine à Raboter à double cylindre . . . . (Page 245.)

Description d'une machine à raboter les deux côtés d'une planche, et employée pour la fabrication de volets, de portes, et autres parties d'une voiture.

Lampes électriques à déplacement . . . . . (Page 246.)

Description d'une lampe montée sur un portant et que l'on peut déplacer d'une extrémité de la voiture à l'autre. En posant la lampe dans son socle on établit automatiquement la connexion entre la lampe et le circuit de la voiture.

Moteurs de Chemins de fer G. E. adaptés au service de traction à grande charge . . . . . (Page 247.)

Description d'un nouveau moteur de 80 chevaux, récemment introduit par la General Electric Company.

Machine à vapeur Corliss, de Saint-Louis, pour grands transports. (Page 247.)

Nouveaux Appareils "Walker" pour Tramways électriques . (Page 248.)

Description d'un nouveau moteur électrique de 30 chevaux, d'un nouveau trôlet et d'un nouveau contrôleur récemment introduits par la Walker Company.

Matériel d'Isolation Medbery . . . . . (Page 249.)

Accouplement de rails sans dérangement du pavage . . . (*Page* 250.)

Description d'un nouvel accouplement facile à établir aux rails posés, sans qu'il y ait lieu de toucher au pavage.

Le système "Cattori" de Distribution par séries pour Tramways électriques. (*Page* 250.)

Description d'un nouveau système employé dans les environs de Rome, Italie.

Moteur à air comprimé . . . . . (*Page* 251.)

Rapport soumis par l'ingénieur d'un systeme à air comprimé, sur le fonctionnement de deux voitures automobiles à air comprimé à New York.

Faits Divers.

Convention annuelle de l'Association des Tramways du Texas . (*Page* 252.)

Sujet principal des débats : L'administration des lignes.

Convention des Comptables de Tramways à Cleveland . . (Page 253.)

Extrait du procès-verbal de la première convention annuelle tenue à Cleveland les 23 et 24 mars.

Câbles pour Conducteurs souterrains recouverts de papier . (Page 256.)

Les avantages et défauts relatifs de l'emploi du papier et de la guttapercha comme matières isolatrices pour feeders électriques souterrains sont décrits dans cet article.

Lista de Materias—Abril 1897.

Operación de los tranvias eléctricos ee Europa. . . . . [Pág. 189.]

Eso es el primero artículo de una serie de estudios, fundadas sobre comunicaciones recibidas directamente de las compañías de tranvías de Aix-la-Chapelle, Versalles, Zurico, Hanover, Coventry, Brusélas, Lieje, Birmingham, Basilea, Hagen, Hamburgo y Leon ; descripción de la construcción de vías, de instalación de conductores aéreos, estación de fuerza motriz, y construcción de carruajes, como tambien los resultados financieros de la introducción del sistema eléctrico.

Operación.

Resultados financieros de la tracción eléctrica y á cable en los Estados Unidos. . . . . . [Pág. 209.]

Eso es el primero de una serie de artículos con numerosos diagramas, que representan la historia financiera de varias líneas de tranvías en América durante los doce años pasados incluyendo la tracción animal y la tracción eléctrica. Eso primero artículo está consagrado á una discusión de los resultados financieros que siguieran la introducción de la trocción eléctrica.

Una Comparación del uso de Ruedas en América y en Europa, por P. H. Griffin. . . . . [Pág. 215.]

Ruedas de hierro fundido y ruedas con fajas cilíndricas de acero son empleadas en el extranjero en proporciones casi semejantes, mientras que en América, sobre un total de más de 200,000 ruedas empleadas en el servicio de tranvías eléctricos, apenas uno por ciento son de acero. Unos ingenieros del extranjero creen que esta preferencia en América por ruedas de hierro fundido es debida á su baratura, pero no es el caso. Las ventajas y desventajas relativas de cada una son discurridas, especialmente respecto de la destrucción del hilo, que constituye un factor importante en la duración de una rueda obrada con rieles estrechos.

Comunicaciones leidas á la Convencion de Contadores de Tranvias. (*Pág.* 217.)

Varias Comunicaciones.

Carretones dobles para tranvías, por C. K. Durbin, Superintendente de la Denver Consolidated Tramway Company, Denver, Col. [Pág. 223.]

Descripción de un tipo de carruaje que ha obtenido un excelente resultado en Denver. Está compuesto de dos compartimientos, el uno cerrado de 14 piés de longitud, el otro abierto del mismo tamaño, y de plataformas de 4 piés á cada extremidad. El compartimiento cerrado va adelante.

Uso y conservación de Ruedas, por J. L. Cox, Presidente de la Terre-Haute Car & Manufacturing Company. . . . . [Pág. 223.]

Llama la atención sobre la necesidad de aparear con cuidado las ruedas destinadas al mismo eje, y de asegurar una distancia de ruedas semejante al ancho de la vía.

Construcción de vías sin travesaños, por F. A. Little, Ingeniero del Detroit Railway, Mich. . . . . [Pág. 224.]

Descripción de los resultados obtenidos á Detroit con una vía colocada en calles empedradas con ladrillos ó asfalto, sin emplear travesaños. Esta construcción está recomendada por su economía.

Consumo de corriente por calefacción eléctrica, por R. M. Douglass, Director General de la Schuylkill Valley Company, Norristown, Pa. [Pág. 224.]

Tres ensayos fueron hechos para fijar la cantidad de corriente usada para calentar carruajes de tranvías por medio de electricidad. Los ensayos prueban que cerca de cinco caballos, ó entre seis y siete amperes fueron consumidos.

Costos de la operación de Estaciones de Fuerza Motriz en Brooklyn. [Pág. 224.]

Se describen en este artículo, incluyendo un gráfico, los costos por kilowatt-hora, durante el año de 1896, de la operación de las tres estaciones de fuerza motriz de la "Brooklyn Heights Railway Company." Esta compañía emplea entre 900 y 1,100 carruajes. En la primera estación funcionan cuatro generadores juntos directamente, de 1,500 kilowatts cada uno; en la segunda doce generadores con transmisión, de 500 kilowatts, y en la tercera seis generadores con transmisión de 300 kilowatts. En las dos primeras funcionan máquinas de condensación, en la última máquinas sin condensación. El costo total varía entre $.005289 y $.009588 por kilowatt-hora.

Contraregistro para tranvías. . . . . . [Pág. 225.]

Descripción de un método conveniente empleado en Brooklyn para registrar las partidas de los tranvías.

Concurrencia en Nueva Orleans durante el Carnaval. . [Pág. 225.]

Breve descripción de las escenas en las calles de Nueva Orleans durante los dos días del "Mardi-Gras" Carnaval.

Jurisprudencia. . . . . . (Pág. 226.)

Artículos de la Redacción.

Organisación de contadores de tranvías en América. . . [Pág. 228.]

Observaciones en respecto de la dirección de los empleados. . [Pág. 228.]

Ferro-carriles eléctricos en Europa. . . . . . [Pág. 229.]

Resumén crítico de la ingeniería y de los resultados financieros presentados en un otro artículo.

Construcción.

Ferrocarril Lorain & Cleveland. . . . . . [Pág. 231.]

Eso es una línea de tranvías, en curso de construcción, sobre la cual los carruajes serán movidos á una velocidad de 48 kilómetros por hora. El artículo trata principalmente con la estación de fuerza motriz, que fué necesario de instalar en las condiciones siguientes: 1.°, en consecuencia de la gran velocidad de los carruajes y de la infrecuencia de los trenes, las fluctuaciones de la carga son considerables, algunas veces 100% en exceso de la capacidad tasada de los generadores; 2.°, se debía hacer provisión para un aumento próximo en la capacidad de la estación; y 3.°, un aumento ulterior en tiempo más distante.

Máquinas compound de condensación son empleadas con generadores juntados directamente. La tubería está dispuesta de manera que se pueden ser operadas, sea los cilindros, sea las máquinas independientemente. El aparato auxiliar está también dispuesto de tal manera que en caso de avería á cualquiera parte, la operación del servicio no se lo impida.

Ingeniería de Tranvías Eléctricos. — Modificaciones necesitadas por condiciones Ingleses, por Alex. McCallum. . . . . [Pág. 235.]

Una consideración de las modificaciones del sistema americano de construcción de tranvías eléctricos necesitadas para cumplir con los requisitos del "Board of Trade" de Inglaterra y conciliar la opinión pública. Muy probablemente se hará un uso considerable de aparatos americanos. No serán requeridas modificaciones en las máquinas, calderas ó dinamos; pero los reglamentos del "Board of Trade" inglés exigirán una construcción de rieles más fuerte, ciertos cambios en la estructura aérea, y probablemente una construcción de vías más compacta. Se cree que las ganancias serán las mismas que en América.

Carretón de rieles para construcción de vías. . . . . [Pág. 236.]

Descripción de un carretón eléctrico para trasladar rieles de un punto á otro; posee una capacidad de carga de cuarenta toneladas.

Tranvías y Ferrocarriles en Grecia, por N. D. Sourmely. . [Pág. 237.]

Descripción de la condición de ferrocarriles en Grecia y sus posibilidades, con breve referencia á cada una de las líneas principales en el país.

Ciencia. — Ingeniería. — Invenciones.

Prueba de aparatos eléctricos en Schenectady. . . . [Pág. 238.]

Descripción de una vía de 2 kilómetros construída recientemente por la "General Electric Company" á sus obrados, para probar aparatos eléctricos. Unos experimentos fueron hechos poco ha con un carruaje motor de 500 caballos para servicio ligero.

Carruaje de una compania de tranvias en Alemania. . [Pág. 239.]

Descripción, con planos, de un carruaje de la "Oberchslesische Dampfstrassenbahn Gesellschafe," con motores eléctricos y freno á aire comprimido.

Grande carbonería y cenizal. . . . . . [Pág. 240.]

Descripción de una carbonería recientemente instalada en los obradores de una grande compañía de iluminación por gas en Nueva York. El trasportador mide 349 metros y consta de pozales de acero en serie, movidos entre dos cadenas. Toda la acción es automática.

Talleres de Máquinas Importantes cercano á Nueva York. [Pág. 240.]

Breve descripción de los Talleres de la Ball & Wood Company, en Elizabeth, N. J. Mucho cuidado está consagrado á la fabricación y probadura de las máquinas. La probadura está hecha por medio de un concepto eléctrico muy ingenioso, y tan sensitivo que las variaciones más menudas en la velocidad pueden ser establecidas.

Nueva coyuntura de rieles. . . . . . [Pág. 241.]

Descripción de un nuevo tipo de coyuntura de rieles que se puede aplicar debajo de las eclisas.

Purificador eléctrico de agua de alimentación. . . . [Pág. 241.]

Descripción de un método eléctrico para purificar agua sucia y rendirla conveniente para uso en calderas. El agua está sometida á la acción eléctrica mientras que pasa á través un cilindro ingerido en el caño de alimentación. Esta acción tanto afecta las impuridades del agua, que no pueden formarse en cortezas en la caldera.

Aplicaciones de alambres de trolley. . . . . . [Pág. 241.]

Nuevos diseños en aplicaciones de alambres de trolley, recientemente perfeccionadas por la "General Electric Company."

Lazo para aislador de conductores aéreos. . . . . [Pág. 242.]

Descripción de un aislador provisto con un lazo, por medio del cual el alambre está mantenido de manera que su peso contribuye á estrechar el lazo más firmemente. La adherencia ó remoción del alambre se hace fácilmente.

Cruceros para pértigas de hierro. . . . . . [Pág. 242.]

Nuevo tipo de suspensor. . . . . . [Pág. 242.]

Color para el exterior. . . . . . [Pág. 243.]

Examinación de la valor de grafito y aceite de linaza para proteger obras de estructura, tejados, etc.

Máquina para serrar piezas de metal á frío. . . . [Pág. 243.]

Eso es una máquina para cortar vigas, cañerías, rieles, etc. Las sierras y transmisiones pueden ser ajustadas en varios modos. La máquina está provista con un motor.

Riel de crucero continuo. . . . . . [Pág. 243.]

Descripción de un crucero hecho de rieles encorvados á el ángulo requisito y juntados por medio de cerrojos.

Nuevo Sistema de señalado eléctrico. . . . . . [Pág. 244.]

Descripción de un sistema á "block" para ferrocarriles eléctricos de vía simple. Los señalados á "block" son operados automáticamente.

Nuevo carretón para tranvías. . . . . . [Pág. 244.]

Descripción de un nuevo "truck" á cuatro ruedas, con resortes inusitadamente largos, y un método simple para ajustar los extremos resortes á fin de acomodar varias cargas de carruajes, con extremidades de pesos diferentes.

Carruaje doble perfeccionado. Estilo de California. . . [Pág. 245.]

Descripción de un carruaje de tranvías con compartimientos cerrado y abierto, conveniente para climas temperados.

Nuevo acepillador á doble cilindro. . . . . . [Pág. 245.]

Lámparas Eléctricas trasportables. . . . . . [Pág. 246.]

La lámpara está fijada sobre una asa y puede trasladarse de una extremidad del carruaje á la otra. Cuando la lámpara está fijada en el cañón, se establece automáticamente la conexión entre ella y la corriente del carruaje.

Motores G. E.-S para servicio pesado de Ferrocarriles. . [Pág. 247.]

Descripción de un nuevo motor de 80 caballos, recientemente instalado por la "General Electric Company."

Máquina Corlis, de Saint Luis, para tráfico de ferro-carril. . [Pág. 247.]

Nuevos aparatos "Walker" para tranvias eléctricos. . . [Pág. 248.]

Descripción de un nuevo motor eléctrico de 30 caballos, de un nuevo "trolley" y de un nuevo controlador recientemente introducidos por la compañía Walker.

Materiae de aislador "Medbery. . . . . . [Pág. 249.]

Rieles juntados sin pertuabar el pavimento. . . . . [Pág. 250.]

Descripción de una ligadura de rieles que puede ser ingerida sin remover el pavimento.

El sistema "Cattori" para distribución en series sobre los tranvias eléctricos. . . . . . [Pág. 250.]

Sistema empleado cerca de Roma.

Motores á aire comprimido. . . . . . [Pág. 251.]

Relación del Ingeniero de una compañía de motores á aire comprimido, en relación de dos carruajes automotrices á aire comprimido, en Nueva York.

Novedades.

Convención anuál de la Asociación de tranvias de Tejás. . [Pág. 252.]

Sujeto principal de los debates fué la administración de las líneas.

Convención de contadores de tranvias en Cleveland. . . [Pág. 253.]

Resumén de los debates en la primera convención anual tenida el 23 y 24 de Marzo.

Cables con envolvente de papel para conductores subterráneos. [Pág. 256.]

Las ventajas y desventajas relativas del papel y del caucho como aisladores para conductores subterráneos eléctricos son discurridas.

Street Railway Journal.

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THE SYSTEM OF THE CANAL & CLAIBORNE RAILROAD COMPANY.

Although among the first cities in the United States to adopt electric traction for street railway service, it was not until October, 1896, that New Orleans witnessed the completion of its last street railway and the passing of its bob tail car to the records of history and the playgrounds of its youngsters.

The system of the Canal & Claiborne Railroad Company, which has furnished the perfecting link to a complete service of electric traction throughout the city, stands out in its various details in striking comparison to the methods adopted in early street railway service as exemplified on some of the first roads equipped in New Orleans. That this city should have been prominent among the first to improve its street car service by electric traction is quite evident when it is considered that unlike many other cities, of far less population, it has practically no suburbs. It covers, however, a considerably greater area than is usually found for the same population, and at the same time is in all details a self-contained city with sharply defined natural boundary limits. By reason of this its people have been quick to realize the importance of rapid transit for business purposes, and for pleasure especially, electric traction over its beautiful avenues of neutral ground, as affording a fitting substitute to the much praised suburban drives of many other cities.

FIG. 1.—VIEWS ON CLAIBORNE AVENUE, SHOWING ACTUAL OPERATION BY ANIMAL AND ELECTRIC TRACTION, WITH POWER HOUSE.

Although the lines of the Canal & Claiborne Railroad Company are now and were originally geographically located to serve a regular and natural business traffic, which before reconstruction was held with remarkable tenacity, even when surrounded on all sides by electric traction, it was not until other roads deprived it of its natural pleasure travel that the management realized as a financial proposition it was necessary to take steps to reorganize and reconstruct the property on modern lines. That they were wise in awaiting the complete demonstration of the economies and efficiencies to be gained by electric traction and the development of economical machinery and methods is now apparent from their newly constructed system.

The present company was incorporated under the laws of the state of Louisiana, June 26, 1888, for a period of ninety-nine years. At this time it purchased the property rights and franchises of the old Canal & Claiborne Street Railroad Company, which franchises included about 16 miles of track located upon the principal business streets and resident streets through the French quarter. From that time until July, 1895, it continued to operate its lines with the mule and horse traction so familiar during that period. In July, 1895, the present management came into active direction of the policies to be pursued, due to controlling stock purchases by new capital. With this change the necessary steps were at once taken to secure additional franchises from the city, not only extending the length of the company's lines from 16 to 58 miles, but also the life of its franchises from twenty-five to sixty-five years. In selecting the extensions desirable to the original lines, most careful consideration was given to the many local elements affecting the city's growth and its probable future development in different directions.

The company was especially fortunate in having as its financial adviser one of New Orleans' most noted financiers and in having its policies directed by men whose

whole life has been spent in New Orleans, and therefore, intimately connected with its growth and needs. Guided by their judgment, the new system was laid out so as to most effectually serve not only the present, but the future requirements of street railway travel.

For economical power distribution the location of the several lines is geographically correct, as they start from the very heart of the business center of the city and diverge to its extreme limits in several different directions. They are also well arranged for traffic as they touch upon the river front at Canal Street, the business center, at Carrollton, the extreme limit of the residence portion of the city, and at the U. S. Barracks and boundary of the city, nearest to Port Chalmette; both of these latter points being located upon the Mississippi River. Besides this, from the pleasure travel standpoint, the franchise includes such points as City Park, whose magnificent live oaks still stand in memory of the many duels fought under their shadows, the Metairie, St. Louis and several other smaller cemeteries, notable among which is the Shrine of St. Rochs Campo Santo Cemetery where daily many worshipers pilgrimage.

FIG. 2.—NEUTRAL GROUND CONSTRUCTION.

the Tulane Avenue Athletic and Amusement Park, with its fast cement bicycle track, ball park and the handsome new double track water Chute, the Oakland Driving Park and the well known Fair Grounds and Race Track.

It should also be observed that the daily ingress and egress of steam railroad travel is amply provided with facilities by the lines of this company, it having direct connection with most all of the steam railroads entering the city and having also in the case of the Louisville & Nashville Railroad and the New Orleans & Northeastern Railroad special depots for connection to the center of the city. Another valuable steam railroad connection made by this company is that with the Shellbeach Railroad to Port Chalmette. To this point daily, throughout the cotton season, hundreds of workmen are transported. This travel is of especial value since it gives to the "down" cars in the morning, when the travel is naturally in the other direction, full loads; while in the evening it is mostly handled by "up" cars running to relieve the congestion of travel away from the center of the city.

Peculiar, almost to New Orleans, is what is termed its neutral ground for the accommodation of the street railways, and while these diverge through the city in numerous directions to serve individual companies, it is not until Canal Street is reached that all the street railway companies are obliged to operate over the same neutral

FIG. 3.—PAVED STREET TRACK CONSTRUCTION.

ground. Canal Street is the center of all the systems which, with hardly an exception, enter upon and run either part or all the way along it toward the Mississippi

FIG. 4.—CANAL STREET SIDE BRACKET, CENTRE SPAN, OVERHEAD LINE.

River; so that one's first impression upon entering the city through this thoroughfare is that it accommodates more

electric cars than are ever seen in the same length of street elsewhere. There are on Canal Street six tracks and the cars often average three or four to the block upon each track. When this is carefully considered and observed the additional and unusual value contained in the franchise of this company by which it owns and controls the outside tracks, with a private sidewalk the entire length of the business portion of the neutral ground for the accommodation of its travel, is fully realized.

The people of New Orleans, most probably due to their characteristic hospitable way, are quick to realize, appreciate and commend the endeavors, either of the individual or even the street railway manager, to fathom and meet their desires for transportation. At the very early stages of the present reconstruction, it was the aim of the company to reach in every possible way the desires of the public and even to go further than this and offer conveniences and accommodations unlooked for, realizing that this policy after all was the only one that would redound most beneficially to all concerned. It may be well said that not only from its first steps in the selection of the new franchise until the completion of the work of reconstruction, but also more especially now during actual operation the company measures every step by its judgment of the people's wishes.

FIG. 5.—CROSS SECTION PAVED STREET TRACK CONSTRUCTION ON TULANE AVENUE.

The two main lines of the Canal & Claiborne Railroad are known as the "Claiborne" and the "Tulane" Avenue. The Tulane Avenue, was always a profitable line, yet, under the old management, never reached that development which its natural location would warrant. This fine, broad avenue, containing a number of large institutions, had ceased to develop, probably from the fact that its transit was as slow as it was dirty. To correct this, it was necessary that there should be established on this, at that time a paved street, a neutral ground similar to that on other streets where high speeds with no dust are obtainable. With this end in view, in face of no little opposition at the start, the company finally established on a larger portion of the street a neutral ground provided with ample roadway on each side paved with asphalt. This accomplished, all obstacles to a thorough and complete system of rapid transit were removed and at the same time the property holders were relieved of no little expense for paving which, of course, upon the neutral ground occupying the center of the street, was dispensed with.

Again on Claiborne Avenue, probably the most beautiful of its kind to be found in any city, the company erected the only double track, steel bridge in the city to enable it to give quick and prompt service across the Old Basin Canal at Carondelet Walk.

The old methods of operation as regards downtown lines were found to be at variance with the wishes of the majority of the people and with the expeditious handling of travel. Alterations were here embodied in the new franchise and further neutral ground established with a number of minor alterations to serve in every way to the best interest of all concerned. The present aim of the company is to carry out in every detail by the arrangement of car schedules and co-operation with employes, the facilities contemplated before reconstruction.

TRACK CONSTRUCTION.

The subsoil of New Orleans, unless properly cared for, stands as a constant menace to satisfactory street railway operation. This is due to the fact that natural drainage in New Orleans is impossible, and that to obtain drainage at all, artificial methods must be employed. The combination of a subsoil without natural drainage and the imperfection of the present drainage methods is accountable for the wet and marshy roadbeds prevalent in New Orleans. In fact, even where the roadbeds have been raised considerably above the natural grade, the character of the soil in many places is such that it holds the water, due to its clay nature, and makes trouble unless it is properly ballasted. There is, however, a very considerable difference in the ability of the soil in different localities to maintain track, and operation over each portion of a roadbed is the only criterion of its character. In dry seasons the subsoil may be so hard that it is impossible to break it with a plow and difficult with even a pick. This same soil, however, after experiencing the very heavy rainstorms, characteristic of New Orleans, becomes sometimes so spongy that wagon traffic over it is impossible. Strata of quicksand are not unknown, and when combined with a marshy soil, render track work both difficult and expensive.

After experiencing the results of numerous methods of track construction for most effectually withstanding the peculiarities of the soil, it has been found, for the cost, that nothing seems to give better results than a layer of 1 in. cypress boards laid closely upon and completely covering the subgrade for the reception of the track ballast.

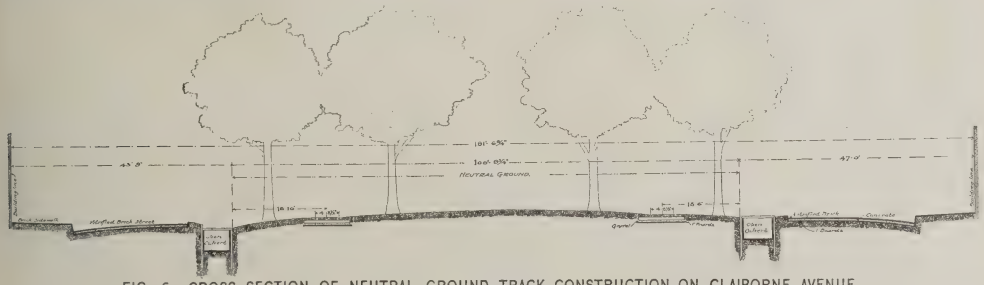


FIG. 6.—CROSS SECTION OF NEUTRAL GROUND TRACK CONSTRUCTION ON CLAIBORNE AVENUE.

In the preparation of the subgrade, it is brought to a smooth, even surface by the use of stakes, the trench or excavation being of sufficient width to allow of free access to all parts of the construction. Especial precaution is taken not to disturb the earth below this grade, except where it may be found necessary to remove decayed wood or where soft spots are encountered. In these cases the material is removed and the excavation filled with gravel, stone or broken brick thoroughly tamped in place and the top finished to conform to the established subgrade. In the preparation of the subgrade, it should be kept as free as possible from water. It is not at all unusual in New Orleans during construction to keep a line of pumps at work on drain pools cut in the subgrade to keep it free from water. In order to obtain good results from track it should be built on a dry subgrade.

Parallel with the rails on the subgrade are laid cypress planks, 1 in. in thickness, and from 6 ins. to 12 ins. in width, and about 12 ft. in length, with the ends cut square. For this work, what is known as pecky cypress is largely used, being less expensive and practically as satisfactory as all sound cypress. These planks are laid so that complete contact with the adjoining planks is maintained and joints carefully broken. They should extend on each side of the subgrade a few inches beyond the ends of the ties. Owing to the fact that the city drainage is on the surface through a series of canals tributary to which are numerous culverts and subculverts, it becomes necessary in track construction to thoroughly protect the subgrade from the water in the culverts, which is usually of a higher level. Wherever tracks cross culverts the sides or walls are cut out to receive the track rails, and since the city ordinances do not permit of any obstruction to drainage through culverts or the lessening to any degree of the full capacity of the culvert cross section it is necessary in construction in order to comply with this stipulation, in the case of 9 in. rail, where the track grade established would let the bottom of the rail about 5 ins. into the culvert cross section, to cut the rail, reinforcing it with angle iron plates and braces to secure the required strength. This adoption by city authorities has been rather an unfortunate one to the street railway companies, without attaining for the city, to any degree, the end desired, since the smallness of the culverts, almost without exception, causes them to overflow upon the occurrence of ordinarily heavy rains. The results of this ruling have made manifest to the street railway companies the weakness of rails cut in this manner, even though reinforced in the strongest way possible, breakage of rails over culverts, due to this cutting, being of frequent occurrence.

The ties used almost exclusively for construction are cypress, the size adopted by this company being 6 ins. × 9 ins. × 7 ft. 6 ins. All cypress ties used should be sound, free from shakes, splits or sap, and for best construction for bottom planking not more than one-quarter of the lumber furnished should be pecky timber. Pecky timber should be of full strength and free from other defects. In the work of reconstruction, lumber was found along the line of the company which had been underground for thirty years, still in perfect state of preservation although thoroughly water soaked.

The necessary depth for placing crushed stone or concreting gravel for electric traction, is about 4 ins. between the bottom of the tie and the top of the bottom planking, when tamped in position. The tie spacings adopted are 2 ft. 6 ins. between centers on tangents excepting at rail joints where the spacing is 20 ins. centers and 2 ft. on curves where they are placed in true radial lines.

In reconstruction of the trunk line on Canal Street, a number of special problems were encountered. In order to most effectually meet the future needs of the company it was decided to alter its original gage of 5 ft. 2½ ins. to 4 ft. 8½ ins. To perform this and at the same time operate, not only its own service, but that of the different companies using its trunk lines on Canal Street, with a 5 ft. 2½ in. gage and to supply the needs of a new company operated with a 4 ft. 8½ in. gage by electric traction with which it had contracted for the use of its trunk lines on Canal Street, was one of the unusual features to be dealt with in the reconstruction. To obtain a correct conception of the work to be performed it should be held in mind that for a distance of 1 mile the trunk lines of this company, occupy the two outside tracks of the neutral ground, including between them three and four tracks of the New Orleans Traction Company, which cross and recross the trunk line tracks at almost every street intersection.

The reconstruction of the latter without interference to the lines of the New Orleans Traction Company crossing them and the lines of the St. Charles Railroad Company, the Orleans Railroad Company and the New Orleans & Carrollton Railroad Company along them, besides the operation of its own service, were complications linked with this construction. In the first place it was necessary in order to accommodate the two gages to be operated on the trunk line to lay a two gage track and to furnish at the intersections two gage special track work. This construction was the first taken up by the Canal & Claiborne Railroad Company, detailed plans of all track and special track work being prepared, and methods adopted by its engineers the

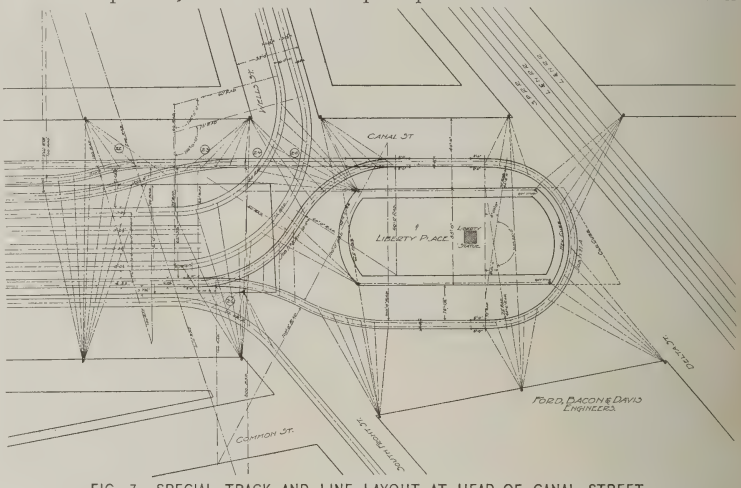


FIG. 7.—SPECIAL TRACK AND LINE LAYOUT AT HEAD OF CANAL STREET.

BALLAST.

Numerous kinds of track ballast have been tried for New Orleans, the best results being obtained from crushed stone, Rosetta gravel, and a mixture of cinders and earth. Of these three kinds of ballast, crushed stone is undoubtedly the best. Since the Canal & Claiborne lines are located largely on neutral ground, and since due to the fact that originally the space between the tracks was paved with cobbles, this company found in reconstruction that it had on hand a large amount of cobble stone which, according to franchise obligations, they were not compelled to replace between the tracks, neutral ground paving being dispensed with by electric traction. In order to obtain the best ballasted roadbed, all of its available cobble stone was crushed and placed under the tracks, filling with Rosetta gravel where possible. In some instances other forms of ballast were used for the remainder of the roadbed construction.

One important feature in connection with Rosetta gravel is that it contains deposits of iron ore compounds. This enables it to concrete after tamping and form a solid mass under the track. It should be composed of about 50 per cent of round pebbles not larger than ½ in. in diameter and 50 per cent of coarse sand and iron ore compound, which sand should not contain any fine particles that will produce dust. The gravel is of a dark reddish brown color and is found in valuable deposits in the northern part of the state.

intricacies of which are seldom equaled in street railway track construction. As this work would be subjected to the closest car schedules, since all the lines in New Orleans center along or cross the trunk lines, it was decided to use on all points of maximum wear of switches, mates and frogs, either manganese, harveyized or cast steel. The first was adopted for this Canal Street special work. In deciding upon the best section of rail for the entire neutral ground and paved street work, important among the considerations were the questions of abolition of compromise joints, of double rail construction for paving at street intersections, of rail cutting where crossing culverts and of securing a uniform rail which could be used throughout, with equal desirability for paved street and neutral ground construction. The company found on Canal Street a system crossing its own track of double T rail track and special track, changing to girder rail construction after diverging from the neutral ground. The owners of this construction naturally enough hoped to induce the Canal & Claiborne Company to use the same type and quality of material, thus obviating on existing lines undesirable joint connections. Since, however, it was impossible for the Canal & Claiborne Company to obtain the quality of the special work which it desired for this construction or to abolish the features of compromise joints on its own line, rail cutting or double rail construction at intersections, it wisely decided, even at the expense of some litigation to adopt that system of straight and special track which would effectually meet its own requirements.

For these reasons a 6 in. girder rail section, weighing 75 lbs. per yard was adopted for all straight and special track, with such variations of design and weight for curves and special work as the conditions to be met, dictated. Outside of Canal Street, where the frequent occurrence of special work rendered it hardly advisable, the company has used 60 ft. lengths of girder rail exclusively, with the standard six bolt joint plate all as manufactured by the Johnson Company, which company also furnished all of the special work except on Canal Street.

work for this construction was laid on frames of 10 in. × 10 in. yellow pine.

By referring to Figs. 5 and 6, the general type of construction as regards neutral ground and paved streets can

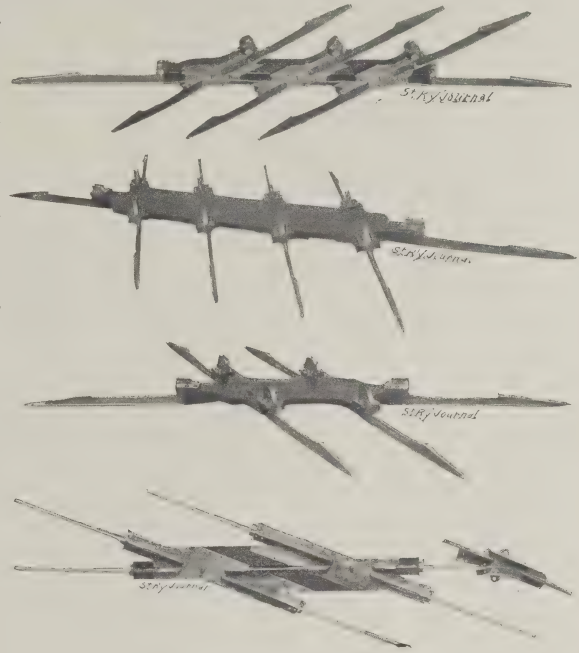


FIG. 8.—CANAL STREET TRUNK LINE SPECIAL CROSSINGS.

be readily observed. Where neutral ground is made use of, it is devoted exclusively to the use of electric railway cars, all vehicles being restricted from passing thereon, by law, ample facilities being offered on either side of the paved streets for wagon traffic. Fig. 2 shows the construction of neutral ground track on the Claiborne Street line, while Fig. 3 shows a like view during the progress of construction on a paved street, and Fig. 1 gives the correct idea of a stretch of finished neutral ground track. Fig. 7 shows a special track layout with some of the complications at the head of Canal Street.

FIG. 9.—FEEDER LINE CONSTRUCTION ON LEVEE, IN FRONT OF FRENCH MARKET.

The distinct advantages to be obtained from the operation of street railway systems in New Orleans upon neutral ground are entire freedom from dust and dirt to the patrons of the road, the maintenance of high speeds, which often reach as high as 25 miles an hour through thickly populated streets of the city, freedom from accidents and collisions as compared with paved street travel, freedom from pavement obligations, and the ease with which track repairs can be made. Greater efficiencies can also be obtained in the return circuit, due to the fact

In the work of the Canal Street trunk line reconstruction, to accommodate the lines of other roads, a great amount of temporary track was necessitated in the street off the neutral ground, and the laying of the permanent special work was performed largely at night. All special

that neutral ground track is always clean, compared to paved street track subjected to wagon traffic with the accompanying dust and dirt. Besides this, neutral ground, similar to that which is to be found on Claiborne Avenue with its four handsome rows of trees, attracts people to it in this climate by reason of its beautiful shade trees and cool spots,

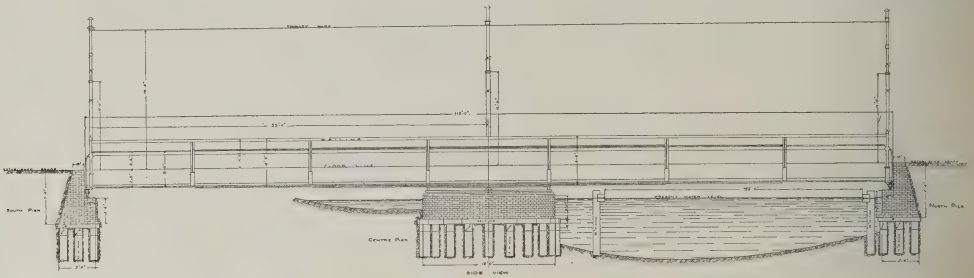


FIG. 10.—CLAIBORNE STREET FULL SWING, DOUBLE TRACK, PLATE GIRDER BRIDGE.

all of which means increased travel. Principal, however, in all these points of advantage for the neutral ground, is the item of improved facilities offered to patrons and the absence of paving obligations on the part of the railroad company.

The bonding of the tracks has received most careful attention. The Columbia bond, manufactured by the J. A. Roebling's Sons Company was used almost exclusively with the exception of special work bonding where a considerable amount of triple laced bonding with channel pins was used.

All tracks have been laid with closed joints placed opposite in order to make repairs to joints the least expensive and to enable the most economical use of ties due to different spacing at the joints, to effect with greater economy cross bonding, and to prevent the rocking motion which is sometimes felt in cars operating on single trucks due to broken joints.

LINE CONSTRUCTION.

There are four distinct types of line construction used by this company, viz.: steel pole, side bracket with center span construction as adopted on Canal Street and as shown in Fig. 4, wooden pole, side bracket construction, steel pole span construction and wooden pole span construction. Of these, the only construction which differs in almost every detail from that usually met with, is the side bracket, center span construction used on Canal Street. The conditions upon this street to be met for the satisfactory operation of the different street railway lines over the trunk tracks were most unusual with probably no parallel, and so presented features of no little intricacy. When all the companies were operating with animal traction the question as to right of companies with operating contracts, to the space above a trunk track, owned by an individual corporation, for the use of overhead wire had never presented itself. All complications however which might have arisen were avoided by an amicable decision between the joint users, by which the construction of a new system of overhead line was turned over to the Canal & Claiborne Railroad Company.

To correctly carry out the best methods for the trunk track overhead line construction without jeopardizing the future interests of any concerned, and at the same time fully meet the immediate needs, necessitated many special features of design in materials and workmanship in construction. The plan as finally adopted, consisted in the erection of a bracket construction over the trunk tracks, from which were carried the four wires of the companies operating thereon. To the ends of these brackets was attached through insulators, the span wire carrying the trolley wires of the New Orleans Traction Company. The poles used for this construction are extra heavy steel poles 32 ft. in length, weighing 1200 lbs. These poles are made in two sections with shrunk and swedged joints 24 ins. in length. In setting the poles there is placed in the bottom of the poles a cypress block 12 ins. square by 2 ft. in length and driven into the bottom of the pole. Large broken rock is firmly tamped around the base of the pole, and the excavation is filled with concrete of the following composition: one part by measure of Dyckerhoff Portland cement, two parts of sharp, clean sand free from loam, and four parts of crushed stone of such a size as will pass through a 1½ in. ring. This concrete is shoveled into the excavation and thoroughly tamped by heavy tamping bars from the time the first shovelful of concrete is deposited until the surface is reached.

Keyboards of cypress plank 60 ins. × 10 ins. × 3 ins. are placed in front of poles, 1 ft. below the sidewalk pave-

FIG. 11.—END VIEW OF SWING BRIDGE.

ment while heel boards are driven back of the pole before the depositing of concrete. The poles for this construction on Canal Street are placed 90 ft. apart on neutral ground for a span of 55 ft. The brackets for supporting the trolley wires from the trunk tracks are made of 2½ in. steel pipe extra heavy and provided with heavy malleable iron fittings for connecting with poles and with double ½ in. truss rods for supporting bracket arms.

In order to secure double insulation and at the same time flexibility, special bracket hangers were designed for this construction, made in two bells each having a separate insulation and joined together by a link with at least ½ in. play to allow flexibility. The top bell of this hanger had cast with it the lower half of a malleable iron sleeve by which both hangers were bolted to bracket arm. Perhaps

however the most intricate part of this overhead line construction was the insulating crossings which were necessary in order to meet the requirements of one wire crossing on one, two, three and four wires, both at right angles and on curves.

Fig. 8 shows these crossings for both the 2, 3 and 4 wire crossings, while Fig. 7 gives an idea of the complexity of the overhead work at the head of Canal Street. Before the reconstruction of the lines of the Canal & Claiborne Railroad Company, there were on the neutral ground curbs of Canal Street over 300 poles of one form or another and most in poor repair, for the carrying of electric light, railway, telephone and telegraph wires. Some of these poles were 70 ft. high and carried one hundred wires. There were also probably one-half as many trees on the neutral ground which offered obstruction to the future operation of electric cars. Most of the above mentioned wires were bare and had to be transferred while

FIG. 12.—INTERIOR OF CAR HOUSE, SHOWING TROLLEY INSPECTION BRIDGE.

in the live state to new poles situated on the street sidewalk curbs, while during this reconstruction the lines of the New Orleans Traction Company, the New Orleans & Carrollton Railroad, the St. Charles Railroad and the Orleans Railroad Company had to be constantly operated by electric traction, and temporary methods resorted to at crossings for overhead special work for such operation. From these statements the difficulty of the task confronting the engineers of this company will be realized.

Fig. 4 shows the present new construction on Canal Street as taken during the recent Mardi Gras procession, in March.

Few street railways have such facilities for economical operation as are found in the location of this company's power house referred to the lines to be operated, the lines forming what is, to all practical purposes, the arc of a semicircle with the power house at its center.

In the layout of the feeders necessary, advantage was taken of this geographical location, and circuits here laid out to feed both ways to the center of the circle located on Claiborne Avenue. In this way, and by use of switches at this point, should the lines of the company located along the river front, as shown upon Fig. 18, be destroyed by fire or other causes, it is still entirely possible to operate the entire system by the feeder lines, without causing any delay to traffic on the road, by taking the opposite course around by Elysian Fields down Claiborne Avenue or *vice versa*. The return circuits to the power house of this company are reinforced by the ample waterway returns and by the naturally fine ground return obtainable, due to the wet nature of the soil. The overhead line crossings and frogs for Canal Street construction, as shown in Fig. 8, were furnished by the H. W. Johns Company, while the line material was supplied by the General Electric Company, and the poles and brackets were manufactured by Morris, Tasker & Company. All wooden poles used are Southern yellow pine, the feeder poles being 45 ft. in length, 14 in. × 14 in. butts and 10 in. × 10 in. tops. For the span construction, two sizes of poles were used, one 32 ft. in length, with 12 in. × 12 in. butts and 9 in. × 9 in. tops, and the other 31 ft. in length, 10 in. × 10 in. butts and 7 in. × 7 in. tops. All wooden poles received two coats of preservative on the butts for a distance of 10 ft. from the bottom and on the tops in all gains and holes. Pole spacing is 90 ft. on wide streets and 120 ft. on narrow streets. General Electric type M lightning arresters were furnished, approximately, one to each mile of track.

BRIDGE CONSTRUCTION.

At Carondelet Walk, where the Claiborne Avenue line of the road crosses the Old Basin Canal, a waterway leading into the city from Lake Ponchartrain, the company erected the largest steel bridge of its kind in New Orleans to enable prompt operation of its cars. This bridge, shown in Figs. 10 and 11, is a plate girder, steel structure, center swing 100 ft. span; width of roadway 20 ft., with 4½ ft. sidewalks on each side. The bridge is supported on thirty-five piles under a center pier, which were driven for the new construction while an equal number of piles still remained in a good state of preservation as a support for the center pier of the original bridge, which was taken down. The very best material and workmanship throughout are found in the foundation and construction of this bridge which, due to its quick method of opening and closing, and its double track, offers facilities which are enjoyed by no other company in the city in the crossing of waterways. Besides this bridge there are on Claiborne Avenue three short span wooden bridges, and on Tulane Avenue there are three short span steel structures, these all being stationary bridges.

CAR HOUSE.

The car house of the company is at the lower section of the city, corner of Urquhart Street and Lafayette Avenue. This location is an admirable one for meeting the convenience of car storage and handling of the early day travel. The section of the city in which it is located being given up almost entirely to the homes of working classes, enables the company to start its cars in the morning and run them loaded right from the car house, doing away with what is too often found in street railway operation, the running of empty cars for some distance from the car house before meeting with the travel desired.

The car house is divided into two parts; one part is used for car storage and the other is given up to the shops of the company. The layout of the shops is such as offer easy facilities of repair or alteration of cars, having both an outside connection with the main tracks of the company and an inside connection which enables the running of any car from any track into the shop without interfering in any way with regular schedules. Between the two main tracks and between the pits located under each of these tracks, has been erected a trolley stand for inspection or alteration

of any parts of the trolley mechanism of the cars, as they pass this car house, while the equipment is being inspected from the pit. This enables every car, if necessary, to be given a quick and thorough inspection without interfering in any way with its regular schedule.

At the entrance of the car house are placed the offices of the general manager with his assistants, while at the other end starter's office, rooms for car operators, and lavatories are provided. A fire protection system is here installed.

CARS.

While the Canal & Claiborne R. R. Co. has adopted throughout its system only that equipment which was best calculated to give it a first class service, yet, probably, in nothing has it scored a more complete success than in the selection of design and construction of its rolling stock.

Up to the advent of its reconstruction, with the exception of a few cars used on lines of the New Orleans & Carrollton Railroad Company, all the cars in the city had been the standard longitudinal seat car so familiar in street

FIG. 13.—CARS ON CANAL STREET.

railway practice. The thought uppermost in the minds of the company was to secure a car which, aside from having features which would at once commend it to the people, would at the same time meet all the climatic conditions with which it would have to deal in New Orleans. With this end in view and to meet it with economy it was necessary to adopt a car which would supply the needs of both summer and winter travel, thus avoiding the expense of carrying two sets of cars and of changing and storing them. In fact, since there were grave objections to the use of open cars exclusively for summer travel, due to the fact that most severe rain and wind storms are often experienced out of a clear sky, it was first of all decided to adopt a car which would answer the requirements of both winter and summer travel. This meant the obtaining of a closed car, so constructed that while operating on the road it could be transformed in a few minutes to an open car or *vice versa*.

The question as to whether it would be best to equip this car with longitudinal or cross seats, was one which was soon decided in favor of the cross seats, so popular with New Orleans people, affording greater comfort and convenience. At the same time the company adopted large platforms, enabling the crowding of as heavy loads upon the car as are handled by the use of the longitudinal seat car and thereby maintained the equivalent of the latter in carrying capacity at periods of maximum travel.

Another reason why the cross seat car is so successful in New Orleans, is that there is here less crowding upon cars, due no doubt to climatic conditions and to the nature of its people. Standing loads are of infrequent occurrence except during early morning and late evening hours.

The cars are 29 ft. over all, 8 ft. 2 ins. in width at sash rails and have 20 ft. bodies. The roof of the car is of the monitor ventilator dome pattern, and extends the entire length of car to give ample ventilation. It is supported on steel rafters from each side post, which are securely fastened to the top plate of car, and are of such weight and design as to prevent any sagging or vibration from the trolley pole connections or the additional weight from repairing men which the roof might be required to carry. The car is supplied with seven side ventilator windows fitted with beveled plate glass, pivoted at center and glazed. All end ventilator windows are fitted with removable sashes and with beveled plate glass colored and lettered to designate the lines of the company. The important feature of this car, by which it is made practically a summer car, is that the side windows are placed so low that when lowered the effect is that of an open car. To more fully accomplish this, however, the fronts of the car are constructed with windows which are placed low and on a level with the front and side windows, all of which when lowered make the car open throughout. In these cars Hale & Kilburn walkover, broad, spring rattan, cross seats are used with reversible backs. The entire framework of the body framing is made of well seasoned white oak of best quality and free from defects, secured with heavy tie rods.

The roof bonnets are framed in a neat bow to suit the depth and width of car and are securely fastened to the top with heavy iron brackets and bolts and supported at the outer end with nickel plate piping and unions extending from platform to bonnets. The body framing is guarded with heavy quartered rails securely fastened to the body and covered with iron holdings.

The platforms are supported on four white oak supporters 2½ ins. × 6½ ins., the nose piece being white oak 4 ins. × 12 ins. with platforms dropped 2 ins. below bottom of sills. Each car is provided with large, spring, radiating drawbars which, however, when not in use are slipped back under the car platform.

The inside finish is of mahogany, of plain yet handsome design, all the metal work being nickel plate. The windows are provided with curtains made of fancy Burgess cloth, mounted on spring rollers with Acme curtain fixtures. Each car is lighted with eleven sixteen candle power, 100 volt lamps and equipped with one Sterling No. 1 car register with adjustments. Each car is fitted with two electric headlights fastened to each dasher and also with stationary fenders surrounding each platform, rendering it impossible for any obstruction to get under the car and derail it.

The mechanical construction and details are of the very best, and it is safe to say that no street railway in the country is equipped with more handsome accommodations than those offered by the cars of the Canal & Claiborne Railroad Company.

The car is painted olive and stone buff, and trimmed with gold, and presents a most pleasing appearance. Fig. 13 shows view of the cars on Canal Street stand and Fig. 12 cars in the car house. These cars were furnished by the American Car Company, through Schminke & Newman, agents.

The cars are mounted on the Lord Baltimore extra heavy single trucks with side truss rod extensions as manufactured by the Baltimore Car Wheel Company, and furnished by Schminke & Newman. The diameter of the wheel is 33 ins., wheel base 7 ft. 6 ins., tread wheels 2½ ins., weight of wheel, 375 lbs.: diameter of axle, 4 ins.

Each car is equipped with two G. E. 800 motors and K2 controllers as manufactured by the General Electric Company.

POWER HOUSE.

The power house is located on the Mississippi River at the intersection of Elysian Fields and North Peters

Street. The adaptability of this location is apparent from an inspection of the lines to be operated. In the consideration however of that site from which the company's lines could most economically be operated, the river site was selected for the following reasons :

1. Economy and accessibility of coal and water supply.
2. Centralization as regards the distribution of copper, permitting of a double feeding system.
3. Greater reliability of soil for foundations.

Referring to the first one of these reasons, it will be noted from Fig. 18 that the power house is approximately 200 ft. from the Mississippi River; also that it is situated on the lines of the Louisville & Nashville Railroad and the Southern Pacific Railroad which, together with use of barges on the Mississippi River, afford coal conveniences that offer sufficient competition to permit of the best

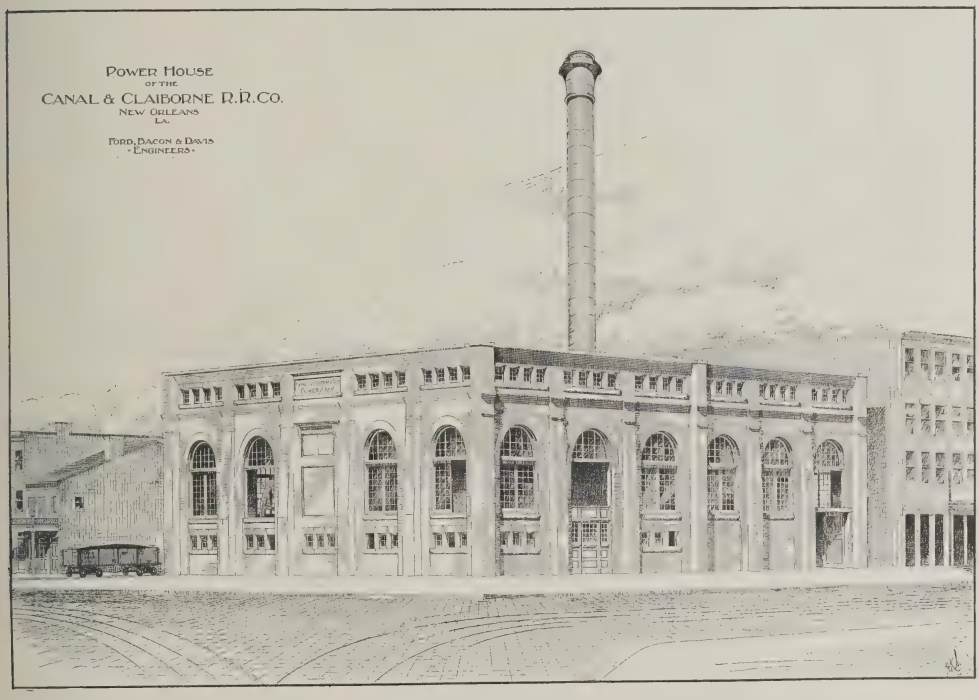


FIG. 14.—EXTERIOR OF POWER HOUSE.

coal at the lowest figures, besides the convenience of local delivery at very reasonable cost. In addition to the Mississippi River, for feedwater and condensing supply purposes, the company has sunk the largest artesian well in the city of New Orleans, it being 785 ft. in depth and 8 ins. in diameter throughout, with an 8 in. strainer 40 ft. in length. While the company was assured that in New Orleans the driving of such a well was impossible, yet, by the erection of proper machinery and the adoption of exacting precautions the well was successfully completed and the capacity desired of 600,000 gals. obtained. It is probable that this capacity will be considerably increased at certain seasons of the year.

As for the Mississippi River water, while it is impracticable at some seasons of the year to utilize it for boiler feeding purposes, yet, during a large portion of the time, it may be used for boiler feed and always is adaptable for condensing purposes.

One important feature in reference to this plant is the very low lift which the condensers have at most seasons of the year. It is usually about 8 ft., but during the spring season of high water there is absolutely no lift, the water running into the condensers by gravity.

As regards reliability of foundations, all those familiar with New Orleans soil will at once realize the value and importance of the location of machinery on the river front where this is practicable. Here the soil, although made ground, is yet much more firm than the soil in the rear of the city. This latter consists largely of alluvial deposit filled in with stumps, roots and remains of trees and different forms of vegetation, presenting all the features of a swamp when excavated for foundation work. The soil along the river front, composed, besides the natural soil, of shell and different forms of ballast used in perfecting and building the levee system, is much more firm than that in the rear of the city, and is underlaid at a depth of about 35 ft. with a stratum of gravel and shell which varies from 3 ft. to 7 ft. in thickness. This stratum, while extending under a large portion of the city, seems however, to be more prominently and regularly defined on the river front than elsewhere. Because of the greater solidity of the ground work along the river front and the more regular definement of the underlying strata, the advisability of this location is apparent.

The power house of the Canal & Claiborne Railroad, shown in perspective sketch (Fig. 14) is conceded by New Orleans people and by visitors from other cities who have seen it, to be not only the most handsome structure of its kind in New Orleans, but also one of the finest power house structures in existence to-day; in fact, although only in operation practically six months, this plant has become so well know that it is quite the customary thing for visitors to make an inspection of it during their tour through the city. This is shown by the numerous admission cards which the company has been issuing. Architecturally, this building preserves a simple yet powerful style which has

been obtained by the combination of large flat surfaces, heavy arches, massive pillars and adherence to straight lines, avoiding detail decoration.

Its design, again, commends itself at once in its thorough practicability for power house work and especially for the Southern climate. As will be observed from Fig. 14, and also from the photo-engraving in Fig. 1, the building is provided with large door windows, occupying most of the curtain walls between the pilasters; besides this, it is furnished with ventilator windows immediately next to the roof on all four walls of the building, furnishing for the engine and boiler rooms ample ventilation.

The structure is of brick with steel trussed roof divided in the middle by a fire wall, between the engine and boiler rooms.

All exterior walls of the building and interior walls of the engine room are finished with salmon pressed brick of a dark buff color. The interior walls of boiler room and engine room basement are kalsomined a light gray. All common brick in the building is best quality hard burned and all brick work is thoroughly bonded in every sixth course, the joints being shoved joints for both inside and outside of building. All courses of brick have been restricted to straight lines with minimum joints and all building walls were accurately plumbed and leveled. Powerful ties between walls are secured by means of wrought iron bands laid in the walls and firm setting and end riveting together of roof trusses.

Stone trimmings are furnished for the sills of all windows, sills of boiler room doors and main entrance, engine

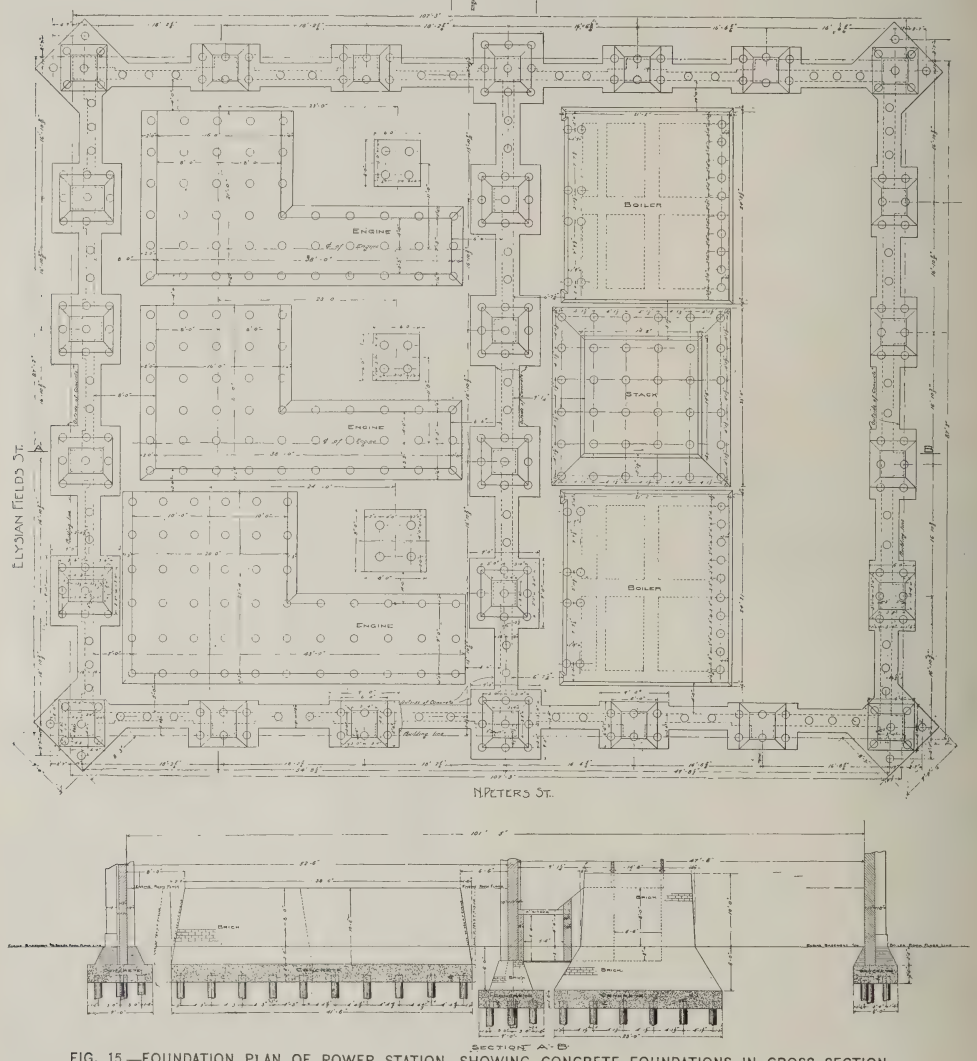


FIG. 15.—FOUNDATION PLAN OF POWER STATION, SHOWING CONCRETE FOUNDATIONS IN CROSS SECTION.

room basement door, sills for fire doors, of which there are three between the engine and boiler room, all templates for trusses and cap stone for crane pilasters, top coping for all walls, slab for feed wire entrance with moulded stone hood and slab for name plate also with moulded stone hood.

The engine room is furnished with basement 8 ft. in height below engine room floor. The engine room contains two 450 h.p., tandem compound Allis-Corliss engines direct connected to two 300 k.w. General Electric railway generators, with switchboard; one engine gageboard and individual gageboards and 10 ton traveling hand crane manufactured by the Brown Hoisting & Conveying Machinery Company. The engine room basement contains two engine and generator foundations, two Reynolds air pump condensers, two engine receivers, besides steam, water and drip piping and electrical connections from generator to board.

The boiler room contains one battery of two 350 h. p. Edgemoor boilers, one steel stack self supported on a brick stub, brick flue from boilers to stack, two boiler feed pumps; one auxiliary feedwater heater, coal scales and steam, water and drip piping.

In the design of the building, space has been allowed for the installation of a third engine and generator of capacity equal to the capacity of the two present equipments

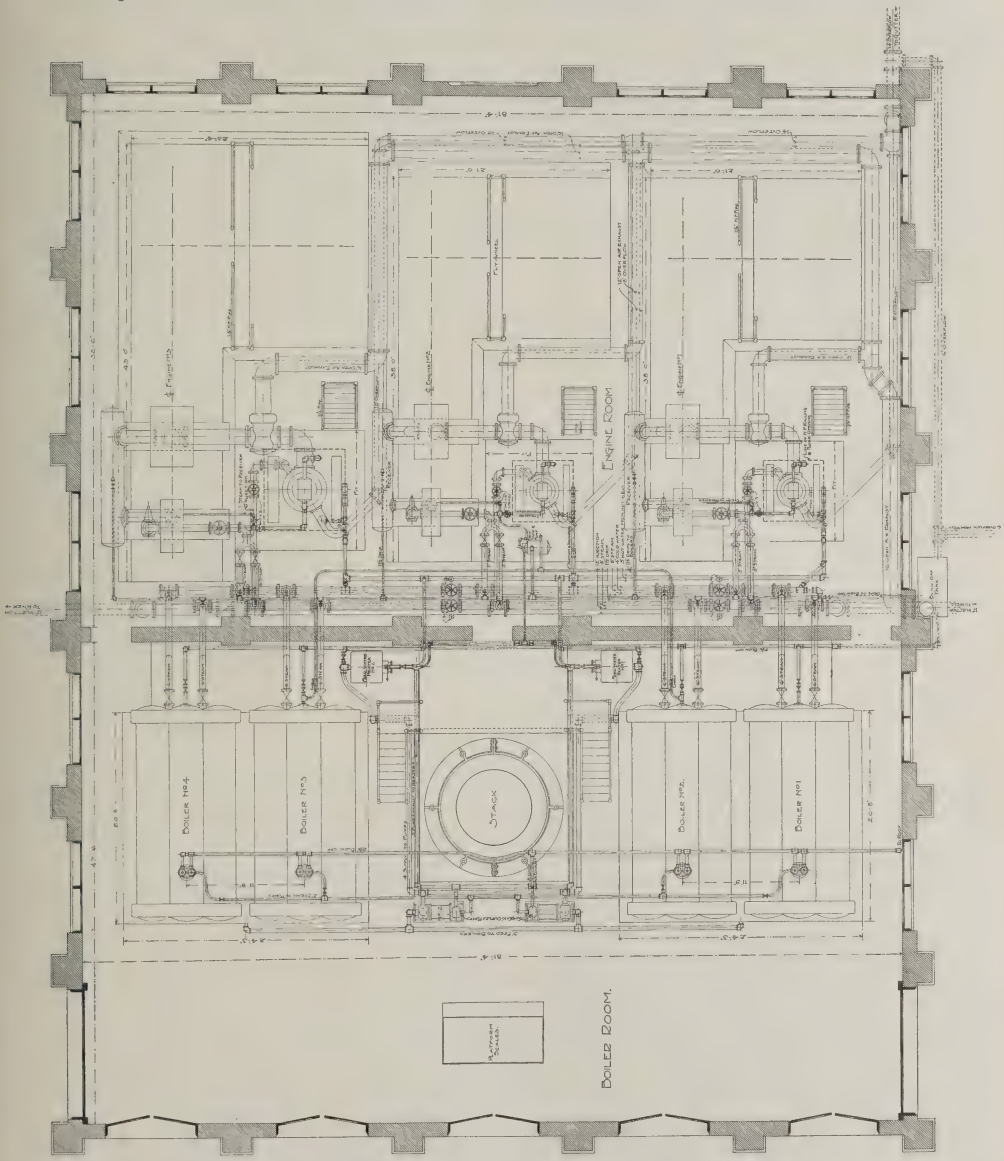


FIG. 16.—GENERAL LAYOUT OF PLANT, WITH PIPING SYSTEM.

and also for the installation of additional boiler capacity of size required.

As previously stated, in the purchase of real estate for the power house, there has been provided room for extension along Elysian Field Street and for the installation of further units of capacities equal to twice those now installed. From this, it will be readily seen that ample provision has been made for the future in the layout of this company's power plant.

FOUNDATIONS.

Fig. 15 shows the methods adopted for securing foundations. The entire building, contrary to the usual practice in New Orleans, is built upon piling, not only for the building itself, but also for the engines, generators, condensers, boilers and stack. All piles are yellow pine, 50 ft. in length, varying from 14 ins. to 16 ins. in diameter at butts and 10 ins. to 12 ins. at tops, showing the usual percentage of heart.

It might be stated that all the piles for this work were subjected to the most rigid specifications and inspection, and that a large percentage of them were rejected in the endeavor to secure only first class material. After being driven, all piles were sawed off square at a distance required below the boiler room floor and, quite contrary to the usual custom, capped as shown in Fig. 15, with stone concrete, instead of with cribbing. While more expensive, this construction was adopted by the engineers, because of its greater reliability and durability.

Fig. 15 also shows the foundation plan with locations of all piles under both the building and machinery, there being 252 under the building walls proper, 141 under engines and generators, 16 under condensers, 36 under stack and 36 under boilers, making a total of 481. In the layout of the piles, previous to driving, strict measurements were adhered to and each pile location accurately defined by actual measurements on the ground, after having brought the surface to an even and level condition. All of the piles, have a footing in the gravel stratum above mentioned.

It is of interest to here note that, although it was quite possible on the last blows given these piles to drive them with a 3000 lb. hammer and a 30 ft. fall a distance varying from 4 ins. to 12 ins., yet after being allowed to rest for a few hours that it was often impossible to move the same pile with the same hammer and 50 ft. fall, a distance of ¼ in. even when the driving was continued to the extent of completely destroying the head of a firmly banded pile.

Resistance to piles of this size in New Orleans soil is approximately 600 lbs. per lineal foot of pile, so that the pile is capable after being driven of holding a load of 15 tons. Since none of them is loaded to an extent greater than 8 tons, it will be seen at once the liberal factor which has been adopted in all of the foundation work. Under moving machinery this factor was still further increased.

After the piles were driven in position and the cut-off made, the surface of the ground was brought to an accurate and level finish for a distance of 1 ft. below the top of cut-off. This surface at the time of construction was practically blue clay mud which would easily work into a

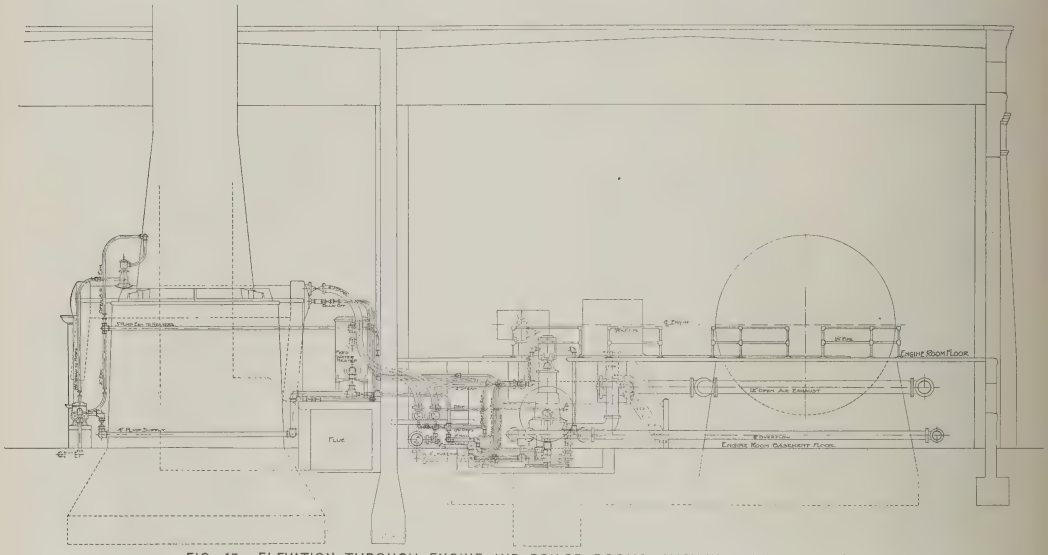


FIG. 17.—ELEVATION THROUGH ENGINE AND BOILER ROOMS, SHOWING PIPING DETAILS.

mixture incapable of sustaining much weight if it were disturbed.

To secure absolutely firm and thorough connection between the surface of the ground and the bottom of the concrete capping of the foundation and to effectually take up the water which would at once accumulate in the excavation, dry concrete in the proportion of one part Dyckerhoff Portland cement, two parts of sharp, clean lake shore sand and three parts of crushed granite of size to pass through a 1½ in. ring, were thoroughly mixed and then rammed in the excavation till all the moisture was completely taken up and the whole upper course firmly compacted by the intermixture of the dry concrete absorbing the moisture held by the blue clay subsurface. After having secured a thoroughly firm coating by this process, concrete mixed wet was dumped into the excavation, at all times kept filled with men to thoroughly ram each coat of concrete, the top surface being kept covered with a thin film of water due to such effectual ramming. All concrete used in these foundations is of the proportion, one part Dyckerhoff cement, two parts sand and three parts of crushed granite. The method of mixing was subjected to the most exacting supervision. The concrete, instead of being mixed by methods too frequently adopted, was disposed of in this manner: two cement barrels by actual measurement of sharp, clean and dry sand were dumped upon the mixing board, over which was dumped one barrel of Dyckerhoff cement. This was then thoroughly mixed

by hand shoveling in the dry state. While this was being done, three barrels of crushed granite, which was kept thoroughly wet, were measured out and then dumped over the dry mixture of sand and cement which had been spread out upon the mixing board. By this system immediate adherence between stone and the cement and sand mixture took place and the whole concrete after being thoroughly mixed together with the addition of only that amount of water required to make the entire concrete mix stiff, produced the best possible cement concrete. The foundations after having been filled in, in the above manner to a total depth of 2½ ft. or of 1½ ft. above the cut-off of pile, were allowed to set for from ten days to two weeks before having started upon them any of the brickwork.

By the above method of foundation construction, the building not only secures the whole bearing area of the pile, but also the supporting area of all of the adjoining surface which, when treated in the manner above set forth, is equal to, at least in total, that of the piles.

From foundation plan in Fig. 15, it will be seen that the building is carried upon a series of heavy foundation pilasters each supported on nine piles, and that also the piling is carried through and under the curtain walls so that there is absolutely no break throughout the entire foundation system to the combination of concrete and piles. The foundations of the engines, generators and condensers, which have been built in the same manner, have been kept independent of the building foundation, although reinforced by abutting masses of concrete at the party wall and stack to provide against any under movement of earth. It will be noted that the foundations for the party wall have been carried below those of the main building walls in order not to have the foundations of the stack which, to obtain stability desired, it was necessary to place at grade shown, below the foundations of the building proper.

It might be stated that after an operation of six months with overloads at times upon the machinery of 50 per cent this foundation work has more than fulfilled all expectations and is carrying the machinery under the above conditions with absolutely no detectable vibration in the foundations, a condition of affairs most unusual in this character of soil and especially in New Orleans. In this work best hard burned lake brick have been used with Dyckerhoff cement mortar, all brickwork being thoroughly bonded with every sixth course a course of headers. The entire construction of the power house building together with all foundations for building and machinery was performed and thoroughly executed by Muir & Fromherz, large New Orleans builders.

ENGINES AND CONDENSERS.

In order to secure the engines more firmly and to facilitate ease and cleanliness of operation, there was speci-

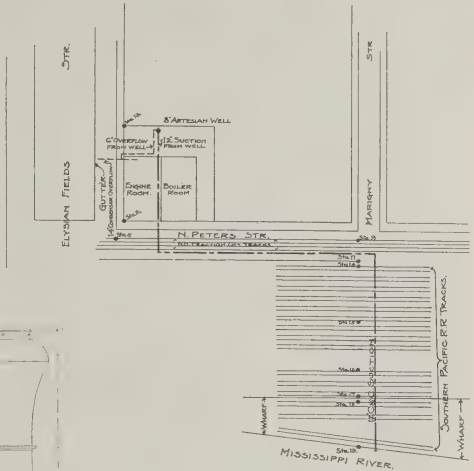


FIG. 18.—LOCATION OF POWER STATION, SHOWING RIVER SUCTION.

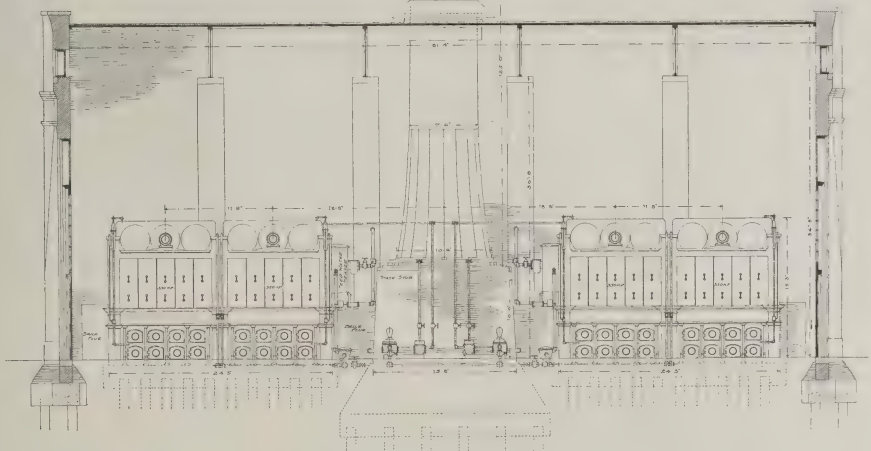


FIG. 19.—ELEVATION THROUGH BOILER ROOM.

fied a continuous sole plate under the entire bed and cylinders of engine in one continuous piece from center of crosshead guides to rear end of rear tandem cylinder. This sole plate unites the bottom of the low pressure cylinder with the bottom of the high presure cylinder, being bolted together under crosshead guides, thus forming a continuous piece to the crank end of engine frame. This feature of these engines is one of the first instances of its application. The sole plates were grouted in an approved manner to the foundation brickwork with pure Dyckerhoff cement, being brought to exact levels by a series of set screws furnished with sole plate. After the engines were placed in position and line, the foundation bolt holes were filled by grouting in a mixture of cement and sand in order to render the whole foundation thoroughly firm and rigid.

The engines are of the well known standard Corliss

type as manufactured by the E. P. Allis Company, having 16 in. and 32 in. × 42 in. cylinders attached to the 1890 Allis-Corliss frame, and are operated at a speed of one hundred revolutions, with 125 lbs. steam pressure. Crank shafts are 17 ins. in diameter where the flywheel and armature are located and 14 ins. in diameter at journals, which are 24 ins. in length and provided with side adjustments for taking up wear. Flywheels of engines are 16 ft. in diameter, turned on the face, cast in two sections, and frame held in place by wrought iron links, the weight of each flywheel being 40,000 lbs. The low pressure cylinders are provided with separate exhaust and admission eccentrics, the valve gear and valves being in design and workmanship the most approved Reynolds-Corliss type. The details of manufacture and regulation of these engines have been most satisfactory, there being provided, beside the ordinary fly ball governor, in connection with the valve gear, a safety fly ball governor. This governor is connected with an automatic steam valve in the main steam lead to the high pressure cylinder. By the means of this valve it is impossible for either engine to accelerate to an excessive speed should the main governor fail to that complete satisfaction which has secured for this type of machinery such merit for this class of work.

The switchboard is of the standard General Electric make, of black enameled slate, provided with three generator panels and eight single feeder panels, with individual generator wattmeter.

BOILERS.

The boilers are of the water tube type, as manufactured by the Edgemoor Iron Company, all rated at 350 h.p. with $\frac{6}{16}$ in. draft, the quality of coal being good Pittsburgh or equivalent. These boilers have an effective heating surface of 3360 sq. ft. in each boiler and a grate surface of 66 sq. ft. The boiler is furnished with three steam and water drums made of best flanged steel $\frac{5}{16}$ in. thick, the longitudinal seams being doubly riveted and alternated. All headers are of ½ in. steel on the inside plate and tube sheet and $\frac{7}{16}$ in. on the outside plate. Oval flange hand holes with approved caps and attachments are located opposite each tube. The tubes are 18 ft. in length, 4 ins. in diameter, of the first quality American lap weld. Each boiler front is provided with five sliding doors made

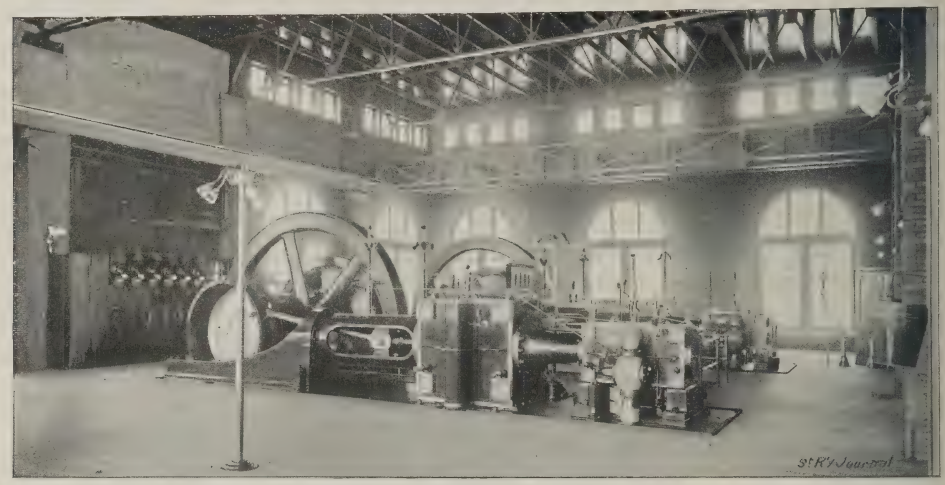


FIG. 20.—GENERAL VIEW OF ENGINE ROOM.

work, or for one engine to be run faster than the other by the reversal of its generator from any cause. This improvement, combined with the addition of the sole plate and the general superiority in workmanship of construction, renders these engines most desirable for the use intended. All lubricators, drip piping, relief valves and the usual trimmings of the engines are nickel plated.

The condensers are the Reynolds independent air pump type, special, however, in being provided with Reynolds-Corliss valves and valve gears.

These condensers, with air pumps, are 20 ins. × 12 ins., the exhaust pipe below the low pressure cylinder and condenser being fitted with back pressure valve for atmospheric exhaust.

GENERATORS AND SWITCHBOARD.

The generators are the standard multipolar, 300 k. w. railway type as manufactured by the General Electric Company. Each generator was specified to be capable of delivering an overload of 40 per cent without any part heating more than 45 degs. Cent. above the surrounding air. Each generator is designed to overcompound 10 per cent at full load, the series coils being so proportioned as to compound by regular increments proportional to the output. The workmanship upon these generators has been of the very best, and they have given to the company

of Russia and sheet iron for access to front headers. Each boiler is also fitted with two 4 in. pop safety valves and one large size polished brass Pittsburgh alarm water column, provided with gage glasses and three self seating gage cocks.

The boilers were tested by the water pressure of 250 lbs. per square inch, and found tight in every particular before acceptance. They have been rendering good service since being in operation.

STACK.

The stack is of steel, 125 ft. in height, made in 5 ft. sections; mounted upon brick stub 10 ft. in height and securely fastened thereto through six 2½ in. foundation bolts anchoring the heavy cast iron ring to stack stub and foundations, to which ring the steel stack is doubly riveted through an inside sheet reinforcing plate.

PIPING SYSTEM.

A description of this power house, presenting as it has thus far, several novel engineering features, would, nevertheless, be lacking without at least a brief review of the piping system installation.

Fig. 16 shows in plan the layout of the piping system while elevations through engine and boiler room and across boiler room are shown in Figs. 17 and 19.

As will be seen from the plan drawing of this plant, the layout of engines and boilers has been such as to permit of the shortest possible line of steam piping between them and at the same time to permit of future extensions in either direction, either in the building as at present or in extensions of the building. This piping system is designed not only to accommodate the present machinery, but also, so that with any additional installations or future extensions of the building, the piping system can be extended readily to meet the needs of the new plant without alteration of the present system or any changes in the present methods of operation.

In the layout of the high pressure and live steam system, contrary to the too ordinary practice, the main steam headers, instead of being suspended in the rear of and above the boilers, are located about 4 ft. above the ground on substantial brick piers in the engine room basement, immediately next to the party wall. The advantages of this location are apparent, affording, as it does, (1) the shortest possible steam connection from the engines to the boilers through headers and (2) the most convenient location for quick and ready access to main steam valves. In order to make connection with these headers in the shortest possible manner and at the same time secure that flexibility necessary for the successful working of an installation of this kind, the steam leaders from boilers to headers were connected to the rear of boiler drums by means of double reverse bends curving down from rear of boiler drums over flue through party wall into headers, as shown, Fig. 17. From headers, connections are made to engines through leaders furnished with copper bends. To permit of perfect flexibility, headers are supported on steel knife edges on top of brick piers. As will be observed from general view in boiler room (Fig. 22) and also from plans, this system of piping connections does away entirely with the usual accumulation of pipes above the boilers and suspended from boiler room walls.

All piping valves, unions, fittings, gaskets and connections used in this system have been specified of the very best quality of material and workmanship to stand, without leakage or rupture of material, 160 lbs. per square inch live steam pressure and also 240 lbs. per square inch hydraulic pressure. All joints are made with approved cement and gaskets, the gaskets being of the best quality rainbow packing, of thickness and dimensions corresponding with size of pipe. All flanges are lathe finished and all bolt-holes drilled true and counterfaced. All flange joints are pared thoroughly to insure the closest possible connection between the threaded surface. All fittings in this system are accurately faced, drilled and counterfaced, the thickness of metal always corresponding in strength with the thickness of the wrought iron pipe, as specified. The wrought iron bends are accurately made to six diameters, bent to true arcs of circles.

Besides the throttle valve stands located in engine room, valve stands of exactly the same design and finish are furnished and attached to main gate valves in steam mains to permit of ease in operation.

The condensing and exhaust system, the length of which is shown upon the general plan (Fig. 16) is located as shown in Fig. 18, the main injection connecting with the Mississippi River and the 8 in. artesian well located in the rear of the company's lot. There are two 12 in. leads from condensers to main 16 in. open air exhaust which is blanked at the tee admitting the 12 in. exhaust from condenser No. 2. The 16 in. open air exhaust extends to the rear of the building, terminating in exhaust head at roof. The 12 in. injection main is located near the party wall, the full length of engine room basement, extending along North Peters Street and under levee to the river, and terminating in a Y. From this Y two vertical 12 in. pipes extend to an elevation of 20 C. D., and terminate in approved foot valves and strainers, protected by means of piling from mechanical injury.

One important feature which is noticed in this injection is that the connections to condensers, instead of being made from top of injection pipe, are made from the bottom. It will be noted that by this arrangement the full benefit of water in the injection pipe is always obtained.

The 14 in. overflow mains from condensers extend, as shown, under the sidewalk from the power house to the Elysian Fields neutral ground gutters where the water of condensation drains back through the different city canals to the lakes. Besides connection to the Mississippi River, the condensing system is also connected to the 8 in. artesian well.

The feedwater and purifying system is connected to the two sources of supply through two 7½ in. × 4½ in. × 10 in. duplex pumps manufactured by the Geo. F. Blake Manufacturing Company. These pumps have given in every way the satisfaction which this apparatus always affords, being that company's standard pattern, with the adjustable valve motion, adjustable canvass packed water cylinders and copper air chambers.

FIG. 21.—SWITCHBOARD AND OAK PANEL FOR HOLDING FEED WIRES.

Each of the condenser feed pumps attached to the condensers are joined to the hot wells and also with the two duplex pumps to the 4 in. water main placed parallel with the party wall which joins with the 12 in. injection at each end of engine room basement, as shown, and outside of the main 12 in. injection valves. The discharge from condenser feed pumps 1 and 2 is into the open air heater No. 1 where hot water is drawn away and forced into the boilers by the duplex pumps 1 and 2.

The duplex pumps, the drip pump and live steam open air heater No. 1, are supplied with live steam as shown. The heater in use in this plant is the vacuum feedwater heater and purifier with oil separator, as manufactured by the Warren Webster Company; it is provided with an extra set of plates and special vacuum pump for removal of gases. The interior parts of heater are made of brass and copper and it is provided, as shown, with by-pass and necessary valves. Particular attention should be called to the location which has been given the heater which is at the rear of the boilers on the top of the brick flue about 6 ft. above the feed pumps.

The arrangement of this piping system is such that either condenser feed pump or duplex pump may be used to feed either boiler with condenser discharge water or cold water and so that either duplex pump will supply either hot or cold water to either boiler. All piping in this system is of standard thickness wrought iron subject to a hydraulic pressure of 240 lbs. per square inch.

The drip and blow-off system consists of a single 1½ in. drip main extending the full length of the 8 in. steam mains and joined to each of the mains with valve connections as shown. There is also a 1½ in. drip from the main steam jackets of each of the receivers, and the live steam piping entering engines is connected to the main live steam drip, which extends to drip pump placed in pit of condenser No. 2. It is also connected through valve to the 2½ in. blow-off pipe extending to blow-off tank situated in the rear of the building. The discharge from drip pump extends through check valves to blow-off connections of boilers. The drips from receivers extend to overflow tank in rear of building.

This power plant is furnished with its own fire protection system, by six 2½ in. fire plugs, two in engine room, two in boiler room and two on roof at the end of the party wall. The entire live steam high pressure system and the hot water portion of the feed, drip and purifying systems with connections, heaters, receivers, hot water tanks, pump cylinder heads, and all exposed hot water or steam surfaces in this system are covered with the best composition and quality of pipe covering.

For the high pressure live steam system, this is composed of a layer of 1 in. of asbestos sponge next to the pipe covering, upon which is placed another layer of 1 in. of hair felt. The entire piping installation represents the most advanced state of high pressure piping for power plant work.

In performing this work the contractor, the Benj. F. Shaw Company, has executed every detail with a thoroughness that does the company great credit and which it would be well for the management of large power plants looking for economies in operation and repairs to imitate.

MISCELLANEOUS.

The completeness in this plant in every way is shown by a general inspection of its engine and boiler rooms. Here are found all of the accessories which clearly signify the careful thought which has been given to every detail, not only of the building construction, but also of its every equipment.

A novel feature in power house design is the handsome oak panel set into two of the main pilasters immediately above the switchboard, for taking the strain of feed wires entering the building through the stone slab, they being securely anchored to the oak panel through insulators and then dropped perpendicularly to the switchboard.

The main station gageboard of polished black enameled slate is at the center of the party wall and contains steam gages, recording gage, clock, thermometer, vacuum gage and mercury testing gage. Besides this, individual gageboards mounted upon neat nickel plated stands are furnished at each engine, on each of which are mounted Crosby steam receiver and vacuum gages. Oil purifiers, alarm whistles connected to boilers, water columns, Spencer damper regulator, a complete system of electric lighting with handsome bracket fixtures located upon walls and upon pedestals near engine valve gears, a complete set of indicator motions, indicators, nickel plated oilers with trays and stands, are among the other appointments. A very good general idea of the engine room, is gotten from Fig. 20, while the details of switchboard and oak panel are shown in Fig. 21. Fig. 22 shows a general view of the boiler room.

OPERATION.

A description of this property would not be complete without a brief mention of the methods adopted for and the results obtained from actual operation. That the results have been most satisfactory is shown by the large daily earnings of the company, which have steadily increased since the first opening of the road, Oct. 10, 1896.

The method of operation is (1) to give that service to the public which their needs require; and (2) to effect perfect discipline among employes to obtain this service by treating with every employe of the road openly, honestly and rigidly, awarding and deducting merit in accordance with service rendered. This system of discipline, the simplicity and thoroughness of which commend it at once, while most rigid and strict in every particular affecting the road's interests and also the interests of its employes, consists in brief of being perfectly fair with every man and insisting upon every man being perfectly fair with the company. It is safe to say that upon no road in New Orleans, at least, does there exist a more thorough endeavor upon the part of the employes to further in every way the company's welfare or a better equipped corps of car operators than those of this company.

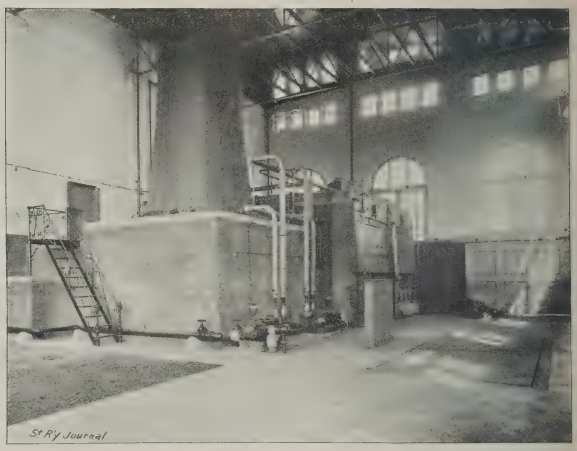


FIG. 22.—GENERAL VIEW OF BOILER ROOM.

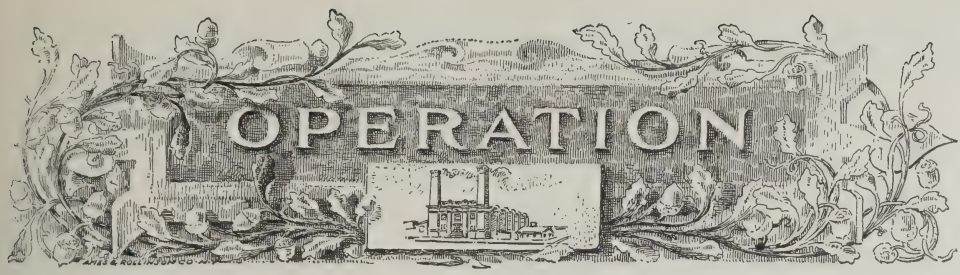
Cars run absolutely upon schedule, the exactness of which will be seen when it is stated that for twelve consecutive hours, two cars running in opposite directions passed each other upon each trip within the same block. In the power house and other branches of the road, the same strict discipline is observed, complete and detail reports being submitted to the main office of the company, daily.

OFFICERS AND ENGINEERS.

The officers of the company are: Joseph De Grange, president, a sketch of whom appears elsewhere in this issue; Geo. H. Davis, general manager; B. J. De Grange, secretary.

The board of directors consists of Joseph H. De Grange, J. K. Newman, I. S. West, Lawrence Fabacher, J. W. Castles, Harris Hyman and C. H. C. Brown, all well known as among New Orleans best citizens.

The engineering for the work of reconstruction of this property in every particular, including all plans and specifications for every detail, was performed by Ford, Bacon & Davis, engineers, under whose direct supervision the entire reconstruction and re-equipment of the road was completed, and by whom the foregoing plans were furnished to the Street Railway Journal.



Financial Results of Cable and Electric Railway Operation in the United States.

II.—Suburban and Interurban Traffic in Massachusetts.

The state of Massachusetts furnishes a most excellent field for investigation (a) of the way in which street railways have encroached upon the field formerly given over almost exclusively to steam railroad operation; (b) of the extent to which the street railway "riding habit" has been cultivated when ample facilities have been given; (c) of the influence upon gross and net earnings of the suburban and interurban additions to city mileage; and (d) of the social influence of these extending street railway networks in distributing and redistributing population.

The state is one of the richest and most thickly populated in the country, being second only to Rhode Island in population density, and second to New York in wealth per capita. Its manufacturing capital and population are extremely large, its people are progressive and enterprising, and although generally careful in small expenditures they are good travelers as will presently be seen. The eastern portion of the state is given up almost entirely to manufacturing and business interests, and residential areas more or less directly tributary to Boston. The central and western portion of the state is more generally agricultural in character, but there are several important cities with considerable manufacturing interests.

In steam railroad mileage Massachesetts has long been specially favored, particularly in the eastern portion, where a large number of formerly independent systems, now consolidated into two or three only, radiate from Boston and give, in addition to a through service north, west and south, an especially perfect and cheap suburban service for a radius of 20 miles around Boston. Nevertheless, it appears that there has been room for additional interurban railway facilities, for during the last six or eight years eastern Massachussetts has been fairly gridironed with electric roads operating on highways until it is now possible to ride by electricity from the extreme northeastern portion of the state well to the south of Boston.

There are fifteen independent street railway areas in Massachusetts, the limits of which are shown in the accompanying map. In each of these areas are found one or more street railway companies operating mileage through all the cities and towns grouped within its limits. Practically all this mileage has been converted, since 1890, from horse to electric motive power.

We are fortunate in being able to obtain thoroughly reliable comparative statistics of population, street railway mileage, capitalization, receipts and expenses for these areas, and are thus able to see exactly what has been going on therein during the last ten years. The regular census of Massachusetts is taken by the state authorities every ten years, alternating with the United States census in such a way that the population for 1885, 1890 and 1895 can be found. In the following statistical tables the financial reports for the years ending Sept. 30, 1885, 1890 and 1896 are used.

Group A. Boston–Lynn–Gloucester System.

That portion of Massachussetts indicated by the letter A on the map is one of the richest street railway territories in the world. It contains no less than forty cities and towns, with an aggregate population of over 1,100,000, of which Boston proper has but 500,000 while the remainder is divided up among three cities of from 50,000 to 100,000, five from 25,000 to 50,000, eleven from 10,000 to 25,000, and twenty of less than 10,000. The beautiful North Shore furnishes a never failing motive for pleasure riding for at least six months in the year, while the multifarious business reasons for traveling among these prosperous and wealthy towns make the annual regular traffic immense.

The street railway system serving this territory now comprises twenty-eight proprietary and twenty operating roads.

The following table shows the main changes which have taken place since 1885, measured by five year periods.

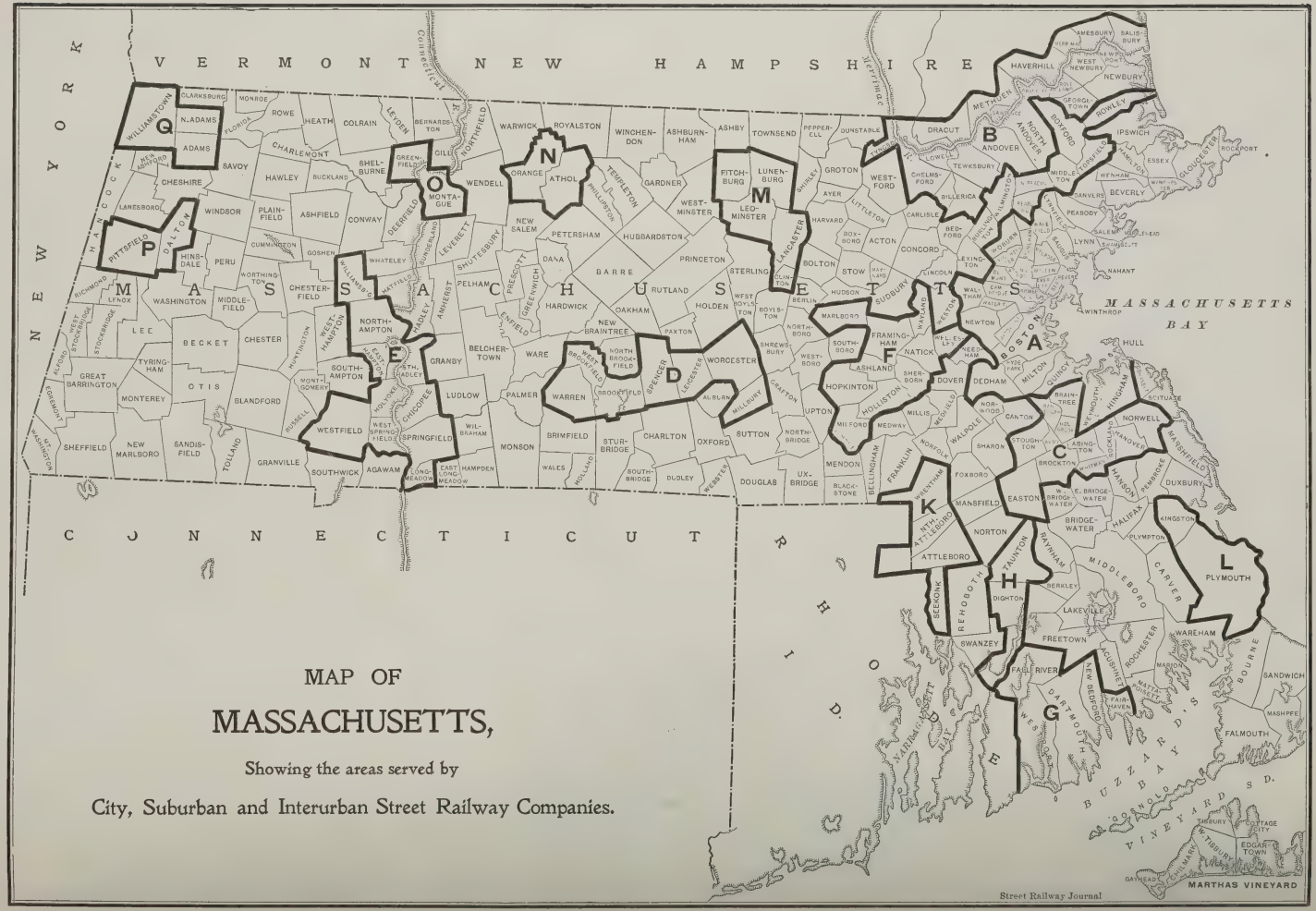
Items	1885	1890	1896
Cities and towns connected by street railways	30	31	40
Population, entire area	821,816	967,706	1,106,102
Per cent increase		17.7	14.3
Population served	763,211	916,750	1,106,102
Per cent increase		20.1	20.8
Miles street railway track	284.2	414.4	609.8
Per cent increase		45.8	47.1
Total capitalization	$10,202,400	$17,144,442	$35,316,660
Per cent increase		68.0	106.0
Passengers carried	89,788,815	130,509,961	205,917,734
Per cent increase		45.3	57.8
Passengers carried per capita served	118	142	186
Gross receipts	$4,468,773	$6,692,397	$9,190,100
Per cent increase		49.8	48.1
Net earnings from operation	$760,519	$1,479,284	$2,444,011
Per cent on capitalization	7.4	8.6	6.9

The rate of increase in the population of the entire area has been on an average about 3 per cent per annum. The street railway mileage has increased at the rate of about 9 per cent per annum and is now (in 1896) more than double the mileage of 1885. The capital investment has increased enormously, being now 3½ times that of 1885 and this without serious overcapitalization of costs. The increase of the riding habit is shown by the fact that the street railways of this group carry their population 186 times per annum as against 142 times in 1890, and 118 times in 1885. The percentage of net earnings from operation to total capitalization has slightly fallen, but may be expected to increase again with increasing population density on the new suburban and interurban mileage. The net earnings from operation are governed to a very large extent by the conservative bookkeeping of the largest system in the area.

It is interesting to note that the ratio of increase in population, during the two five year periods, is slightly greater in the minor cities and towns than is the case in the two principal cities, thus showing the outward expansion brought about by better facilities.

Group B. Lowell–Lawrence–Haverhill–Newburyport System.

In this area are found twenty cities, having now a total population of 235,000. The street railway system is operated by five companies, whose lines extend from Low-


VERMONT
NEW HAMPSHIRE
NEW YORK
CONNECTICUT
RHODE ISLAND
MASSACHUSETTS BAY
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MAP OF
MASSACHUSETTS,
Showing the areas served by
City, Suburban and Interurban Street Railway Companies.
Street Railway Journal
MARTHAS VINEYARD

ell, through Lawrence and Haverhill to Newburyport, with connections to the remaining sixteen townships. This is one of the great manufacturing sections of Massachusetts, the valuable water powers on the Merrimac River being the original cause of its manufacturing prosperity. The eastern portion, comprising the old fishing town of Newburyport and other towns in the immediate vicinity, are almost stationary in population; Lowell, Lawrence and Haverhill show moderate increases; while the greatest proportionate growth seems to be in the immediate suburbs of those three cities.

ITEMS	1885	1890	1896
Cities and towns connected by street railways. . . .	11	13	20
Population, entire area . . .	184,239	213,658	234,730
Per cent increase		16.0	9.9
Population served	162,932	195,191	234,730
Per cent increase		19.8	20.2
Miles street railway track. .	26.5	90.6	177.4
Per cent increase		241.9	95.8
Total capitalization.	$275,000	$916,000	$5,625,500
Per cent increase		233.1	514.1
Passengers carried	2,741,496	8,381,726	18,864,077
Per cent increase		205.7	125.1
Passengers carried per capita served	17	43	80
Gross receipts	$159,760	$444,972	$956,800
Per cent increase		178.5	115.0
Net earnings from operation	$26,863	$79,442	$338,870
Per cent on capitalization	9.8	8.6	6.0

In the accompanying table the most striking feature is the large proportionate increase in rides per capita, which were, in 1896, nearly double those of 1890, and nearly five times those of 1885. A correspondingly large percentage increase in gross receipts is seen, and the net earnings are, in 1896, more than four times those of 1890, and more than twelve times those of 1885.

Group C. Brockton System.

Brockton is a busy shoe manufacturing city and is little dependent on Boston, though some of its immediate suburbs are, to a certain extent, the dormitories of the metropolis. For some years the Brockton street railway system was a purely local one, but since 1890 a number of neighboring towns have been reached by its lines, and these, together with connecting systems operated by other companies, make a combined system serving thirteen cities and towns and operated by six separate companies. The general results are seen in the following table:

ITEMS	1885	1890	1896
Cities and towns connected by street railways. . . .	2	2	13
Population, entire area . . .	66,459	77,799	86,174
Per cent increase		17.1	10.8
Population served	22,167	28,678	86,174
Per cent increase		29.3	200.5
Miles street railway track .	11.3	18.2	83.9
Per cent increase		61.1	361.0
Total capitalization.	$200,000	$345,000	$1,850,200
Per cent increase		72.5	436.3
Passengers carried	1,016,753	2,210,706	9,340,186
Per cent increase		117.4	322.5
Passengers carried per capita served	46	77	108
Gross receipts	$55,446	$102,647	$450,816
Per cent increase		85.1	339.1
Net earnings from operation	$14,751	$22,735	$147,961
Per cent on capitalization	7.4	6.6	8.0

The population of this section shows a smaller rate of increase in the last five years than in the preceding five. The proportionate increase in mileage has been very large, and there has been, as usual, an even larger increase in capitalization. The population served by street railway lines was carried 108 times in 1896, as against but 77 times in 1890, and 46 times in 1885, the figures showing that the interurban mileage has added very largely to the gross and net earnings. The latter are now sufficient to return 8 per cent upon the combined capital liabilities, a material increase over the other two years represented.

Group D. Worcester System.

A rather sleepy town for its size is Worcester, and one which is not entirely self-centered, being, in spite of its distance from Boston, more or less dependent on that city. It was one of the later converts to electric operation, and has not yet achieved, perhaps, the full benefit of the change, although, as will be seen from the table, the rise in gross and net receipts and in rides per capita is by no means inconsiderable. Seven towns are contained in this

ITEMS	1885	1890	1896
Cities and towns connected by street railways . . .	1	1	7
Population, entire area . . .	92,906	110,575	124,018
Per cent increase		19.0	12.1
Population served	68,389	84,655	124,018
Per cent increase		23.8	46.5
Miles street railway track. .	6.0	20.4	74.3
Per cent increase		240.0	264.2
Total capitalization.	$80,000	$500,000	$2,434,000
Per cent increase		525.0	386.8
Passengers carried	1,451,691	4,851,574	13,238,983
Per cent increase		334.2	172.9
Passengers carried per capita served	21	57	107
Gross receipts	$70,124	232,475	
Per cent increase		$231.5	$644,490
Net earnings from operation	19,490	57,017	177.2
Per cent on capitalization	24.4	11.4	$151,872
			6.3

group, and four street railway companies operate independent systems. The reduction in percentage of net earnings from operation to total capitalization is very marked, but is due, as can readily be seen, to the small capitalization of 1885 and the large capitalization of 1896.

Group E. Springfield–Holyoke System.

Springfield is the wealthy and prosperous center of a rich agricultural district, and has large manufacturing interests as well. Holyoke is an important paper making center. South Hadley and Northampton are the seats of well-known institutions of learning, and the six other townships included in this group add to the value of the territory from a street railway point of view. Four separate systems are in operation here, of which the most important is, of course, centered at Springfield.

ITEMS	1885	1890	1896
Cities and towns connected by street railways . . .	3	6	10
Population, entire area . . .	115,222	136,634	153,606
Per cent increase		18.6	12.4
Population served	78,366	118,194	153,606
Per cent increase		50.8	30.0
Miles street railway track. .	14.3	31.4	105.3
Per cent increase		119.6	235.4
Total capitalization.	$225,000	$525,000	$2,525,000
Per cent increase		133.3	381.0
Passengers carried	1,758,051	4,628,570	15,806,737
Per cent increase		163.3	241.5
Passengers carried per capita served	22	39	103
Gross receipts	94,700	$236,407	$798,402
Per cent increase		149.6	237.7
Net earnings from operation	19,357	$41,746	276,130
Per cent on capitalization	8.6	8.0	10.9

The accompanying table shows results similar in many respects to those hitherto discussed in a general way. The percentage of increase in passengers carried in 1896 over 1890 is considerably greater than in the Worcester and

Lowell systems, but less than in the Brockton system. The absence of overcapitalization is indicated by a happy increase in the percentage of net earnings from operation to total capitalization. Every city and town in this group with two exceptions—Williamsburg and Long Meadow—show rapidly increasing populations.

Group G. Fall River–New Bedford System.

Fall River is an important cotton print manufacturing center, and New Bedford an old time seat of the whale oil industry, which has, however, taken a new lease of life and is increasing in population quite rapidly. The two cities have had until recently purely local street railway systems, but are now joined by a ten mile line which passes through two towns on its way between the principal cities.

Items	1885	1890	1896
Cities and towns connected by street railways. . . .	3	3	5
Population, entire area . . .	99,297	123,771	153,577
Per cent increase		24.6	24.1
Population served	93,143	118,050	153,577
Per cent increase		26.7	30.1
Miles street railway track. .	19.9	33.5	58.5
Per cent increase		68.3	74.6
Total capitalization.	$335,000	$653,000	$3,065,000
Per cent increase		94.9	369.4
Passengers carried	3,282,535	6,378,328	12,213,641
Per cent increase		94.3	91.5
Passengers carried per capita served	35	54	80
Gross receipts	$163,727	$297,748	$622,068
Per cent increase		81.8	108.9
Net earnings from operation	$21,470	$63,348	$209,090
Per cent on capitalization	6.4	9.7	6.8

The increase in rides per capita is fair, although this territory is not so valuable as that of the Brockton, Worcester and Springfield systems from this point of view. The percentage return on capitalization is about the same in 1896 as in 1885, though less than in 1890.

Group F. Framingham–Natick System.

Between Boston and Worcester is found a group of eleven townships, in which reside a large number of people who do business in Boston, and which are also centers of a rich agricultural district. Five companies operate systems in this group, and the combined results from this operation are shown herewith. The scale of operations is evidently

Items	1885	1890	1896
Cities and towns connected by street railways. . . .	2	3	11
Population, entire area . . .	52,850	58,398	59,132
Per cent increase		10.5	1.2
Population served	10,406	20,417	59,132
Per cent increase		96.2	189.6
Miles street railway track. .	3.2	13.9	52.8
Per cent increase		334.4	280.0
Total capitalization.	$25,000	$235,000	$780,000
Per cent increase		840	231.9
Passengers carried	32,149	894,220	3,402,339
Per cent increase		268.1	280.5
Passengers carried per capita served	3	44	58
Gross receipts	$2,260	$49,259	$165,783
Per cent increase		2,079.6	236.5
Net earnings from operation	$379	$12,524	$41,407
Per cent on capitalization	1.5	5.3	5.3

not large nor is the return upon the capital investment, but this group is particularly interesting as indicating the possibilities of building up a sort of visiting and pleasure traffic between towns which have no important business connections. For a system of this kind to carry its population fifty-eight times per annum is doing very well, all things considered.

Other Groups.

A discussion of the remaining groups shown on the map may reasonably be confined to a few points only. In North Adams (*Group Q*) a single system serves three townships having a total population in 1895 of 31,859. This population is carried about forty-two times per annum, and the system earned in 1896, on 12.1 miles of track, $67,074 gross and $29,727 net, equivalent to a return of nearly 20 per cent. on its capitalization, which amounted to but $150,000. In 1890 this road carried but 561,832 passengers, earned $30,144 gross and $11,427 net—the latter equivalent to 11.4 per cent. upon its then capitalization.

In Pittsfield (*Group P*) the street railway system serves a population (in 1895) of 23,671, which is carried about thirty-two times per annum. In 1896 its gross earnings were $37,341 on 8.7 miles of track, and its net earnings from operation were $14,352, equivalent to 13.7 per cent on a capitalization of $105,000. The gross receipts in 1890 on 3.6 miles of track were $15,236, and the net earnings from operation were but $794, the latter being equivalent to less than 2 per cent. on the then capitalization.

In Taunton (*Group H*) two street railway companies now serve the city itself and the two suburbs, which have a total population of 30,895, of which the suburbs contribute but 3780. The entire population was carried about seventy-five times in 1896. The gross earnings were $131,298 in 1896, as against $37,560 in 1890, and $23,307 in 1885, and the net earnings were $51,854 in 1896, as against $6,256 in 1890, and $3912 in 1885.

Two systems operate 13.3 miles of disconnected track in Greenfield and Montague (shown in *Group O*). The entire population served is but 12,287. This was carried about sixty-two times in 1896, while the gross receipts were $36,179, and the net earnings from operation $14,713, equivalent to 10.6 per cent on a capitalization of $140,000.

Two companies operate 30.4 miles of track in Fitchburg and four townships situated, as shown in *Group M*, having a combined population of 50,534, which was carried in 1896 fifty-two times. The gross receipts in this year were $153,093 and the net earnings from operation were $39,569, equivalent to 9.1 per cent upon a capitalization of $434,800. In 1890 the net earnings from operation were $5807, equivalent to 6.4 per cent on a capitalization of $90,000.

The Attleborough system (*Group K*), which has passed through some trying times, is now apparently prosperous, serving five cities and townships with an aggregate population of 46,546, which it carries fifty-one times per annum. Its gross receipts in 1896 were $117,926 and its net earnings from operation were $32,327, equivalent to 10.8 per cent on an investment of $300,000. In 1890 it served three towns only, Attleborough, North Attleborough and Wrentham, which had a combined population of 16,870, and in that year it earned only $23,085 gross and $10,249 net.

The Plymouth system (*Group L*) serves two towns, having a combined population of only 9703, which it carried sixty-eight times in 1896. It earned $32,668 gross and $10,269 net, equivalent to 7.6 per cent on a capitalization of $135,000. This is considerably better than the 1890 figures, which showed gross receipts of only $17,142 on 4.5 miles of track and net earnings from operation of $3670, equivalent to 5.2 per cent on a capitalization of $70,000.

A curious feature of the population feature is that in each of the major groups the percentage increase of population in the last five years is less than that of the preceding five years. No explanation is offered of this. Another interesting fact is that the largest percentage increase in any of the major groups is found in Fall River and New Bedford (*Group G*), in which it is almost the same in both five year periods, viz., 24.6 and 24.1 respectively.

Power Station Controversy in Chicago.

There has recently been an interesting controversy between prominent engineers in Chicago on the subject of direct connected, compound, condensing plants versus belt or rope driven, simple, non-condensing plants, and particularly on the results obtained from the Chicago City Railway Company's power stations. The controversy originally grew out of a report made by Messrs, Pierce, Richardson & Foster on the results to be expected from a station of the former type to be installed for the South Side Elevated Railroad Company. These estimated results were so far ahead of those actually (or apparently) found in the plants of the Chicago City Railway Company as to excite the attention of a gentleman who was a director in both companies, and at his instance Messrs. Pierce, Richardson & Foster made a critical examination of, and report upon the Chicago City plants. This report in turn was examined and commented upon by R. J. Hill, chief engineer of the Chicago City Railway Company who took decided issue with Messrs. Pierce, Richardson & Foster on most of their criticisms. An abstract of the two reports follows:

(*Copy*) CHICAGO, Feb. 20, 1897.

DEAR SIR: As per your instruction, we have made an examination of the Chicago City Railway plant at Forty-ninth Street and Oakley Avenue, and have also secured as much data as possible, in a limited time, as to the operating expenses of the Fifty-second Street power station, which station has essentially the same equipment and layout as the new station on Forty-ninth Street. We will hereafter refer to the Fifty-second Street station as station No. 1 and the Forty-ninth Street station as station No. 2.

We spent the afternoon of the 16th inst., in company with Mr. Bowen and Mr. Riley, in making a general survey of the equipment at the two stations. We again visited Mr. Bowen at his office and he afforded us every facility in his power in getting from the records all data regarding the cost of operation of station No. 1 and the specifications and data covering the equipment of station No. 2.

As above stated, the equipment of station No. 1 and station No. 2 is very similar and we would expect you to get about the same economy, in the way of fuel, in the old station as in the new. As station No. 2 is not in a condition for an economy test—it being operated only a few hours each day—we have therefore taken the data as given us by Mr. Bowen as to the cost at station No. 1 per kilowatt hour of fuel, water, etc., the data given being the average for the year 1896, and we have figured for same, as closely as possible, the efficiency of the boilers and engines, the results of which calculations are given later. We would say in this connection, however, that we do not see how very accurate data could be gotten, as the kilowatt hours were figured from the readings taken from the log book and not with the aid of a wattmeter. Furthermore, we are informed that all of the water, which is delivered to the building for all purposes, is charged up in one item against water supply, the water which is fed to the boilers not being separately metered to determine the amount evaporated for steam purposes.

Our report on the equipment of station No. 2 is as follows:

BOILERS.

The station is at present equipped with twenty-four tubular boilers, 78 ins. in diameter, 20 ft. long, with eighty-four 4 in. tubes. They are arranged in four batteries of six each, each boiler being equipped with a "Murphy" furnace. The dimensions of the chimney given us are 14 ft. diameter of core, 200 ft. above the foundation, the chimney standing outside of the boiler house at the west end. The boilers stand in two rows facing each other, and are connected into the chimney by two sheet iron breechings, each of full size for the twelve boilers it serves throughout. At the point where the breeching enters the chimney, a nozzle is provided, into which it is proposed (so we are advised) to connect a third breeching, which breeching is to be supported on "I" beams over the firing floor and is to contain a fuel economizer. The ends of the two breechings away from the chimney are to be connected into this third breeching, so that the hot gases from the boilers can, in one case, pass directly into the chimney, or, if desired, be sent in the reverse direction through the economizer and thence into the chimney.

The pattern of the boilers which have been installed, known as "horizontal tubular boilers," is not, in our opinion, the proper type for a plant of this size and requirements. Water tube boilers would have, unquestionably, been more desirable from considerations of economy, space occupied, expense of operation and greater degree of safety. The station could have been equipped with boilers of the latter type and of the most improved design at only a slight, if any, increase in cost, which increase in the cost, if any, would have been entirely wiped out in a very short time by the greater economy obtained by their use.

FURNACES.

The "Murphy" furnace with which the boilers are equipped stands well in the estimation of engineers as a smoke preventer, and it will give a fairly good economy. Furthermore, it will, unquestionably, decrease the amount of labor required for firing, which may, in a plant of this size, justify its use.

STEAM PIPING.

The steam from each boiler is led into a steam header, 40 ins. in diameter, there being four of these headers, one lying behind and above each battery of six boilers. The two headers at each side of the boiler room are connected by 18 in. copper bends lying horizontally. Each boiler is connected directly into the sides of the header by a copper bend pipe, the main steam valve lying against the header. This arrangement is decidedly faulty. Each boiler, in addition to the present valve, which is located against the header, should have a main controlling valve plated directly upon the boiler, the need of the same being perfectly evident. The connection between these two valves could just as well have been made with wrought iron pipe and elbows, instead of bent copper pipe, and the connection to the header should have been made on the *top* and *not* on the side. Such a connection would have better provided for the expansion of the header, due to heat, than can be done with the copper bends, and would have the additional advantage of being much cheaper.

Each header should have been placed upon rollers and its center should have been prevented from moving by anchoring, so as to throw the expansion in both directions from the center. The 18 in. connections between the headers could also have been with wrought iron pipe instead of the 18 in. copper bends aforesaid. The pipe leads from the headers to the engines are apparently all right as they have been installed.

WATER PIPING.

The method of feeding the water into the boilers is bad unless an internal pipe connection has been provided, leading up into the boiler to the water line, which pipe, however, we understand is not there. The feedwater is apparently delivered directly into the mud drum. The province of the mud drum is to provide a perfectly quiet place in connection with the boiler, into which any impurities may deposit themselves, undisturbed by the circulation of the water in the boiler and anything which causes a current through the mud drum in an opposite direction to the course naturally followed by any subsiding matter, defeats the intent of the mnd drum to just that extent. It is therefore bad practice to cause an ascending current of water through the connection between the mud drum and the boiler proper. This method of attaching the feedwater is old and its impropriety has long been recognized, it being no longer practiced, even where horizontal tubular boilers are installed.

ECONOMIZERS.

As heretofore stated, we are advised that an economizer is to be placed over the firing floor. In a new station properly planned an economizer is never necessary. A careful study of the conditions and situation should enable an engineer to so design a boiler plant, that the hot gases from the boilers should only be of such temperature as may be necessary to maintain the proper strength of draught to burn the kind of fuel required. With common soft coal from the Illinois mines, experience has proven that it is necessary to maintain a temperature of from 400 to 450 degs. F. at the base of the chimney, and it is seldom that it is safe to run at a much lower temperature at this point. On a properly designed plant, the gases should leave the boilers at a temperature not below the temperature of the steam, nor above that necessary to maintain the draught, which should, as a maximum, never exceed 450 degs. F. As the temperature of steam at 125 lbs. pressure is 353 degs., it is evident that if the boilers are operating as they should, the hot gases would leave them at very close to the proper temperature necessary to maintain the required strength of draught in the chimney.

An economizer is a very expensive adjunct to a boiler plant and a great economy may result from the use of such a device to justify this expense, which economy is not possible if the plant has been properly designed and installed.

COAL AND ASH HANDLING MACHINERY.

It is contemplated to place a conveyor in the boiler house to bring the coal to the bunkers which have been erected over and in front of the boilers and also to remove the ashes from the basement of the coal room. The conveyor has not as yet been installed, but from the description of it, we find that it is about the same as those built by C. W. Hunt & Company, of New York, which type is well known, largely adopted and successfully used for the handling of large quantities of material.

ENGINES.

The present installation consists of three pairs of single cylinder, high pressure engines, each cylinder of which is 36 ins. in diameter, 60 ins. stroke, the engine to be run at seventy-five revolutions per minute. Each double engine is connected by a rope transmission with two electrical generators of the Walker Manufacturing Company's make. The engines are apparently of the proper capacity for the generators. The type of engines however, which has been installed, is an entirely improper one for the conditions. Compound condensing engines should have been selected. There is no question about the superiority of a compound condensing engine over high pressure non-condensing engines, such as have been installed in this plant, and recent improvements have rendered it possible to secure these advantages in locations, where a few years ago, the use of a compound condensing engine would have been impossible, on

account of the prohibitive cost of the necessary water for condensing purposes. The devices referred to have rendered it possible to use the water for condensation over and over again, simply replacing the loss due to evaporation in the open air; therefore the use of such a device means simply a small increase in the cost of water to be purchased, but a much larger saving in being able to utilize a much higher pressure of steam, giving a larger number of expansions, and the benefits of the use of a vacuum, making the net saving exceed many times the additional expense for water. There are several firms building such devices, so that the element of competition would have had its usual force in the case of a purchase.

ENGINE AND DYNAMO CONNECTIONS.

The best modern practice is to connect the engines to the generators, without the intervention of any transmission device. These direct connected units are in use in practically every large modern station in the country, and it would have been better for many reasons to have installed such a type in this plant. The argument is sometimes used, in connection with installations of this character, that it is desirable to use either a belt or rope drive from the engine to the generator, in order to get a flexible connection. This argument has no force to any one conversant with the capabilities of the steam engine and experienced in these matters. The flexibility of the connection is relied upon to save the engine from damage, in case of a sudden load. This objection is entirely without weight, as any steam engine of good design is as well capable of withstanding the shocks, due to the sudden increase or decrease of load, as is a generator. A large saving would also have been made in the foundation, which would not have been to exceed one-half as large as they are at present.

LOCATION OF PLANT.

We are informed that the location which has been selected is very close to the actual power center of the system of lines contemplated five years hence; but this fact we are unable to verify, owing to the lack of time and knowledge of the requirements of the lines existing and to be built. The railroad facilities for the delivery of fuel are excellent. It, however, would have been a great additional advantage if proximity to free water for condensing purposes could have been obtained, but this latter objection could have been largely overcome by the use of the devices already mentioned.

The cost of operation, comparing station No. 2 with the data gotten from station No. 1 which we had intended to include in this report, we will give to you on a separate sheet the first of the coming week.

In conclusion it may be stated broadly:

First. That a plant of the same capacity could have been installed in about one-third the space.

Second. That such a plant as we have outlined could be operated at anywhere from 25 per cent to 50 per cent greater economy in fuel.

Third. That a great saving would have resulted in the first cost of land, foundations and buildings, which saving would have largely, if not entirely, offset any increased cost of machinery due to using types better adapted for your needs.

We take pleasure in commending the quality of the materials which have been used and of the mechanical work which has been done.

The dynamos selected are of standard manufacture, of high grade and are apparently giving excellent satisfaction.

The engines are excellent machines of their kind.

The boilers are made by a highly reputable manufacturer and to all outward appearances are very well constructed. We, however, have not as yet been advised as to the grade of steel.

The great amount of masonry work made necessary by the requirements of the machinery selected is of the highest grade.

The piping throughout seems to be excellent from a mechanical standpoint, but as to the proper sizes having been selected, we have not had time to inform ourselves.

Very respectfully submitted,
PIERCE, RICHARDSON & FOSTER,
Per C. F. Foster,
R. E. Richardson.

REPORT OF R. J. HILL.

CHICAGO, Mar. 20, 1897.

MR. G. H. WHEELER, President Chicago City Railway Company, Chicago, Ill.

DEAR SIR: Mr. Bowen handed me a report made a few days ago by Messrs. Pierce, Richardson & Foster, in relation to stations No. 1 and No. 2. On page No. 1, third paragraph, the gentlemen state that the equipment of stations No. 1 and No. 2 are similar. They evidently do not know what they are talking about, as there is no similarity between the two stations, as in station No. 1 we have 1000 h. p. units, while in station No. 2 we have 2000 h. p. units.

They take exception to the water not being metered separately to boilers. I claim that all water passing through the meter to the building is charged to this company and should be charged to the operation of that plant.

EQUIPMENT OF STATION NO. 2.

They maintain that the type of boiler, known as the horizontal return tubular, is not an economical steam generator. I beg leave to differ with the gentlemen, and will refer you to page 211, of the *Engineering Record*, dated Feb. 6, 1897, under the head of "Central Heating and Lighting Plant," and you will find the article gives full details and cuts of plant installed by Dr. Chas. E. Emery, consulting engineer of New York City. You will find that the installation has five horizontal return tubular boilers, of about the same make as all our tubular boilers. If the above boilers were not considered to be the most economical at the expiration of ten or fifteen years, I do not think that such an eminent man as Dr. Emery would install same.

I also refer you to pages 120 and 121 of report of Transactions of Institute of American Engineers, March, 1893.

I also refer you to page 265 of *Electrical Engineer*, dated Mar. 10, 1897, under the head of "Power Plant Engineering on Steam Railroads. You will find that in this article it states that horizontal return tubular boilers are installed by such people as the New York, New Haven & Hartford Railroad Company. I think, that after the thorough investigation that I know was made by the above mentioned company, they deciding to take the horizontal return tubular boilers and install same in their plants, means that some engineers of note consider the horizontal return tubular boiler to be the best and most economical steam generator, commercially, in existence to-day.

The report claims that we should have placed a controlling valve directly upon the boilers. We have no controlling valves in any of our plants. I would like to ask you, as president, how many times our plants have been disabled for the want of controlling valves upon any of the boilers.

The report claims that the connection between valves and tops of boilers should have been made of wrought iron instead of copper, and should be connected on the top of header and not on the side. I do not understand what they mean by having the valve on top of header instead of on the side, to assist in taking care of expansion, due to heat. The gentlemen claim that 8 in. connections between boilers and headers should have been made of wrought iron instead of copper. If you investigate you will find that 8 in. copper pipe made here is cheaper than 8 in. wrought iron pipe bends which would have to come from Pittsburgh, as that is the only place where such large pipe can be bent.

HEADERS.

The report says that the headers should have been placed on rollers and anchored in the center, to prevent same from moving, to throw the expansion in both directions from the center. I should like to ask you, if, in place of the 18 in. copper connections, we had put in wrought iron pipes, and connected same with the headers, and the headers on rollers anchored in the center, how in the name of common sense could there be any expansion and contraction between the centers of the drum, where same are anchored, and the 18 in. pipe?

WATER PIPING.

The report claims that the method of feeding the water to the boilers is faulty. The exception they take carries no weight.

The water in its passage through the mud drum up through the connecting nozzle to the boilers becomes heated to about the same temperature as the water in the boilers, which reduces the contraction that would occur if the water was delivered to the boilers direct from the heater. I can only refer you to our boiler repair account, and you will find that we have expended about $1000 for repairs on tubular boilers during the past six years. The feed pipes in all our plants are the same. Had same been faulty, as the gentlemen claim, we would have nothing but a succession of repair bills to pay and, perhaps, several explosions.

STEAM PIPING.

Had the gentlemen made the request, drawings would have been furnished them, giving all information as to detail, sizes of pipes, etc.

ECONOMIZERS.

In stating that, "In a new installation properly planned an economizer is never necessary" they place themselves in direct controversy with such men as William Kent, E. D. Leavitt, Edwin Reynolds, George H. Barrus, F. S. Pearson of New York, Professor Carpenter of Cornell, Professor Cooley of Ann Arbor, B. J. Arnold, and William Bryan of St. Louis.

In practice they condemn by this statement the very latest designed plants both in Europe and America. Throughout Germany, France and England, economizers are universally used and the very latest designed plants in America are now installing economizers or have them in operation. As a substantiation of this statement we cite the following new stations using fuel economizers, which installations, as near as I can get at it, have all been made during the last three years:

Boston & Maine Railroad Company, Boston, Mass. . . .	2000 h. p.
West End Street Railroad Company, Boston, Mass. . . .	2000 "
Brooklyn City Railroad Company, Brooklyn, N. Y. . . .	12000 "
Baltimore City Passenger Railway Company, Baltimore, Md.	4000 "
Cincinnati Street Railroad Company, Cincinnati, O. . .	3000 "
Columbus Central Railway Company, Columbus, O. . . .	1500 "
Detroit Railroad Company, Detroit, Mich.	5000 "
Holyoke Street Railroad Company, Holyoke, Mass. . . .	1000 "
Lake Cities Electrical Railroad Company, Michigan City, Ind	300 "
Consolidated Traction Company, Newark, N. J.	2500 "
St. Charles Street Railroad Company, New Orleans, La. .	2000 "
New Orleans Traction Company, New Orleans, La. . . .	2500 "
Philadelphia Traction Company, Philadelphia, Pa. . . .	1500 "
Union Railroad Company, Providence, R. I.	2500 "

South Chicago City Railway Company, South Chicago, Ill. 1500 "
Springfield Street Railroad Company, Springfield, Mass. . 2000 "
Terre Haute Electric Railroad Company, Terre Haute, Ind. 1000 "
Toledo Traction Company, Toledo, O. . . . . 2000 "
Troy Street Railroad Company, Troy, N. Y. . . . . 1500 "
Grand Rapids Consolidated Street Railway Company, Grand Rapids, Mich. . . . . 1500 "
New London Street Railroad Company, New London, Conn. 500 "
Columbia & Maryland Railroad Company, Illchester, Md. 2000 "

Finally, I myself will admit that at one time I was opposed and held similar views to this report, but recognizing the necessity of keeping up to the requirements of modern practice I made a thorough personal investigation of the economizer, visiting Detroit, New York and Brooklyn for this purpose. I also very thoroughly examined an economizer that has been in operation for sixteen years in this city, and which to all appearances is good for ten years longer.

This report on economizers is so one sided that it appears to me that the writers can have but very little knowledge of the practical working of economizers in modern plants, or of the modern methods of firing boilers to make steam with economy. You can, I will admit, so design a boiler that the gases will exit so low an economizer is undesirable, but this at a great loss of fuel burnt under the boilers, for the reason that the greater the initial heat under the boilers the more rapid circulation of water in the boiler, which circulation all boilers must obtain to run economically. With boiler pressure of 125 lbs. it would be impossible under any circumstances to get any results at all from the boilers with less than 450 degs.

The idea of firing boilers with the aim in view of lowering the exit gases to the least possible point is bad enough, but the statement that it is necessary to have gases from 400 degs. to 500 degs. at the base of the stack to produce draft is still worse. In large stations of proper design, the stack should be designed with a view to furnish ample draft almost entirely independent of the gases. The statement that it is necessary to have from 400 degs. to 500 degs. temperature of gas at the base of the stack means that 13 per cent of the fuel is wasted in this way. According to this, boilers should be designed so that 13 per cent can be wasted in order to burn the balance of the fuel economically. When they say that it is necessary to maintain a stack temperature of 400 degs. to 500 degs. in order to secure sufficient draft they are manifestly in error, for with a stack of proper dimensions for a given installation of boilers, practically nothing is gained in draft by increasing the gases above 300 degs. Actual tests bear out this statement. In view of the fact that gases expand rapidly with rise of temperature, it is reasonable to presume that the stack resistance is greatly increased, due to the much greater volume of gas to be moved. This resistance, of course, increases with the rise of temperature.

The object of the draft is not forestalled if, by the introduction of an economizer, the steam pressure can be kept up, and at much higher efficiency than could be obtained without such economizer. This, in actual practice, has been demonstrated in hundreds of instances.

Economizers are necessary adjuncts to boilers inasmuch as they are additional heating surface to the boilers and utilize in a practical way heat units that are otherwise wasted.

The principle which will throw away heat units amounting to 13 per cent of the fuel, which years of experience has proved can be utilized in a practical way to heat the feed, must be wrong. And in practice it has been found that the height in stack alone is sufficient to produce the desired amount of draft to maintain the boiler pressure. With gases leaving the boiler at 450 degs., 150 degs. can be used to increase the feedwater temperature with an economizer from 210 degs. to 285 degs., and a saving of 12 per cent in fuel will result. The manufacturers of economizers stand ready to abide by an evaporative test to determine this, and have also the results of numbers of tests to produce at any time.

In a properly designed plant, boilers should be purchased with a view solely to their evaporative ability. This as regards fuel consumption, durability, first cost, maintenance and accessibility to clean should also be taken into consideration.

The temperature of gases leaving the boiler should not be the main factor of consideration in the purchase of a boiler on economical grounds. On the other hand the initial temperature of heat under the boiler and the adaptability of the boiler to utilize high initial temperatures to produce rapid circulation of water in the boiler must always be considered if the best results are to be obtained. It is a recognized fact among modern engineers having experience with the building of large electric power stations that the most economical boilers are those which have the most rapid circulation, and to obtain this circulation the temperature of the gases must leave the boiler considerably above the temperature of water or steam in the boiler.

It is interesting to note that economizers have lately been installed at the plant of the Armour Packing Company, of Kansas City. These condensers were put in on contract and under guarantee of 12 per cent saving of fuel. The economizers in question were lately subjected to an evaporative test of eight days' duration, twelve hours a day, and showed a saving in favor of the economizers of 12.5 per cent in fuel consumption. As the result of the test the Armour Packing Company has just ordered a second economizer for its new boilers, of 1500 h. p., now being installed.

ENGINES.

The report gives us credit for selecting the proper sized engines for the generators, but considers the engines very improper, as they should have been compound condensing, as they term it. I have always maintained that simple non-condensing engines, for street railway work was the most economical for your company to use and I believe from the reports herewith attached, marked Exhibit "B" you will agree with me. I base my calculations on the commercial efficiency of a plant installed with simple non-condensing engines, boilers and generators of the same general plan as our No. 2 station as against the commercial efficiency of a direct connected, compound condensing plant, of the same capacity, with water tube boilers and all the other appliances necessary to make such a plant complete.

GENERATORS.

It is an established fact that the repairs in a direct connected plant are something enormous. I claim that the following are the advantages of rope driven generators over direct connected:

1. Flexibility between engines and generators.
2. Distribution of weight in eight bearings instead of two.
3. Two to four per cent less frictional load.
4. Do not have to disconnect generator to repair engines, or *vice versa*.
5. Thorough insulation to generators, thereby lessening accidents.
6. Increase in life of apparatus from 25 per cent to 50 per cent.

On Mar. 3, 1897, the power house of the Union Traction Company, Philadelphia, was destroyed by fire, caused by grounding the current through the overhead traveling crane, the hook coming into contact with the commutator of one of the generators that was in operation. This plant had compound direct connected units.

On Mar. 10 or 11, 1897, The Detroit Street Railway Company that has compound, condensing, direct connected units, lost two of their armatures, the third armature was in repair, tying the road up for several hours, until they got steam on their other plant.

The Western Avenue plant of the West Chicago Street Railroad Company, have been tinkering with their generators contiually since they were installed.

It will be four years on May. 15, 1897, since the first current was turned on the Chicago City Railway lines, and we have not up to date had $200 in generator repairs.

The gentlemen give us credit for locating the plant where the railroad facilities are excellent.

OPERATION.

The report does not give the relative cost of operating station No. 1 and station No. 2, as they had no data to figure from, but the following figures give all the information necessary, and you will also notice the cost of operating expenses for several other plants.

Cost of compound, condensing, direct connected plant with six 880 k. w. units.	$600,000
Estimated cost of fuel, interest and depreciation, daily average twenty hours, 4445 h. p., on basis of twenty-five per cent less fuel than present plant.	
150 tons per day, at $1.10 . . . . . per annum,	$ 60,225
Interest at 5 per cent. . . . . " "	30,000
Depreciation, 5 per cent. . . . . " "	30,000
Total . . . . . " "	$120,225
Cost of present plant, including one-half of present building.	$345,000
Estimated cost of fuel, interest and depreciation, daily average twenty hours, 4445 h. p.	
200 tons per day, at $1.10 . . . . . per annum,	$ 80,300
Interest at 5 per cent. . . . . " "	17,250
Depreciation, 5 per cent . . . . . " "	17,250
Total . . . . . " "	$114,800
Actual saving per annum, in favor of single expansion engines, or 2⅜ per cent less.	$5,425

Will also say that A. H. Blackburn, A.S.M.E. and M.I.M.E., in giving his experience and opinion on rope driven work states as follows:

"At the Liverpool (England) Elevated Railroad, after careful consideration, it was decided to use the rope drive when the plant was first erected 3½ years ago, and a new engine having been lately installed, the engineers decided that there was no reason to change to direct connected, the rope drive having given satisfaction in every way.

"In the Detroit electric light plant, erected by the city engineer about two years ago, it was decided to use rope drive for all their machines, and when the writer was last there the city engineer said the same was giving them every satisfaction. He decided on this arrangement in preference to direct connected for reasons similar to those stated above.

"In the new plant of the Edison Electric Company, Paterson, N. J., I noticed they are using the rope drive for arc light machines, which plant is considered up to the very latest practice, and is the most economical light plant in America to-day." (It is interesting to note that this plant has the same type of rope drive as we have in our No. 2 electric station).

"English engineers have to design their plants to show good economical results at the end of each year, and not so much to show great results on special tests and, therefore, he has to eliminate every chance of breakdown and expense of repairs.

"In looking over your plant this winter I noticed many features about it, and especially your rope drive, which must commend itself to the practical engineer; it having been designed with a special

object to avoid any chances of breakdown, and being quickly and easily repaired if a breakdown should occur."

For convenience of comparison I have carefully inquired into the cost of building and operating certain street railway plants in this city. I have tabulated this, as well as our own, and furnish you attached the information in regard to these plants.

	C. C. Ry. Co. Station No. 1.	C. C. Ry. Co. Station No. 2.	Metrop. West Side Station.
Fuel	$.004876	$.003666	$.003342
Water	.000356	.000267	.000082
Labor	.002190	.000742	.002130
Supplies	.000125	.000108	.000418
Total	.007547	.004783	.005972
Interest	.001802	.000843	.002184
Depreciation	.001502	.000702	.001819
Total	.003304	.001545	.004003
Repairs	.00002	.000030	.000327
Total	.010871	.006358	.010302
Cost of station	$385,000	$400,000	$636,000
K. W. capacity	5,250	5,280	4,500
Cost per K. W.	$73.33	$75.75	$141,33
K. W. hours	1,067,900	2,375,000	1,460,000

I will call your attention, particularly, to the fact that our No. 1 station cost, per kilowatt capacity, $73.33½. Our No. 2 station, in its present form, complete, cost $75.75 per kilowatt. This takes into account the land and building for a plant double the present size. When the balance of the machinery is installed, making the total capacity 10,560 k. w., the cost per kilowatt will be $66.28. You will notice that this is fully 30 per cent. below the Western Avenue station, which is the highest type of a direct connected plant that runs non-condensing.

I consider the minimum investment a very attractive feature, inasmuch as there is a lessening danger of a large loss being scheduled through any accidents which may befall a plant of this size.

The only station approximating our No. 1 station, in commercial result, is the West Side Metropolitan station. They are only doing this from the fact that their kilowatt capacity is 4500. The basis upon which I have figured their cost of operation is 1,400,000 k. w. hours per month, while our No. 1 station, which has a kilowatt capacity of 5250, was figured upon a basis of 1,067,000 k. w. hours. When this station can be in service, giving the same percentage of output per kilowatt capacity, we will show a better commercial result than the Metropolitan Elevated.

You will note carefully the schedule of our No. 2 station. We will operate this station for less than .006 per kilowatt hour. You will kindly note the figures given as proof of this statement.

Does it not occur to you that the proper way to look at this matter can only be from a commercial standpoint?

Yours very truly,

R. J. HILL, Chief Engineer.

Depreciation.*

BY H. E. MCJILTON, SECRETARY AND AUDITOR BALTIMORE TRACTION COMPANY.

I will first take up what the definition of the word "depreciation" is. As laid down by Webster, it is as follows:

First.—The act of lessening, or seeking to lessen, price, value or reputation.

Second.—The failing of value; reduction of worth. "Burke."

Third.—The state of being depreciated.

The second definition seems to most clearly define the subject to be treated, and with that in view, my next step will be to divide the subject under two heads, as follows:

First.—"What should not be charged to depreciation," and

Second.—"What should be charged to depreciation."

For convenience, I will give, first, some of the most important items which should not be charged under the heads of the different subdivision of accounts.

WHAT SHOULD NOT BE CHARGED TO DEPRECIATION.

Transportation Expenses.—Renewal of fare registers, punches, etc.

Motive Power.—Repairs or renewals of dynamos and their parts, the labor in removing and replacing; renewals or repairs of the switchboard equipment, and labor making such repair or renewal; renewal of armatures, commutators, bearings and boxes, fields, gears, pinions, trolleys, lightning arresters, rheostats, switches, etc., the cost of labor replacing same, and making connections with those damaged or destroyed.

Renewals or repairs to steam plant in power houses, including boilers, engines, pumps, shafting, belts, piping, steam fitting station fixtures, etc., etc. The cost of labor necessary in making such renewals or repairs.

Repairs or renewals of tools, machinery, shafting, boilers, engines, etc., in shops of the company, including labor, etc.

Maintenance of Way.—Renewal of conduits (cable or electric), rails, cross ties, paving, trolley poles, feed and span wires, and appliance for suspension and insulation of same; track bonding, drains under tracks, flooring bridges, frogs and switches, joint fastenings, tools, implements, wages of laborers engaged in this work; repairs to power stations, car houses, car shops, repair shops, blacksmith and machine shops; coal chutes and bins; pits in car houses and shops; cranes in power houses, buildings, wharves, etc., etc.

Maintenance of Cars.—New cars taking the place of old to make the number good; repairs, including labor, to keep cars up to standard; renewals of trucks, axles, wheels, brakes, headlights, brake shoes, axle boxes, springs, sand boxes, etc., etc.

None of the above items should be charged to "depreciation," for the reason that the first cost has either been charged to construction (or plant) account, or carried as an asset in other accounts, and to these nothing should be added, except for the first and original cost of the property. If, therefore, these are not chargeable to any of the above accounts, repairs of every description and character must necessarily be chargeable to operating expenses, less amounts received from sale of removed or defective parts, in order not to wrongfully increase the assets of the company.

Further, inasmuch as the operating accounts of the road receive all the benefits of the cost of the first installation, operating expenses should stand the cost of repairs, including labor and all renewals. This is essential notwithstanding they all add materially to the present or future value of the property; but in order to get at the correct cost of the operation of the road, as a whole, or per car mile, you do not arrive at a proper basis for calculation until the second or third year of operation; and it is not fair to compare a newly equipped road with one which has been in operation a number of years.

WHAT SHOULD BE CHARGED TO DEPRECIATION.

It is, no doubt, a well understood fact, that it matters not how much is spent and charged to operating expenses in order to keep the plant of a street railway company or manufacturing corporation in first class condition, it is never, after once put in operation, considered as good as new, for the reason that more improved machinery, etc., can be purchased later on to replace same—often at a reduced cost.

This is most important in the case of loss by fire, when you are making up your schedule, preparing for settlement of your loss with the insurance companies (as those having gone through the experience of fires know), there is always a certain amounted deducted by insurance companies on account of "depreciation," whether apparent or not. And the same state of affairs applies to the sale of any particular piece of machinery, etc., which has been discarded.

Therefore, conceding the above to be true, by charging the cost of repairs and renewals to operating expenses, your property is virtually in as good a condition, physically, at the end of each year, as it was in the beginning. At the same time, agreeing that there is a "depreciation," it is wise and appropriate for corporations to set aside, at the end of each year, such an amount as is warranted, after a thorough and impartial inspection of the property.

I further believe that it is thoroughly understood that circumstances alter cases, but by carefully following out the above method, it is the opinion of the writer that you will not go wrong, but will be protecting the assets of your company, and I know of no better way of doing this than by charging to operating expenses all renewals and repairs, as I have indicated in the first part of this paper, and by the accumulation of a fund as an offset against such depreciation as cannot be covered by charged to operating expenses.

*Paper read before the Association of Street Railway Accountants in Cleveland, Mar. 23.

Meeting of the International Tramways Institute.

The International Tramways' Institute of Great Britain was held at Huddersfield, Apr. 8, with quite a large attendance of delegates present. Pres. John Fell, of Leamington, presided. Two papers were presented; one, on the "Huddersfield Tramways and the Municipalization of Tramways," by J. Pogson, general manager of the Huddersfield tramways, and the "Walker System of Electrical Traction," by Justus Eck, chief engineer and managing director of Laing, Wharton & Down, of London and Leeds. Mr. Pogson gave the financial results of the operation of the Huddersfield Tramways Company which employs steam motors and which has a length of about 20 miles of single track and 1 mile of double track. In the discussion which ensued most of the delegates advocated the operation of cars on Sundays, which is not done in Huddersfield.

Mr. Eck described the construction of the Walker generators and motor equipment, and stated that this company was manufacturing five standard types of motors, from 25 h. p. to 125 h. p., and twenty-two types of generators. Nearly one hundred lines were working on this system with great success. The paper was illustrated by means of lantern slides and diagrams.

Street Railway Parks.—III.

KANSAS CITY, MO.

The Metropolitan Street Railway Company, of Kansas City, serves two pleasure parks, one of which is on a city line about 2 miles from the center of the city, and the other on a suburban line about 6 miles from the center of the city. Both of these parks are leased and improvements have been made by the railway company. In the city park the company operates a merry-go-round, shoot-the-chutes, boats, etc., and keeps a small zoological garden. This little collection of animals has been found very interesting to patrons, especially to children, and the company is endeavoring to add to the collection from year to year, as it thinks that in a park that is so easy to get to and where attractions are somewhat limited, a zoological garden pays better than anything else that it can furnish.

At the suburban park, bowling alleys, bathing and fishing are used as attractions and Shetland ponies are also kept for children to drive. The officers of the company state that they have tried not only theatrical performances, but vaudeville shows of every class from the poorest to the highest priced, and have found that nothing pays as well as good music. The company, therefore, hires the very best bands that it can secure. A small home band was employed for awhile, but the drawing qualities of home talent were found to be quite limited, and for this reason, especially during the month of August, the company endeavors to secure some band of national reputation. It is able to employ higher priced attractions at its suburban park, owing to the fact the charge for the round trip is fifteen cents. At the city park the company supplies cheaper music, and finds that it draws very well, owing to the fact that the park is very convenient to get to, and the round trip is but ten cents. The "shooting the chute" attraction is operated by a separate company and proved a very good drawing card last summer. Fireworks have always been very successful. On its suburban line the company finds that the increase in traffic due to the park is about 40 per cent, and on the city line about 30 per cent.

CINCINNATI, O.

The Cincinnati, Newport & Covington Railway Company serves one park which is owned by private persons, who are also interested in the road. The park is situated about four and one-fourth miles from the city and twenty-five cents admission fee is charged. The park contains a large lake on which illuminated parades are held. Electric launches, steam boats, sail boats, row boats and canoes are in operation on the lake and are operated by the lessees of the park. The electric launches are four in number and were made by The Electric Launch Company. They have been a good advertisement, and one of the best paying investments on the grounds. A charge of ten cents is made for a trip around the lake, which is about two miles in circumference and has five small islands, on which are different kinds of amusements. The water is from fifteen to forty feet deep, and admirably adapted to all kinds of river craft. An electric light plant of about 400 h. p. is used to produce handsome illuminating effects during the evening. The batteries of the boats are charged from the regular lighting circuit of 110 volts for four to seven hours each morning, depending upon the amount of service the day before. The park has been in operation two seasons and $33,000 was netted the first season, and $21,000 the second season. A few entertainments have been given, which have, however, proven expensive, although successful. The restaurant privileges are owned by the lessees. The company states that traffic on the park line increased from $125 per day when the park was closed, to $550 per day when the park was opened.

LAKE AND PAVILION—TROOST PARK, KANSAS CITY.

CLARKSVILLE, TENN.

The Electric Street Railway Company, of Clarksville, serves one park which is owned by outside parties. The street railway company pays the park owners a certain percentage of the receipts on the line, and five cents admission fee is charged to persons not going on the cars. Music is provided twice a week and on Sundays. The company found that the increase in the railway traffic was very large when any special attraction was offered at the park.

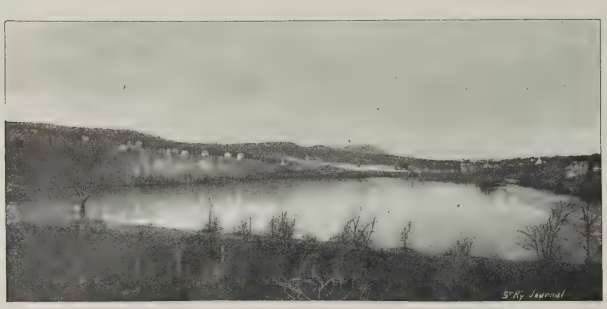
MARINETTE, WIS.

The Marinette Gas, Electric Light & Street Railway Company serves two parks, one of which, Lakeside Park, is owned by the company, and the other, Higgins Park, by the president of the company. Higgins Park is in the city and Lakeside Park is situated on Green Bay. No charge for admission is made, except to the theatricals and band entertainments. Row boats, sailing boats and baths are in operation and leased to outside parties. The company

has not had very good success with theatrical performances, but thinks that parks, properly built and located, and properly run, help to increase the traffic.

PATERSON, N. J.

The Paterson Railway in addition to serving a park also serves a pond which is used for skating purposes during the winter season. The company does not own the pond, but has made arrangements with the owner by which he permits skating on the pond. This pond is located on the outskirts of the city near the terminus of one of the street railway lines. The owner of the pond charges an admission of five cents which keeps the rougher class off the pond and induces a better class of people to patronize it. The company shares the expense of electric lights at night and the pond is well lighted with arc lamps. During Christmas week the owner of this pond made gross receipts of about $1000 at five cents a person, and the Paterson Railway Company carried the majority of these people both ways, and without very much additional car service to the regular schedule. The railway company looks after the pond during the entire winter, and in some



SKATING POND—PATERSON.

cases assists the owner in clearing it of snow, but usually the owner of the pond does this himself, and at his own expense.

The Paterson Railway also serves a place on the Passaic River called "Dundee Lake," on which good skating is usually had for a part of the winter. This place is about 2½ miles from the center of the city, and when the ice is in good condition it is a most popular place for skaters, and the company derives a very large traffic from skaters going to this place. On two days during the last season there were about 5000 people each day on this lake. The railway company cleared the snow off the ice for a sufficiently large space to accommodate these people. The snow was cleared in the following manner: the company has a wedge-shaped plow built which is about 15 ft. across the base, to which two horses were attached. This was pulled over the lake, cutting a great many paths. This can be done in a very short time and gives skating immediately. At various places on the lake an ordinary scraper used by icemen was put in operation with which large patches of ice were cleared. The paths connected these open places with each other. The officers of the company state that it costs about $35 for clearing the snow after a recent hard storm, and on the next two days about $400 in fares were received from the skaters going to and from the lake. The company provides a neat waiting room at the terminus of its lines where hot and cold drinks are served, together with sandwiches, pies, etc., and where coats can be checked. Benches are provided at different places on the ice for the convenience of the skaters.

SEDALIA, MO.

The Electric Light & Power Company, of Sedalia, serves two parks, one of which it owns. The latter park contains about 40 acres and is about 3 miles from the center of the city. The company provides at this park boating, balloon ascensions, shoot-the-chutes, etc. The shoot-the-chutes and boating privileges are leased. The restaurant privileges are now operated by the railway company, as it is found that when these privileges are leased to outside persons only a small amount can be derived therefrom. It is found that the park more than doubles the railway traffic during the summer, and that the income derived more than pays the expense of maintaining the attractions.

ST. JOSEPH, MICH.

The St. Joseph & Benton Harbor Street Railway serves one park which is situated 3½ miles from St. Joseph and 1½ miles from Benton Harbor. The principal attraction at this park is a large pavilion where entertainments of various kinds are given. These entertainments are found to draw very large crowds. The restaurant privileges are leased to outside persons. The company states that the railway traffic is increased from 10 to 100 per cent per day by this park.

HOT SPRINGS, ARK.

The Hot Springs Street Railroad serves two parks, one of which, Whittington Park, is owned by the railroad company and the other, a U. S. Reservation park, is owned by the United States Government.

Whittington Park contains about 40 acres and is situated about 1¾ miles from the center of the city. The street railway company supplies all the attractions and amusements at this place. On special occasions a small entrance fee is charged, but usually the park is free to visitors. This park contains a large lake, which is a very great attraction. Arrangements are made for good boating, fishing, swimming, etc., the privileges for operating the boats being leased to an outside company. Very fine baseball grounds and a good bicycle track have been laid out, and a large number of baseball clubs, professional bicycle riders and football teams give exhibition performances here while training for their season's work. Live bird shoots, Wild West shows, fireworks, chariot races and pony races are frequently given. No intoxicating liquors are sold on the grounds and perfect order is maintained at all times. The company makes a specialty of attracting ladies and children to the place. The park is always given free to Sunday school picnics, church entertainments, political meetings, etc., and at these times the gates are usually closed. A small admission fee is then charged, the railway company receiving a percentage of the gate receipts. This company has introduced a particularly novel attraction in the shape of negro revival meetings and baptisms. These baptisms are held in the lake on Sunday afternoons and draw large crowds. Noted colored evangelists are secured to take charge of the services. The restaurant privileges on the ground are leased for about $300 a year. The expense of maintaining the park and attractions is about $3000 a year, but the receipts of the park about cover these expenses, besides paying for all labor at the park and for all improvements and repairs. The receipts of the park line are increased fully 25 per cent by reason of the park. The park also helps the other lines of the company considerably.

BINGHAMTON, N. Y.

The Binghamton Railway Company serves three parks; one is owned by the city, one is leased and the other is owned by the company itself. These parks are situated 1½ miles, 1, and 8 miles respectively from the center of the city. The company gives a varied class of entertainments at its parks and states that the increase in traffic on the lines leading to the parks is very large.

POTTSTOWN, PA.

The Ringing Rocks Electric Railway Company owns a park 200 acres in extent, situated about four miles north

of Pottstown. Minstrel and theatrical performances are provided and there are a number of caroussels, a switchback, bowling alley, shooting gallery, etc. The privileges for all these are leased to outside persons. The company states that about $4000 is received from these sources alone. Theatrical performances have always been a success financially at this park. The restaurant privileges of the park are leased for twenty-five per cent on the gross receipts. The road depends greatly on the park for its traffic.

FREEPORT, ILL.

The Freeport General Electric Company serves a park of about 70 acres which is owned by private persons. The park is situated about a mile from the center of the city. No admission fee is ordinarily charged, but when some special attraction is given at the park, from five cents to $1 is charged for admission. Bicycle and horse races are frequently held, and vaudeville shows, concerts, etc., are provided at intervals. It has been the experience at Freeport that fireworks and theatrical performances do not pay very well except where the entertainments are given entirely on a percentage basis. It is found that entertainments of this character increase the travel to a certain extent, but not sufficiently to warrant the company in hiring the attractions outright.

NEW BEDFORD, MASS.

The Dartmouth & Westport Street Railway Company owns and operates Lincoln Park, which is situated half way between the cities of Fall River and New Bedford, about 7 miles from either city. It consists of a station, casino, theatre building, merry-go-round, Ferris wheel, toboggan slide, clam bake, pavilion, band stand, etc., all nestled in a deep pine grove. The park season opens May 30 and closes about Sept. 15. During July and August a band gives daily concerts, and there is free dancing in the casino and light vaudeville shows in the theatre afternoons and evenings. Clam bakes are served Wednesdays and Sundays in the pavilion built for that purpose. From a restaurant meals are served. The catering and clam bake privileges are let out by bids. The toboggan and merry-go-round privileges are leased. Admission to the park is free, but a small charge is made to the theatre. It was found last season that light vaudeville shows were the best attractions that could be provided, and the receipts of the road were very materially increased by the park riding.

BRANTFORD, ONT.

The Brantford Street Railway Company serves one park which it has leased for a period of twenty years. This park is known as Mohawk Park and is situated 1¾ miles from the center of Brantford. All passengers on the cars of the company are admitted free to the park if they so desire. The park contains about fifty acres of wooded rolling land with high bluffs looking over a beautiful little lake about one-fourth mile wide, three-fourths mile long. This lake has been formed by damming up an old canal through which the steamers used to come to Brantford from Buffalo. Boats and canoes, which are leased to another company, are kept on this lake for hire, and bathing houses are being talked of for next year. The boats are kept very clean and neat, are richly cushioned, and at night are hung with Chinese lanterns. The park is also provided with athletic grounds and a bicycle track where ball games, la crosse games and bicycle races are frequently held. It has been the experience at Brantford that fireworks are too expensive to be successful as attractions, and that theatrical performances do not take very well. Band concerts, however, have always attracted large crowds. The cost of maintaining this park, together with the attractions,

PAVILION—BRANTFORD.

amounted to about $531 last year. The company derived about $600 from the lease of restaurant privileges and about $400 from other privileges. About sixty special excursions were carried to the park during last year, and the company states that the park is a great benefit to the line.

VIEW IN MOHAWK PARK—BRANTFORD.

BENNINGTON, VT.

The Bennington & Woodford Electric Railway serves two parks which are owned by outside corporations. These parks are situated 4½ miles and 9 miles respectively from the center of the city. The owners of the parks derive their income from the amusements provided and from the

restaurant privileges. Fireworks, theatrical performances, vandeville shows, orchestra concerts, etc., are provided at the parks at frequent intervals. These parks are paying the owners about 12 per cent on the investment. The railway company states that the traffic derived from these parks is very heavy and that the largest crowds were carried when fireworks were the attractions.

RICHMOND, VA.

Richmond has a very interesting park, situated about 5 miles north of the city on the Brook Turnpike Boulevard, which is a macadamized road 100 ft. wide. This resort is known as Lakeside Park and contains 145 acres of ground, 15 acres of which are covered with a lake. This place was formerly an old mill site, but several years ago it was purchased by a wealthy gentleman, who has made a great number of improvements. The park at present is reached by electric cars to Sherwood Station, from which a dummy line carries passengers to the park. Arrangements have been made, however, by which the Richmond Railway & Electric Company will extend its electric line the full distance to the park. The owner of the park

PAVILION—LAKESIDE PARK, RICHMOND.

has recently built a dancing pavilion, a restaurant, a bowling alley, and several other buildings upon the grounds. He has secured quite a collection of animals and is enlarging this collection from time to time. The Lakeside Wheel Club House is situated in the park, and has a membership of 250. A nine-link golf course has been laid out, and a half mile bicycle track is in process of construction. A small admission fee of five cents is charged in order to keep out an objectionable class of people. No intoxicating liquors are allowed.

HOMESTEAD, PA.

The Homestead & Highlands Street Railway serves one park known as Schenley Park, which is owned by the City of Pittsburgh. This park contains about 400 acres and is fitted up with a large number of attractions, most of which are private enterprises. The street railway company does not provide any of the attractions, but secures a very satisfactory railway traffic to the park. This park is provided with an electric fountain, free public library, museum, art gallery, etc. Band concerts are frequently given and flower shows are held at frequent intervals at a conservatory on the park grounds. The restaurant privileges are usually leased for one-third of the gross receipts.

SHAMOKIN, PA.

The Shamokin Street Railway serves a park which is known as Indian Park, and is leased by the railway company. This park contains 80 acres, and is situated 1½ miles from the center of the city. The company provides musical entertainments of various kinds, and finds that they make good attractions. The restaurant privileges of the park are all leased. The expenses for maintaining this park for the last year were $1836.

OPERATING EXPENSES.

A company operating a very fine park on the Atlantic Coast gives the following cost of operating its park during 1896. As will be seen, the park does not quite pay its own expenses, but the increased pleasure traffic a great deal more than balances the deficit.

EXPENSES.

Orchestra in park—10 pieces	$1,200
Free shows	2,400
Fireworks	800
Expense of running electric fountain	175
Balloon ascensions and parachute jumps	400
Other miscellaneous attractions	300
Attendants	500
Total	$5,775

RECEIPTS.

For rentals	$3,500
Seats for entertainments	500
Percentage from ball games and from grounds	500
Total	$4,500

A Terse Opinion.

The Brooklyn Heights Railroad Company has a very complete system of investigating the record of every applicant for employment on its lines, and its experience has shown that too much care cannot be given to looking up the previous career of persons wishing to enter its service. Not only must a man bring a letter of recommendation from some person upon whose word the managers can rely, but he must also give three other references as to his intelligence and ability. These references are not simply filed away, but are investigated before the man is employed. The wisdom of this has been shown in a number of cases. In one of these which occurred recently an applicant for a position on one of the company's suburban lines brought a very strong letter of recommendation from a prominent city official. Among his other references he gave that of his last employer. Inquiry from the latter as to the applicant brought forth the following letter:

"In reply to your recent favor I would state that———— has been in my employ nearly two years as a man-of-all work around the place. He is in my opinion, a person whose brain acts slowly, the lapse of time between thought and action is abnormally long; in other words he is mentally obtuse. His other fault is that he has an alcoholic tendency. He is invariably incapacitated for work after his return from the city. Otherwise the man is strong, healthy and honest.

"I would hardly regard him as fitted for the position of motorman where sobriety and quick action are essential features."

It is needless to say that the man was not engaged.

Sanding Tracks in Albany.

The sand cars employed in Albany are constructed from old horse cars. The storage bins, which are about 2 ft. wide and 2½ ft. high, extend the whole length of the car and are placed on each side, leaving an aisle in which the operator stands and controls the valve for regulating the flow of sand, the delivery pipes being placed between the wheels directly above the rails. On the steep grades the tracks are cleaned and sanded by hand. The equipment of the Albany Railway, including track, line work and rolling stock, is in exceptionally fine condition and demonstrates that an electric system can be kept in first class shape even under heavy service. The system is to be extended during the coming season, and the addition includes a line to Cohoes and on this extension double truck cars will probably be employed.

LETTERS AND HINTS FROM PRACTICAL MEN.

Trolley Pole Protective Device.

Union Traction Company,
Thirteenth and Mt. Vernon Streets,
Philadelphia, Pa., Mar. 23, 1897.

Editors Street Railway Journal:

To avoid the trouble, breakage and loss of time caused when a trolley pole leaves the wire, while the car is in rapid motion, I some time ago devised the apparatus shown in the diagram below. Being aware that there were already on the market for this purpose, several mechanical devices which merely serve to pull the pole down out of harm's way and leave the car to drift, I sought to obtain some simple and efficient automatic electrical method, which would act more quickly and satisfactorily.

It quite frequently happens, as I have often noticed on our city lines, that the conductor is busy inside the car when the pole flies off the wire, and by the time he manages to reach the rope, the car has passed a span or bracket arm. The chances are then that the span breaks or the trolley pole bends, as a weak spot is developed in either.

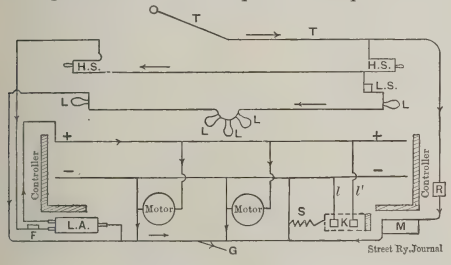


DIAGRAM OF CONNECTIONS.

The advantages of such an arrangement as I suggest are therefore manifest.

In making the sketch I have not attempted to give the exact connections of motors and controllers, as it would involve a complicated drawing not easily understood by those not familiar with car wiring.

The operation of the device depends upon the magnet, *M*, which is supplied with current by tap, connected to the trolley at trolley base, so that it will receive current as long as the pole remains on the wire. *R* is a high resistance in series with the magnet, so that the current used is reduced to as small a quantity as is consistent with the correct action of the magnet. Let us say that it is 5000 ohms. Then with current at 500 volts only one-tenth of an ampere would be required to compensate for low amperage; turns can be piled on to bring the magnet to the desired excitation.

The spring, *S*, is to be so adjusted that it will pull the sliding switch and short circuit the leads, *l l'*, when the armature is released by the magnet, as the current ceases to flow through its coils.

The action of the magnet is as follows: when it does not receive current, it releases its armature, thus closing the circuit of the motor through leads, *l l'*, causing the motor to generate current and bringing the car by this means rapidly to a stand. The instant the current flows again the armature is attracted and moves up towards the magnet, breaking the motor circuit. The spring which actuates the switch blade should be considerably weaker than the tractive force of the magnet, so that under normal conditions the action will be positive.

The connections could be so made as to cause one machine to generate current to turn the other as a motor, as utilized in some forms of electric brakes. The extra apparatus required for a car equipment with a fuse in circuit can be placed in a small box beneath the car, in an easily accessible position.

W. Sonneberg.

Employes' Club in San Francisco.

Market Street Railway Company,
San Francisco, Cal., Mar. 19, 1897.

Editors Street Railway Journal:

In the latter part of 1896 a movement was set on foot among the employes of the Haight Street division of the Market Street Railway Company to see what might be done toward starting a reading club. It was quietly talked of among the employes, even going as far as to see what our company would do toward constructing a room suitable for our uses. For some reason or other, after going as far as this, the whole matter lay in abeyance for a month or more, and would have died a natural death had not our general manager, E. P. Vining, taken up the question, asked our desire, and requested a petition to the company, making known our wants.

From here we started with a new lease of life. The petition mentioned was circulated, resulting in the signatures of very nearly our whole working force, some eighty men, and forwarded to the general manager. In the course of a week or ten days, a force of carpenters was at work on our new room, which is 25 ft. × 30 ft., nicely painted in a light drab, furnished with a large table, and settees extending all around the room. Our next move now was to secure funds to complete furnishing the room and procuring instructive reading matter. A subscription list, levying an assessment of $1 for all regulars, and 50 cents for all extras was posted. As is usual in subscriptions of this kind, a flat failure resulted. Here we were with a fine room on our hands and the purpose we were most anxious to accomplish going to its second death. But for the zealous efforts of a few, and the volunteering of two of our number to make a personal canvass for funds, the room so graciously furnished us would have been but a foolish caprice. Success always attends determined efforts, so it was with our volunteers. After making their canvass we found we had a fund of $50. We were in a position to properly organize, which we did on the evening of Jan. 12, 1897.

A meeting was called and arrangements perfected for a permanent organization, to be known as the "Haight Street Car House Reading Club." The officers consisted of president, secretary and treasurer, and an executive committee of three. Rules and by-laws were also adopted.

The executive committee was instructed to secure the best literature possible, with the following results: we have three San Francisco dailies, Street Railway Journal, *The Century*, *Harper's Weekly*, *Scientific American*, *Railway Age*, *Power*, *and American Electrician*. As amusements, we have several games of checkers and dominoes.

It might strike distant minds, that ten standard periodicals would not reach around among eighty men, but the facts are, tastes are so divided that between the harmless games and papers, each finds what is to his liking, and there is no conflict. Think of being a subscriber to *Harper's Weekly*, Street Railway Journal, *Century*, *Scientific American*, and half a dozen more of the very best periodicals, for only fifty cents per year.

Our room has so gained in popularity that many who first subscribed reluctantly, will, no doubt, do so with alacrity at the expiration of the year, when we mean to add a comic paper to our list, for the benefit of those who desire it for diversion, or for those who have a chance ten minutes in which they may pick up a paper and trade off cares for a smile.

It may perhaps be out of place for an ordinary conductor to offer suggestions, but is it not to the best interests of the railway companies to have intelligent men operating

their cars? Granted for argument sake, such is the case, why would it not be a good idea for the managers to assist in pushing a scheme of this kind on their various roads?

In conclusion, would say, to anyone wishing further information regarding this work, we will be pleased to give all data in our possession.

H. W. Nelson.

Cost of Electric Motive Power for a Small Railway Plant.

Apr. 20, 1897.

Editors Street Railway Journal:

In your April number I see you give many figures on cost of power in European railway plants. We are thinking of building a street railway and it occurred to me that you perhaps could give us some valuable information in regard to cost of power for same. I will give you a description of what is proposed.

The power house is at one end of line (located there for easy hauling of coal and plenty of water). The engine is of 200 h. p., compound condensing; the coal is common "run of mine" costing $1.45 per ton. The main line of road will be about 3 miles long, and about 1 mile from from power house a branch is run off at right angles, and this branch is about 2 miles long. There are about 5 miles of road in all. The furthest point on either line is about 5 miles from the power house. There are no heavy grades, but two or three long gradual ones, nothing over per 4 cent and I don't think over 3 per cent. Some or all of the track from the power house to the branch will be of about 48 lb. rail, bonded, and a No. 2 iron return wire can be used together with the gas and water pipes for return. Beyond this the rails will be heavier, say, 60 lbs. and bonded with two No. 0 wires, but with no return wire. The trolley wire is all we wish to use at first as a feeder, but may afterwards use a feeder as far as the branch, or 1 mile. The expectation is to run five cars, not less than this number, and possibly six cars. They would be the ordinary 18 ft. or 20 ft. cars equipped with two 25 h. p motors. The traffic will not be heavy, as the town has not over 8000 population.

Now can you and will you give us an estimate of about how much power each car will require, and how much it should cost us per day of seventeen hours for them? Say, divide it up this way: how much for the first two cars, then for the third car, then for the fourth car, and how much per day each for all over that number?

S. J. F.

[Information regarding the questions raised in the foregoing letter from those having experience with plants of this size will be welcomed and published in the next issue of the Street Railway Journal.—Editors.]

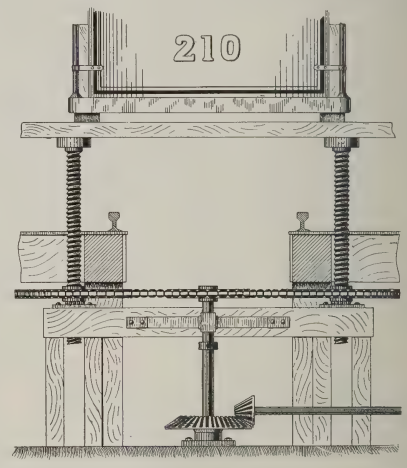
Guard Wires for Telephone Service.

Ira A. McCormack, general superintendent of the Brooklyn Heights Railroad Company, has been experimenting with the use of the ordinary guard wires carried over the trolley wire for telephone work. On a section about 3 miles in length of the company's Ridgewood lines three telephones have been installed. These are of the Keystone pattern and are connected by the guard wires. One is located at one end of the division where a starter is stationed, the second is placed at the other terminal of the line at the car depot at Ridgewood, and the third is installed between the other two and is employed by inspectors to notify either end of the line in case of blockades along the route by fires or for any other reason so that the starting schedule can be modified if desired.

The telephones seem to work very well and there is no apparent induction on the guard wires due to the fluctuations in current in the trolley wire. The system will probably be extended as by its use a complete system of telephonic communication can be maintained between the different stations on the line without any additional expense for cost of line construction.

Convenient Car Hoist.

The accompanying engravings show an ingenious form of car hoist for pit work in use by the Cleveland City Railway Company in its Lorain Street car shops, and for



END VIEW OF HOIST.

the information about which we are indebted to C. B. Easty, superintendent of those shops. As will be seen, the hoist consists of four screw jacks operated simultaneously by sprocket chain. The hoist can be operated either by hand or by motive power. Two men can raise or lower a car body

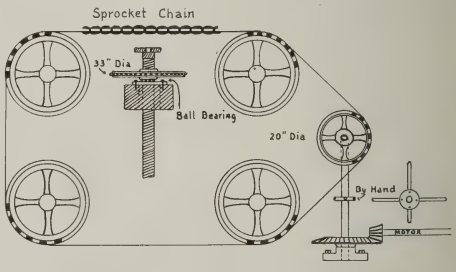


DIAGRAM OF HOIST CONNECTIONS.

by hand in about twenty minutes, or it can be raised or lowered by motor power in about two minutes. Since putting the hoist in operation it has been found very convenient, as it keeps the car bodies level.

The Denver Tramway Company has now permanently decided to issue book passes to women health inspectors. The men inspectors are allowed to ride free when in uniform, but as the women are not uniformed the pass is necessary.

A novel method of braking was tried on a car of the Albany (N. Y.) Railway not long since. The method consists in coupling the motors as generators and utilizing the electric heaters in the cars for resistance so that the speed of the car is readily controlled and the surplus energy is employed for warming the car. A second controlling stand is employed.

Repair Shop Accounts.

M. R. McAdoo, general manager of the Paterson Railway Company, Paterson, N. J., has recently introduced a very simple and effective method of keeping repair shop accounts, so that the work spent by the repair shop force on each car and all apparatus used on the line can be quickly determined by the managing official. The entire system requires only three books. One of these is the day book which is kept at the repair shops. Into this is entered all of the work done at the shop. The number of each car and the manufacturer's number of each motor are recorded after each item. The repairs indicated in this book are entered daily into a ledger in which a separate page is devoted to the repairs on each car. Each page of this book is ruled off into seven vertical columns with the following headings:

Date in.
Motor number.
Armature number.
Material.
Make.
Date out.
Miles.

The third book is a mileage book and a page is devoted to each car, the mileage made for each day by each car being entered therein.

The method of entering reports in the ledger is then as follows: in the first column, "Date in," is given the date in which the car is taken to the repair shop, and the date at which the car is taken out is entered in the column "Date out." The part of the apparatus renewed is entered in the column, "Material," and the mileage made since the last time of its renewal is entered under "Miles." To determine the comparative life of brake shoes, which are purchased by weight, the weight before inserting and when taken out are both recorded to give the mileage per pound of wear.

By means of this system a glance at the ledger not only tells the life of each part of the equipment removed from the car, but also shows the manager whether the time during which the car was removed from service for repairs was excessive for the amount of work done by it.

Accident and Car Accounts in New Orleans.

The method of keeping car and accident accounts by the New Orleans Traction Company is very complete, and differs from that employed by most companies in several particulars. One of the principal of these is the fact that the runs of the different cars are not kept by the car number directly, but by a "run number" which is marked on a small tag carried on the dash just under the dash rail. When an employe is assigned to any particular run he is given the "run number" not the car number, making it much easier for him to find his run. It frequently happens that a car is run into the car house for repairs and another run out in its place. In such a case the run number is transferred from car to car. This also affords an easy method of checking up a conductor, for when the run number and the time on and off duty are given the secret service man, he finds the car without difficulty. Since this system was inaugurated by the New Orleans Traction Company one other railroad has taken it up.

The general manager, general superintendent and all superintendents, station masters and inspectors are furnished with a copy in book form of the running schedules of the system. The schedules are reduced so as to get them in book form by photographing the original schedule down to the required size, and then binding them. All schedules are made out on ruled paper 14 ins. × 18 ins. in size, and india ink is used to write them out.

All accidents are reported to Claim Department by telephone, and if of a serious nature are immediately taken up and investigated. An accident report blank in folder form and printed on thick manilla paper is carried by every conductor, and when filled out is turned over to to the station master who sends it to the general office.

The blank is as follows:

New Orleans, La.....189.....

To Superintendent:

Dear Sir:—We have to report the following accident which took place in connection with our car this day, as follows:

Car No..... Line.....

Weather-Fair, Cloudy, Raining, Foggy: Track.....

Place of Accident..... Time.....M.

Car going in Direction..... Speed of Car..... No. Pass.....

Direction of Vehicle..... Speed.....

Name Owner..... Address..... Lic. No.....

Name of Driver..... Address..... Color.....

Name of Person Injured..... Address..... Color.....

Statement of Accident.....

.....

.....

Number of steps from point of collision to front end of car after car was brought a standstill after accident?

.....Steps This measurement was made by.....and witnessed by.....address.....

We certify the above is a true statement of the occurrence:

.....Conductor. .....Motorneer.

Badge No..... Badge No.....

Report any Accident within Ten Feet of Track, no Matter how Trivial.

As will be noticed, the distance from the point of the accident and the front of the car when stopped after the accident is carefully measured by the conductor or motorman and is witnessed by a bystander. On the back of the folder is a place for entering the names and addresses of witnesses and an index blank by which the report can be filed. Accidents are entered in an accident ledger, and monthly comparison is made on a special form under the following headings, the accidents for each line being kept separate.

Personal Injuries.

Killed.
Fell boarding or fell alighting from car.
Struck by car.
Injured in wagon collision.
Miscellaneous: Ejectments, disturbances, etc.

Other Accidents.

Intersection wagon collision.
Miscellaneous wagon collisions.
Animal shied and damaged car.
Miscellaneous accidents.
Car collisions.
Pavement accidents.

Total.

Average number of accidents per car for month.

Every conductor and motorman before being engaged is required to fill out an application. He is then sent on order to the station master at the station to which he is assigned, to be broken in. He is instructed by the instructor of that system and is examined by inspectors. If he passes muster, the station master approves his order, the inspector that examines him sends in his report, and reports on his behavior during the time of instruction. If after these reports the superintendent is satisfied with the work done by the man he is allowed to make his deposit of $25 and go to work. His application and reports are filed in an envelope, which in turn is filed away in the rack kept for this purpose. Every future complaint or reported violation of rule is filed in the same envelope; thus a complete record is kept on each employe.

THE Main Street and Agricultural Park Electric Railway Company of Los Angeles, Cal., commenced electrical operations Apr. 1. Power is being taken for the present from the station of Los Angeles Railway Company. The system is one of the oldest in Los Angeles and extends through one of the most important sections in the city. The rails are 6 in. T and are 60 ft. in length. The rolling stock was built by the St. Louis Car Company. The cars are mounted on double trucks with seating capacity for sixty passengers each and are equipped with the Westinghouse apparatus. Fred. W. Wood is the consulting engineer of the new system and J. L. McLain, the superintendent.

LEGAL NOTES AND COMMENTS.*

Edited by J. Aspinwall Hodge, Jr., and George L. Shearer,
of the New York Bar.

Conflicting Rights of Street Railways and Municipalities in the Highway.

In the August number of the Street Railway Journal we referred to a question that was being raised in several states as to the rights of street railway companies to prevent, by injunction or otherwise, the laying of sewers or other mains beneath their tracks in such a way as to interfere with their traffic in cases where the surrounding conditions were such that they could be as easily laid alongside of them or elsewhere without inconvenience to the railway company. To the cases then cited (*Lynch* v. *the Mayor, 76 N. Y. 760; Kirby* v. *Citizens' St. Ry. Co., 48 M.D. 168; Des Moines City Ry. Co.* v. *City of Des Moines, 58 N. W. 906; Clapp* v. *City of Spokane, 53 Fed. Rep. 515*) is to be added a case we then referred to which was at that time undecided. In that case the decision is quoted elsewhere, but it seems to be a matter of sufficient importance to review it more fully. (*City of San Antonio* v. *San Antonio St. R. R., 39 S. W. 136.*) We understand that the case was very fully argued, and a motion for a re-argument was denied.

Of course each case is governed more or less by the terms of the franchise, the rights of the city granted under legislative authority, and the city ordinance, but assuming that these contain the ordinary provisions, the following propositions now seem to be established by the weight of authority:

The power of the city, after the granting of a franchise to a railway company, to lay mains is unquestioned. Even while the disturbance of the surface of the street causes a temporary cessation of traffic, the discretion is in the municipal authorities as to how and where and when the mains are to be laid, and that discretion ordinarily cannot and will not be reviewed by the courts. Where the legislature vests the discretionary power with any board or officer, a court of equity will not interpose to overrule such discretion by an exercise of its own. The necessity of the work and the advisability of each of the particular features of the work and of all details are all to be passed upon by the municipal authority which is laying the main, but in all of the cases, even the one last cited, which may be said to be as strong as any of the opinions that have been rendered in supporting the rights of the municipality, it is conceded that, where the municipal authority is shown to have acted "arbitrarily or capriciously," in regard to the laying of sewer pipes, the court might interpose.

In some of the decisions, in place of the words "arbitrarily and capriciously," we find the word "unreasonably." This would seem to be somewhat widening the power of the court, for if the court is to pass upon the reasonableness of a particular plan, it would seem to be getting dangerously near the point where it may be said to be exercising its discretion. But after all, it is probable that the court uses the word in the sense of "without reason," which is little removed from "arbitrarily," and the decisions are not at variance, notwithstanding the use of adverbs and adjectives which are different, but all of which are more or less flexible in their meaning.

In the San Antonio case, before the matter reached the appellate court, a question of fact had been submitted to a jury, to wit: whether or not under the system of sewers adopted by the city it was *necessary* for the sewers to be laid along the center of the street, and they answered that question in the negative. It would seem that, if the question submitted to the jury had been whether or not the sewer could have been laid with equal facility and convenience at some other place than in the middle of the street, and whether if, by so laying it, damage to the railroad company would have been wholly avoided and no damage caused to anybody else, and if the jury had answered that question by finding that it could have been so laid then it would be seen under the decision of all the cases, even those which most strenuously uphold the power of a municipality, that a court of equity might conclude from such a finding that the municipal authorities had exercised their discretion arbitrarily, capricious or oppressively, and the court would enjoin them from proceeding.

There is one phase of the question which does not seem to have been discussed in the decisions which have been rendered. The arguments of counsel and the decisions of the court seem to have been mainly directed to the question as to whether the proposed location of the sewer was as convenient or available for the purpose to which it was finally to be used—as, for example, the convenience of the householders on either side of the street who were to use the main, and the relative expense of connecting their pipes with it and other like questions. It would seem that where it is proved that there is but little difference as to such questions that then the test of whether the municipal authorities had exercised their power and discretion without reason and arbitrarily would be the relative inconvenience and injury caused to the traffic of the street during the period of construction. It is manifest that a municipal body might decide that the convenience of the traffic on the street other than that of the street car line was more important to the municipality and the common weal than the traffic on the street car line, and the interference with that would be a greater detriment than the interference caused the car company by putting the sewer beneath its tracks.

On the other hand, it is quite manifest that the car tracks when properly laid are equally available for the horse car traffic and the street traffic, and further that the disturbance of the ties and rails is a much greater expense, whoever has to bear it, the municipality or the street car company, than the tearing up of the roadway alongside, so that there must be something more than the semblance of interference with the wagon traffic of the street before it could be urged as a legitimate reason for placing the main underneath the car tracks.

The whole matter is one which will receive consideration by the courts of last resort, both because of its increasing importance as the roadbeds of street car company become more and more expensive and substantial and because so few decisions have as yet been rendered. H.

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EXCESSIVE DAMAGES.

Minnesota.—The Supreme Court, in holding a verdict for $4000 excessive where a plaintiff seventy-five years old had sustained a fracture of one of the bones of the ankle and other injury to that joint, had been confined to her bed for three months, and would never be able to walk without a crutch, say: "there is another consideration which we think we may take into account, and that is, that, however statesmen and financiers may disagree as to the cause, a given sum of money has greater value—that is, greater purchasing power—than it had years ago. Decisions may be found, probably including some of our own, which would, by comparison, justify the size of this verdict. But our conclusion is that it is so clearly excessive that it ought not to stand."—(Johnson v. St. Paul City Ry., 69 N. W. Rep. 900.)

New York.—A verdict of $4300 is excessive, where the injuries to plaintiff, a boy seventeen years old, caused him considerable pain for several months, and diminished his earning capacity $6 per

week, but from which it is probable that he will entirely recover in three or four years. O'Brien, J., dissenting.—(Levitt v. Nassau El. R. Co., 43 N. Y. Supp. 426.)

LIABILITY FOR NEGLIGENCE.

NEW JERSEY.—Anyone who undertakes to propel a street railway car in a condition in which a reasonably prudent man would apprehend that it would frighten horses is bound to employ reasonable means to prevent injury to persons riding or driving along the street.

Where black coats were hanging on a projection at the side of a street water sprinkler operated by electricity, by, along and on the tracks of an electric street railway, and the coats, by waving to and fro in the wind, or by operation of the car sprinkler along the tracks, frightened a well broken horse of gentle disposition, and caused injury to the plaintiff, who was thrown from his carriage, the question whether the employes of the defendant, the street railway company, were in the exercise of reasonable care to prevent injury, in operating such street car sprinkler, and the consequent liability of the company for the injuries to the plaintiff, is a question which the trial court must submit to the jury for their determination, even though it be that the coats belonged to such employes, and were by them hung up on the projection of the car. The car being in such a condition as to cause fright to the horse and consequent injury to the plaintiff, it became a question for the jury to determine whether the defendant company was negligent in the performance of its duty to exercise reasonable care, by its servants, in the use of the public street, by operating the car while in this condition.

Quære: Can the operation of a street railway car, painted a conspicuously bright and attractive color, along a public street, causing fright to a horse, with injury resulting therefrom, constitute negligence on the part of the street railway company, and render it answerable for injuries resulting from such cause?—(McCann v. Con. Tr. Co., 36. At. Rep. 888.)

KENTUCKY.—In an action for injuries caused by collision with a street car, defendant's witnesses testified as to a mark on the car showing where the wheel of the wagon driven by plaintiff struck. *Held*, that evidence of witnesses who had examined a car of the same number as that causing the accident that no such indentation as testified to was on the car was admissible in rebuttal, though the examination was made one year after the accident.

In an action for injuries received in a collision with a street car, an instruction that, if a street car ran into plaintiff's wagon as it was being driven off the track, the jury would find for plaintiff, was proper.

An instruction that, if the collision resulted from the wagon running towards the car while the wagon was completely off the tracks, and coming in contact with it, the jury should find for the defendant, was proper.—(South Covington & C. St. Ry. Co. v. Pulzer, 39 S. W. Rep. 496.)

TEXAS.—Where a street railway company contracted with a city to keep the streets in repair, and a traveler was injured by defects in the track, the city was liable therefor, and was entitled to judgment over against the railway company.

Where a street railway company is placed in the hands of a receiver, and he abandons one line thereof to the company, and it enjoins the city from tearing up the track on such line, and fails to repair it, it is liable to a traveler injured through its defective condition.

Where a street railway company builds its line on the condition that it will keep the streets in repair, it cannot relieve itself from such liability by leasing its line to another company.—(Ft. Worth St. Ry. Co. v. Allen, 39 S. W. Rep. 125.)

MASSACHUSETTS.—Whether parents exercised due care where their child, about four years old, was permitted to play in the yard, from which he escaped into the street through a gate, and was killed by a street car, is a question for the jury.

As bearing on the question whether parents exercised due care in looking after a child, the father may state that he considered the child of average intelligence.

The virtual discharge by a street car company of a servant, who was in charge of a car as a motorman at the time of an accident, cannot be shown as an admission by the employer of the servant's negligence or incompetence.—(Hewitt v. Taunton St. Ry. Co., 46 N. E. Rep. 106.)

MASSACHUSETTS.—Under St. 1887, c. 270, § 1, c. 2, making an employer liable for the negligence of a servant intrusted with and exercising superintendence, a street railway company is not liable for the negligence of its paint shop superintendent while acting as motorman, in shifting cars, whereby a shop employe, who was assisting in the work by guiding the trolley, was injured.—(Brittan v. West End St. Ry. Co., 46 N. E. Rep. 111.)

ILLINOIS.—Where recovery was sought solely for the negligence of street car companies in so operating two cars in opposite directions, on parallel tracks, that plaintiff was caught between them, and injured, the ordinance allowing them to lay the tracks as they were was immaterial. 62 Ill. App. 180, affirmed.—(West Chicago St. R. Co. v. Annis, 46 N. E. Rep. 264.)

MICHIGAN.—Since the intoxication of a plaintiff at the time he received a personal injury is not negligence as a matter of law, where plaintiff alleged that the injury was caused by his being pushed from defendant's street car by the conductor, an instruction that he could not recover if he was intoxicated was erroneous.—(Kingston v. Ft. Wayne E. Ry, Co., 40 N. W. Rep. 315.)

NEW YORK.—There is no evidence to support a verdict against a street railway company for injuries to a child struck at a street corner by a car, where the motorman turned off the power before coming in sight of the corner, his view of which was obstructed till within 100 ft., and as soon as he saw the child fall on the track applied the brake so vigorously that the car stopped just as it struck the child, though by reversing the power, instead of using the brake, the car could have been stopped sooner, unless reversing would have resulted in blowing out the fuse, since the motorman in the critical moment was bound only to do what seemed best on the facts as he then saw them.—(Stabenau v. Atlantic Ave. R. Co., 44 N. Y. Supp. 36.)

MICHIGAN.—Negligence and contributory negligence are questions for the jury, where plaintiff driving a wagon so loaded with barrels that he could not see behind it without leaning to the side, failing so to look, pulled in towards defendant's street car track to pass a carriage standing by the curb, so that the barrels were struck by an electric car which came from behind, frightening his horses, and causing them to run away and injure him, there being evidence that the wagon, before being struck, traveled 35 ft. while within the line of the car and that the motorman though seeing the wagon in time to stop, being 30 to 50 ft. from it, increased his speed to 6 miles an hour, thinking he had room enough to pass.—(Blakeslee v. Con. St. Ry. Co., 70 N. W. Rep. 408.)

INDIANA.—In an action for personal injuries sustained by plaintiff in falling from a wagon when he undertook to drive across a street railway track, the fact that he knew that there were deep ruts between the rails is not conclusive on the issue of contributory negligence.—(Citizens' St. R. Co. v. Sutton, 46 N. E. Rep. 462.)

PENNSYLVANIA.—It is contributory negligence as a matter of law to alight from an electric car moving at the rate of from 4 to 5 miles an hour.

An electric railway company is not bound by its employes' practice of slacking the speed of a car to enable a particular passenger to alight at a point where no stop is ordinarily made.—(Jagger v. People's St. Ry. Co., 36 At. Rep. 867.)

NEW JERSEY.—Upon a request to charge "that it is the duty of a driver approaching the line of a street railway company where his view is impeded by vehicles so that he cannot see up the track, to wait till he reaches a point where his sight is not impeded, before going on the track," the trial judge instructed the jury that "he ought to be able to see far enough up the track to see that he has the right of way; and he has the right of way if he can get upon the track before the car would reach that point if going at a reasonable rate of speed." *Held*, that he should, in effect, have charged that the driver would have the right of way, if proceeding at a rate of speed which, under the circumstances of the time and locality, was reasonable, he should reach the point of crossing in time to safely go upon the tracks in advance of the approaching car: the latter being sufficiently distant to be checked, and if need be stopped, before it should reach him.—(N. J. El. Ry. Co. v. Miller, 36 At. Rep. 885.)

NEW YORK.—Negligence and contributory negligence are questions for the jury, where plaintiff, a girl nine years old, was struck by defendant's horse car at a street crossing, and it appears that plaintiff was accompanied by her mother, another woman, and six children; that when plaintiff, who was slighly ahead of the others, reached the car track, the car was 40 ft. away, and that the driver did not see plaintiff, and increased the speed of his horses as the car approached the crossing.—(Wihnyk v. Second Ave. R.R. Co., 43 N. Y. Supp. 1023.)

NEW YORK.—The granting of a new trial to defendant on the ground that the verdict was against the weight of evidence should not be disturbed, the question being whether plaintiff was injured by trying to board the defendant's car while it was in motion, or whether it was stopped when he attempted to get on, and suddenly started up, and the testimony of plaintiff and that of his one witness, who was somewhat contradicted and discredited by his own cross-examination, being contradicted by facts testified to positively by five witnesses, four of whom were entirely disinterested. Williams and Patterson, JJ., dissenting.—(Suhrada v. Third Ave. R. R. Co., 43 N. Y. Supp. 904.)

WASHINGTON.—An instruction that if plaintiff alighted from a moving street car without notice to the conductor, or without his knowledge, she did so at her peril, provided the conductor "could not, by the exercise of the highest degree of care and caution, avoid injury" to her; and that if the conductor, knowing that she was about to alight, "or by the exercise of extraordinary care * * * could have known it, started the car," etc., plaintiff could recover, —is not erroneous, where the jury were also told that it was not incumbent on the conductor to anticipate such action on plaintiff's part.—(Brown v. Seattle City Ry. Co., 47 Pac. Rep. 890.)

MISSOURI.—Plaintiff was a passenger on an electric car which collided with a cable car at a crossing. The two car companies, defendants, jointly employed a flagman, and it was his duty to direct the crossing of the cars on each line by signals. *Held*, error to charge that, if the flagman signaled the cable car forward, it had the right to proceed, though the electric car could be seen by the grip-man, and was then approaching the crossing.—(Tayler v. Grand Ave. Ry. Co., 39 S. W. Rep. 88.)

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THE problems presented in the construction of electric railway systems differ in every case and to obtain the best results the local conditions must be considered separately. While in this respect electric railway construction differs from steam railroad construction, in which practice follows more regular lines, it does not make a study of the methods employed any less interesting. For this reason considerable space is devoted in this issue to a description of the recent construction of the Canal & Claiborne Railroad Company, of New Orleans. The local conditions at that city, particularly the marshy soil, necessitated many divergences, both in roadbed and station construction, from the practice usually found in other cities, while, owing to the complexity of tracks on the main artery of the city, Canal Street, the overhead construction was forced to follow along original lines. The method in which the particular questions were met may afford valuable help to other managers who have similar problems to solve. The theory of construction of foundations for all heavy structures in New Orleans is that of providing a broad watertight base, anchored when possible to the soil at all points, to prevent any change in position and unequal sinking. The difficulties encountered in securing a good foundation in such a soil can be well appreciated when it is stated that a watertight vault built by one of the banks in that city recently, and insecurely anchored, was found soon after its construction to have floated to the surface of the ground. In building the roadbed no anchoring was required, but the danger of uneven sinking was avoided by the use, common in New Orleans, of a layer of planking directly on the subgrade covered with a 4 in. layer of ballast, to the bottom of the tie. The demand for a car which should be equally well adapted to summer open, and winter closed service led to the adoption of a type in which, it is thought, these qualities will be secured. The station equipment is novel in a number of respects. Independent condensers with Corliss valve gear are used, while the furnaces are raised so high that they will not be affected by ordinary floods. The piping is in duplicate, but its size is calculated on the basis of the constant use of both sets instead of upon their alternate use. The advantage of this lies in the fact that all piping is ordinarily carrying steam, so that any defects can be promptly detected; while, in case of emergency, one set can be employed with a slight increase in boiler pressure.

THE State Board of Railroad Commissioners of New York having voted to allow the Metropolitan Street Railway Company to proceed with its proposed electric conduit equipment, the company will commence active construction as soon as certain legal questions involved in the wording of its franchises are settled. This, it is thought, will be within the coming month. The lines upon which the conduit will be installed are those on Fourth, Sixth and Ninth Avenues. The aggregate length of the track to be equipped in this way amounts, as has already been stated in these columns, to more than 40 miles, making the most important enterprise of the kind ever undertaken. The decision to install the conduit system was based upon the generally satisfactory service secured on the Lenox Avenue division of the company, 6.78 miles in length, which has been in operation for about two years. As regards electrical leakage, the electrical engineer of the company states that the average leakage on the Lenox Avenue line has not been more than might be expected upon a similar length of track equipped with the overhead system. The current required during the two or three months which have just passed averaged, with the heaters, about 30 amps. per car. It should be stated, however, that the conditions for maintaining good insulation are exceptionally favorable. In no other city in the United States, except possibly in Washington, where the only other successful conduit lines are in operation, are the streets kept so clean by the municipal authorities as in New York. Again, the snow and rainfalls in New York are never excessive, while the drainage is good. The method of caring for the snow last winter was to put the snow plows in operation as soon as the snow commenced to fall, and thus keep the track clear. Salt was sparingly used on the switches and in the conduit during very cold weather and during snowstorms to keep the conduit from clogging up. The use of salt in this way had no appreciable effect in reducing the

insulation resistance between the conductors. In addition to this, the conduit was cleaned about once a month. The method employed was the same as that on the New York cable railways, that is, by hand. Long scrapers so designed that they could be slipped through the slot were used, the mud and debris being pulled to the nearest manhole. The policy of the company in regard to the equipment of its other lines, now operated by animal power, has not yet been determined. While none of these is of a suburban character the use of the conduit is regarded as out of the question for any except those of the densest traffic, owing to its high cost of installation and the impossibility of effecting a sufficient increase in gross and net earnings by a change to any form of improved motive power.

Street Railways vs. Municipalities.

We make no apology for giving special and extended attention this month in our editorial and reading pages to various phases of the public discussion of street railway matters found in several of our major cities, which sometimes appears as an attempt to force a reduction of fares, sometimes in the imposition of heavier burdens of taxation, and is always based on the idea that street railway profits are excessive and should be reduced. The situation is serious, and even critical. One thousand million dollars of invested capital—the savings of a hundred thousand investors who have personally, or through banks, trust companies, insurance companies and other financial agencies, placed money in street railway securities—is menaced by forces which it would be unfair, perhaps, to characterize broadly as demagogic or socialistic, since they contain large numbers of absolutely honest and well meaning citizens who have no axes to grind, and who are, therefore, more free to follow the leadership of those who have, and to commit grave injustice, without in the least understanding why it is injustice. *This better element must be convinced that it is in error*, if crushing burdens on the street railway industry are to be avoided. That street railway manager is wise who avoids litigation about "vested rights," except as a last resort, but endeavors, rather, in a courteous, good natured and fair minded way, to present the local street railway case to the public for its intelligent judgment.

The first step in any discussion of a disputed question is to thoroughly understand and weigh the arguments of the opposition. In a case where additional burdens of any kind are sought to be placed on a street railway company, they are, generally speaking, three in number. The first argument is that street railway operating profits are excessive. When this argument is met by the statement that a company is paying no dividends, or but admittedly moderate dividends upon its capital stock, the second argument is used, to the effect that "the company is overcapitalized." The third argument is that if the municipality were in control of its street railway system, its annual revenue from this source would be larger than at present, and the existing company should, therefore, be compelled to pay over to the city all, or some portion of this lost revenue as a condition of continuing in operation. Other arguments are used, with more or less pertinence, but nearly or quite all are dependent upon the successful establishment of these three fundamental ones.

Are street railway profits excessive? Our ability to generalize upon this subject in such a way as to fit individual cases will, of course, be questioned at once, and with some propriety. We certainly cannot pretend to make a statement which will be true in every city. We say, however, with a full belief in the correctness of our statement, that in more than nine cases out of ten the *true* net earnings from operation of street railway companies, large and small, are much less than the *apparent* earnings on which the arguments of the public are based. This arises from the fact that American street railway companies do not, as a rule, make adequate provision for the inevitable renewals of plant and equipment due to "depreciation"; any provision whatever for possible improvements in the art of railroading calling for greater or less expenditures; or for entire or partial loss of investment due to termination of franchises at the end of the period for which they were originally granted. If a property is to be conducted on correct financial principles, its managers must so handle their trust as to eventually return every dollar of the initial investment to those who have made that investment, in addition to paying them an annual return upon it, when earned. If, therefore, these managers fail to provide for all possible contingencies which may tend to impair capital, or if, in order to keep the operating expenses down, they are forced to capitalize expenditures which do not add to the earning power of the property, they fail, to that extent, in their trust. The apparent profits from operation are too large, and the stockholders who are receiving these profits do so at the expense of a portion of their capital investment. Moreover—and this is the important point for present purposes—the public is deceived into believing that street railway profits are excessive.

The measure of this difference between real and apparent profits can best be understood by briefly discussing a concrete example. We will use for this purpose a close approximation to the actual figures of a certain existing street railway property, only making such changes as will serve, for obvious reasons, to conceal its identity. This property was a consolidation of several horse railways which were purchased by a group of capitalists for large sums. The cost of these purchases plus the cost of reconstruction and electrical equipment made a total investment by the owners of, roughly, $6,000,000. There construction and equipment material was the best known at the time of its purchase, but turned out to be so much less efficient and economical than that produced later in the development of the art as to make a substitution of the new for the old a present necessity, though the original equipment has been in use hardly five years. The company's engineers estimate that nearly $2,000,000 of new money must in some way be provided in order, only, to maintain the present earning power of the property. This sum cannot properly be capitalized, but should be charged to operating expenses since it adds nothing to the earning power. It is an extreme case of the influence upon earnings of improvements in the art, *plus* depreciation. Who will say, however, that the future has no such improvements in store for street railroad managers to consider? Certainly not a public which is even now clamoring for underground conduits, storage batteries, air motors—anything which is different from the best known motive power to day. But to continue.

The gross receipts of the system under consideration

are roughly, $1,500,000 per annum. Its direct expenditures for operation including $60,000 for state and municipal taxes, consume about 65 per cent of its gross receipts, and its net earnings from operation are *apparently* sufficient to return slightly over 8.7 per cent upon the assumed capital investment. But its engineers estimate that at least $200,000 must be annually added to operating expenses and subtracted from net earnings in order to anticipate the effects of general depreciation of plant and equipment—in other words to provide a fund to pay for the renewals necessary at some time in the near future. That this sum is a reasonable one may be gauged from the fact that it assumes a life of from ten to twenty-five years for different portions of the plant and equipment—a life which is considerably in excess of anything so far achieved in electric railroading. This reduces the true net earnings from operation to 5.4 per cent upon the capital investment.

But this is not all. The franchise of this company has now but thirty years to run. What will happen at the end of that thirty years no one can tell. If present indications are of value, the company will be forced out of business by the disposition of the municipality to impose constantly heavier burdens upon it. It must certainly face the possibility of being obliged to sell its tangible assets to the municipality or to a new company at a more or less heavy loss. If this should actually be done, the salvage, including all moneys in the depreciation fund held in the treasury could hardly, in this particular case, exceed $3,500,000 at a liberal estimate. The lost investment, therefore, would be at least $2,500,000, and if the original investors or their successors are to have back their capital investment, dollar for dollar, this loss must in some way be provided for. There is no other source but earnings, and a simple calculation on actuarial principles shows that we must annually deduct from net earnings for amortization of franchises not less than $40,000 per annum. This will bring the percentage return on investment down to 4¾ per cent.

There are still other contingencies in street railway operation—uninsured losses by fire—damages for accidents (and a single serious accident may cut a year's profits in two) and the ever present danger, already mentioned but not considered in this annual statement of earnings, that new discoveries in science or invention may make changes necessary. The case cited above is hardly an extreme one, though burdens are there being carried which would not be found with a road equipped with the new and improved appliances of the present day.

Let us now consider the question of "overcapitalization." This second argument urged by the advocates of heavier street railway burdens is certainly plausible, for there is no doubt that, with not a few street railway companies, overcapitalization of costs has been attempted by the original promoters. But we are convinced, from a close study of latter-day balance sheets, that these attempts have been wholly successful in comparatively few cases because of the unexpectedly large repair and renewal expenses of roads equipped with early apparatus and material. These have made heavy additions to cash investments, or transfers from operating profits, (?) imperative. In other words, with the best intentions in the world to overcapitalize costs, the large owners of street railway properties have been forced to put their hands deep into their pockets again and again to provide for absolutely necessary reconstruction and re-equipments. Even if this were not so, however—even where it can be demonstrated that the total liabilities of a street railway company are largely in excess of the actual accumulated cash investment, any attempt on the part of the public to right this wrong, if wrong it be, is almost sure to reach, not the real culprits, but those small investors upon whom have been unloaded the watered securities. Are these now to find themselves doubly deceived and unfortunate—deceived as to the intrinsic earning power of their property, and unfortunate in being made the scapegoats of their deceivers?

Before leaving this question of overcapitalization it should be noted that the clear distinction between overcapitalization of *costs* and overcapitalization of *values* is not always drawn by those who seek, whether honestly or dishonestly, to create a prejudice against street railway corporations. It is common, for example, to hear the statement made that "prominent engineers estimate that our entire street railway system could be duplicated for half its capitalization." Such an argument is worse than worthless—it is almost criminal, for it means in effect that it is proposed to coolly appropriate the result of the costly experimental work which has been done in past years and to hold an old company up to the standard of those who—guided by its experience—can now avoid its errors and install a perfect plant at minimum expense. So long as a manager is human, so long will his errors of judgment increase the legitimate capitalization of his company.

The third argument of municipal champions, that a street railway company should be compelled to pay to the city all, or a large portion, of the revenue which the latter loses by reason of not operating its own system, may be briefly disposed of. A street railway company cannot borrow money at a rate of interest anywhere near as low as would be accepted from a municipality in good credit; its risks of all kinds are far larger; its control over its property is less; and it cannot be expected to enter into so one-sided a partnership. Reasonable taxation of those who operate under public franchises should never be resisted; we should be the last to urge that municipalities have no rights of revenue which street railway companies are bound to respect. But if there is anything which past experience proves to be certain, it is that excessive taxation means poor public service, while generous treatment of corporations means liberality and progressiveness in management.

We have purposely limited the scope of this argument to a cold-blooded discussion of profits. In times past we have discussed other important phases of the general problem of street railway taxation, and shall often have further occasion to emphasize them by the presentation of statistics bearing upon the phenomenally low cost of street railway transportation in America as compared with every other country in the world; the greatly increased value in length of ride and elegance of service given by electric street railway companies to-day as compared with the ride purchased for the same price in the horse railway era; the benefit to the people of living in suburbs instead of in tenements; the wonderful difference between American and European cities in the matter of population densities; and the thousand and one ways in which the public is benefited, and will be benefited, by dealing in a broadminded and generous way with those who are so faithfully serving its interests.

New Track Construction in Pittsburgh.

During the past year the Consolidated Traction Company, of Pittsburgh, Pa., has undertaken a large amount of new track construction, taking out all track in which the rails were less than 90 lbs. to the yard. The construction adopted has been very substantial. After the excavation in the street was completed the soil of the subgrade was rolled with a 6 ton roller, except on those parts from which cable tracks were removed, where an 11 ton roller was used. Where it was impracticable to use a roller the soil was made compact by using iron hammers heavy enough to obtain the same result as with the 6 ton roller. After the subgrade had been rolled, ballast was laid to a depth of from 4 ins. to 5 ins. and also rolled. This ballast was of hard limestone, ligonier or cobble stone of a size to pass through a 3 in. ring.

The ties rest on the rolled ballast, and care was taken to place all ties with the heart or inside of the log down. The spacing is 2 ft. centers, except at joints, where the ties are spaced 18 ins. centers. The rails are laid so as to "break joints" and tie rods were used every 6 ft.

In tightening up the splice bars the bolts were tightened three times, by using an 8 lb. sledge hammer on the head of the bolt, and screwing the nut with a wrench having a 4 ft. handle. In this work two men were required, one to continually hammer the splice bars and heads of bolts, the other to tighten the bolts. Four spikes per tie were used, and after the rails were bolted and spiked, the whole structure was gradually and uniformly raised on jacks, a height of 2 ins. to the street grade. Then ballast was tamped in between and under the ties. This second ballast was of ligonier stone only, and of a size to pass through a 1½ in. ring. It was well screened and clean. After tamping this the rails were aligned, and then each tie was again tamped.

The drainage of the roadbed was carefully provided for before filling the space between the two tracks of a double track. A drain made of 3 in. unglazed drain tile was installed and connected to the sewers at all changes in grade. Drain boxes were also put in at different points.

After tamping and aligning, the spaces between the ties were filled with a third ballast of such a size that no piece exceeded a 2 in. cube. It was of hard limestone, ligonier cobble stone or broken concrete taken from the tracks where the concrete was hard and in good condition, and was all cleaned and screened. During the filling in or placing of this ballast it was rammed constantly with heavy iron rammers, making the ballast between ties thoroughly compact and firm so as to prevent the settling of the pavement.

Over the tops of the ties and this ballast was placed a 1 in. layer of a lighter ballast made of ligonier stone only, of such size that no piece exceeded a ¾ in. cube. This layer was also thoroughly rammed with iron rammers.

Before paving, the space between the head and base of rail without, and the tram and base of rail within the tracks, was filled with concrete made of one part Louisville cement and four parts clean sharp river gravel, thoroughly mixed.

The paving rests on a bed of river gravel 2½ ins. thick which is placed on the ballast. Ligonier stone blocks were used between the tracks and 1 ft. outside the rails for part of the system, and sheet asphalt in the rest of the system for the same places except alongside of each rail where block stone was used, forming a header and stretcher. All block paving was laid in regular courses, all courses broken; the block paving was sheeted with clean river gravel, broomed and rammed separately twice.

The rails, joint plates, etc., were furnished by the Johnson Company, under specifications which included the following clauses:

Analysis.—The manufacturer shall furnish daily the determination of carbon of each heat, and a complete chemical analysis of at least one heat for each day and night turn, in which each element is to be determined.

Tests.—From each heat two test ingots shall be taken; one ingot from each heat to measure 2½ ins. × 2½ ins. × 4 ins. As may be designated, either one or the other test ingot shall be rolled to measure ½ in. × ½ in. × 20 ins. long, to bend cold by blows of a hammer through 90 degs. without showing fracture or break.

Rejection.—If from any heat a "second" or "imperfect rail" be rolled, the inspectors shall have power to reject all rails rolled from such a heat, provided, however, that "second" or "imperfect rail" be not caused by overheating of the ingot.

Process of Manufacture.—Steel may be made by either the open hearth or Bessemer process.

Finish.—All rails to have a smooth and unbroken surface, free from flaws, fins, seams or particles of scale or other foreign matter, and to have a workmanlike finish. The ends must be milled smooth after cold sawing, so as to leave no burr that might interfere with proper fits of splice bar.

Chemical Composition.—

Carbon	.45 to .55
Silicon	.15 to .2
Manganese	.08 to .1
Sulphur not to exceed	.07
Phosphorous not to exceed.	.06

The inspector of the railway company shall have the right to select the minimum limit of the carbon, silicon, manganese, or the three, as he may consider furnished the best rail by the plant of the manufacturer.

Weight and Section.—The section to vary as little as possible from drawing No. 355 attached hereto. The weight per yard of rail to be furnished shall be not less than 90 lbs. or more than 91 lbs.

Length.—Standard length of rail shall be 60 ft. but bids for rail of 30 ft. long will be considered. Shorter rails of 24 ft. lengths or over will be accepted to the extent of 5 per cent of the entire order. A variation of ¼ in. either way in length will be allowed.

Straightening.—All rails must be straight in all directions as to surface and line without twists, waves or kinks. Straightening shall be done in such a manner as to leave no impression or mark of the "gag" on head or base of any rail.

Drilling.—All rails are to be drilled for splice bar bolts in strict conformity with attached blue print. Holes to be left free from burrs. Rails to be punched for tie rods in accordance with attached blue print. The holes for tie rods are to be spaced so as to permit rail joints being staggered 30 ft. apart (unless 30 ft. rails are used, then to be staggered 15 ft. apart), and tie rods being placed 6 ft. apart. Rails are to be punched for electrically connecting overjoints in accordance with blue print.

STEEL SPLICE BARS.

Process of Manufacture.—Steel may be made by either the open hearth or Bessemer process.

Finish.—All splice bars to have a smooth, unbroken surface, free from flaws, fins, seams or particles of scale or other foreign matter, to accurately fit the under side of head and upper side of base of rail.

Chemical Composition.—

Carbon	.25 to .40
Manganese	.75 to .90
Silicon	.025 to .05
Sulphur not to exceed	.05
Phosphorous not to exceed	.04

Tests.—Two (2) test pieces to be furnished from each heat from which splice bars are rolled. Test piece to measure ½ in. × ½ in. × 20 ins. to bend cold through 180 degs. to a diameter three times the thickness of test piece.

Section.—All splice bars are to be rolled channel shaped with rod in center, to conform to a templet.

Lengths.—The standard length of splice bars shall be 26 ins.; no variation will be permitted.

Straightening.—All splice bars shall be straight through the entire length and shall have no twists, waves or kinks.

Punching.—Splice bars to be punched in strict conformity with blue print hereto attached. Holes to be left free from burrs.

SPLICE BAR BOLTS.

Bolts for splice bars to be 1 in. diameter, 3¼ ins. long, made of the best quality of refined iron, to be tough and soft, and test piece ½ in. × ½ in. 20 ins. long, to bend cold until the sides are in close contact without sign of fracture on the convex side of the curve.

Bolts to have full United States standard threads cut on so nut must be screwed with wrench all the way. Nuts to be hot punched and of the same material as bolt.

Bolt heads and shoulders to be upset hot. Heads to be concentric with bolt.

STANDARD TIE RODS.

Tie rods to be made of high test or tension iron ⅜ in. × 1½ ins. having ¾ in. bolt and forged on bar. Bolt end to have full United States standard thread cut on for track gage for 5 ft. × 2½ ins.

Tie rods to be made in accordance with plan for track gage, of 5 ft. × 2½ ins. Each tie rod to be supplied with four nuts. Nuts to be made of the same material as rod. Hot punched nuts, to be tapped to fit tie rods hand tight.

STANDARD SPIKES.

Spikes to be made of best quality of refined wrought iron. Spikes to bend cold to a radius equal the thickness of spike through 180 degs. without sign of fracture on concave side of curve.

Spikes to measure 5 ins. long × $\frac{9}{16}$ in., to be made in accordance with blue print attached hereto.

Feeder Conduit Construction.

In accordance with an ordinance passed by the Common Council of Baltimore, a careful investigation has been conducted by the Electrical Commission of that city upon the cost of construction of a subway system for electrical conductors to be owned by the city. An extended report upon the subject by N. S. Hill, Jr., engineer of the Commission, has recently been submitted as a result of this investigation.

In regard to the different styles of conduits and methods of ventilating them, Mr. Hill says:

Different Styles of Conduits.

After inspecting all the different styles of tubes or ducts used for the "drawing-in" system of conduits, and carefully studying the results obtained from them, I consider for trunk lines the following four styles of conduit as best adapted to the requirements in Baltimore, as most durable and efficient. The method of construction for the distributing mains, laterals and branches will be considered later.

1. Cement lined conduit.
2. Wrought iron pipe.
3. Camp terra cotta conduit.
4. McRoy terra cotta conduit.

Cement Lined Conduit.—The cement lined conduit, as manufactured by the National Conduit Manufacturing Company, is made in lengths of 8 ft. It consists of an outer sheet iron shell lined with pure cement mortar 5/8 in. in thickness, with cast iron male and female rings fitted at either end. The lengths are brought together by joining the male joint of one length to the female joint of the next, thereby securing rigidity of connection.

The pipes are surrounded with concrete 6 ins. in thickness, bottom, top and sides, and spaced 5¾ in. apart, vertically and horizontally, the space between the pipes being filled with concrete as shown. The pipes should be laid so as to break joints.

Wrought Iron Pipe.—The wrought iron pipe conduit consists of standard thickness wrought iron pipe, treated while hot with asphaltum inside and out, and joined with couplings supplied with the so-called vanishing thread.

The pipes are spaced 5¾ ins. apart and laid in concrete, in the same manner as the cement lined tubes.

Camp Terra Cotta Conduit.—The Camp terra cotta conduit is made by the H. B. Camp Company. The material of which it is composed is vitrified clay, the inner and outer surfaces being salt glazed.

After the trench is graded, a concrete base 6 ins. in thickness is laid, upon which the first layer of pipe is placed, the pipes being laid with a space of ¼ in. between them, and so as to break joints; after the first layer of pipe is in place a semi-liquid mortar is poured over the whole and allowed to fill the spaces between the pipes, and cover the top of the pipes to a thickness of ¼ in.; after which the second layer of pipes is placed, and so on until the desired number of layers are placed. When the total number of pipes are laid in the manner described, the top and sides of the whole are covered with concrete to a thickness of 6 ins. The sections of pipe are butted together and the joints made tight by putting cement mortar around them.

McRoy Terra Cotta Conduit.—The McRoy terra cotta conduit, manufactured by John T. McRoy, is made in multiple duct form of any desired number, from two to twelve ducts, and in sections from 4 ft. to 6 ft. long. The sections are glazed inside and out, and the material used in its manufacture is shale, finely ground.

This conduit I recommend to lay upon a 6 in. concrete base, in the same manner as the Camp conduit, the sections to be spaced with ¼ in. clearance between them. After the first layer is placed the whole to be flushed with semi-liquid cement mortar, the top of the layer to be covered with this mortar to a depth of ¼ in. The next layer is then placed and treated in the same manner, this being continued until the total number of sections desired are laid, when the whole is covered, top and sides, with concrete 6 ins. in thickness. The ends are butted together, and to preserve proper alignment dowel pins are used, the joints between sections to be made tight by sealing them with cement mortar.

Method of Ventilating Conduits.

The soil in all cities is usually impregnated with gases, some of which are explosive when mixed with air, others deadly poisonous, or both. The gases readily find their way into the manholes and conduits, where they combine with the air there present and become a very dangerous element, creating the possibility of explosions and menacing the health and lives of the workmen engaged in or about the conduits.

In New York, where the conduits were first built, explosions on this account were not uncommon and often fraught with serious damage until precautions were taken to prevent the ingress of the fluid.

It is practically impossible with the materials of construction available to exclude the gas without excessive cost. The remedy, therefore, lies in providing an escape for the gas after it enters the conduits, or else by creating a counter pressure in the conduits preventing its ingress. Three methods by which the conduits may be ventilated are suggested:

The first method is, by means of a perforated manhole cover which is supposed to give the gas an opportunity to escape through the perforations. This cover is equipped with a drip pan to catch the surface water and silt, which would otherwise pass into the manholes. The covers are periodically removed and the drip pans cleaned. The objections to this form of ventilation are (1) many gases found in manholes are either of a greater or about the same specific gravity with air, and hence the small perforations in the covers do not effect sufficient circulation to free the holes. The openings, therefore, become an element of danger, insomuch as a lighted match, a cigar or a coal from a passing engine might drop through the openings and cause an explosion; (2) the difficulty of keeping the drip pans clean, and preventing the water and silt from overflowing into the manhole, and (3) the unsanitary features of allowing the gases from the hole to escape in the street close to pedestrians and the retention, in the drip pans, for long periods of time, of the offal from the street, which becomes exceedingly foul in hot weather.

The second method is by means of ventilating stand pipes placed opposite the manholes and connected therewith by two vent pipes. The stand pipes may be made in any manner to have them the least unsightly. As shown, the stand pipe consists of an I beam with two wrought iron vent pipes fastened to it and carried to the top. The channel iron is set in a concrete base to give rigidity. The two pipes are supposed to furnish a sufficient circulation of air to prevent a dangerous amount of gas accumulating in the conduits. This construction is cheap and strong. The objections to this form of ventilation are (1) inability of the pipes to furnish sufficient circulation to free the manholes from gas where it is present in large quantities, the points at which ventilation is most needed; (2) placing on main thoroughfares the stand pipes, which at best can but mar the beauty of the streets, and (3) in residence sections delivering the foul air discharged from the manholes near to the windows of dwellings.

The third method is by means of a central blower plant and ventilating mains laid alongside of the conduits, the mains being connected with each manhole and delivering thereto air at a pressure of about 6 oz. per square inch. This plan is, of course, very expensive, the total cost of the blower plant and mains being estimated at from $60,000 to $80,000, and the annual cost of operation being about $15,000 or $20,000.

The delivery of fresh air to the manholes at a pressure above the pressure of the gases in the surrounding earth not only serves to efficiently free the conduits of any gas which may accumulate in the manholes and ducts, and evaporate any moisture, but to positively prevent the ingress of gas and water as well by creating a counter pressure in the conduits. The ventilating mains can be laid with the conduits, and will therefore necessitate no extra tearing up of the streets.

Although the initial expense seems heavy, and the cost of operation large, I would strongly urge the adoption of this method of ventilation.

The comparative cost of the three methods is found in the statements given below.

First Method, by Perforated Covers.	Second Method, By Means of Stand Pipes.				Third Method, By Compressed Air.	
	For Combined System.		For Separate System.		For Either System.	
No Additional Cost.	Cost.	Interest, Maintenance, Etc.	Cost.	Interest, Maintenance, Etc.	Cost.	Interest, Maintenance, Etc.
	$10,000	$1,200	$19,276	$2,313	$69,549	$15,462

The Construction of Rail Joints.

A very complete article on this subject was recently published in the *Bulletin of the International Railway Congress.* The author was Alfred Birk, of Vienna, and his paper is given in part below:

It is an undisputed fact, recognized by all authorities on railway matters, that the methods generally employed for joining rails do not satisfy the requirements of the traffic. When we consider a joint and its action from this point of view, we first of all find that the space left clear between the two rail ends has no deleterious effect when its size is such as occurs under normal conditions. This has been clearly shown by the experiments of Wiesner, who cut deep grooves into the heads of rails up to 0.787 in. wide; this can also be demonstrated on purely theoretical grounds.

Let the diameter of the wheel (Fig. 1) be R inches and the gap between the two rail ends 1 in.

Then H, the height of the segment which drops between the rail ends, is given by the formula:

$$H = R - \sqrt{R^2 - \frac{l^2}{4}}.$$

Now, if we suppose that R is about 40 ins., H becomes about 0.004 in., when l equals about 1.13 ins. In this case, which certainly

does not occur in practice under normal conditions, the wheel would act as a polygon, having a side of about 1.13 ins. long, which would strike the next rail end after falling through the height, H, which approximately is equal to 0.016 in.

The pernicious effects observed at rail joints are due therefore to other causes; they are due to the fact that the arrangements hitherto available did not provide for the necessary stability of the rail ends in minimising horizontal and vertical strains.

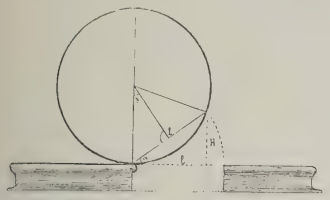


FIG. 1.

In the present state of knowledge there appears to be no doubt that the immediate cause of the want of efficiency of the fishjoints is due to play between the rails and the fishplates.

The efficiency of the fishjoints diminishes when the play between the fishplates and the rails increases. When the amount of such play exceeds a certain limit, which Zimmermann represents by E_g, the fishplates are of no effect; on the other hand, a certain amount of play, the limiting value of which Zimmermann calls E_g, has no injurious effect on the joint.

In the case of E_g the smallest load (such as that on one wheel of an empty open freight car) say, a ton and a quarter, is taken; in that of E_o the largest, say, seven tons and a half.

The result then is

		With short fishplates.	With long fishplates.
If the coefficient of ballast $K =$	$E_o =$	.0941 in.	.1256 in.
108.4 lbs. per cubic inch (1)	$E_g =$	.0083 "	.0094 "
If $K = 289.0$	$E_o =$	.0508 "	.0697 "
	$E_g =$	.0032 "	.0033 "

The nature of the ballast exercises a preponderating influence on the values of E_o and E_g, particularly on the latter; the deleterious effects of play become more and more important when the line is more rigid. In addition it is shown, by theory, that the limit of permissible play becomes lower when the moment of inertia of the fishplates decreases.

The play between the fishplates and the rails also influences in a pernicious way the inclination of the rail ends relative to each other. According to Zimmermann, for instance, in the above quoted case with long fishplates and a coefficient of ballast $K = 108.4$, the angle ν, made by the upper surface of the two rail ends (*i. e.*, of the tangents at those points) amounts, in the case of $E = o$, to 179° 50′; but when $E = E_g$ the value becomes $\nu = 179° 20'$.

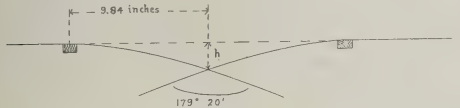


FIG. 2.

This divergence from a straight line does not seem to be great, but yet it is not without effect on the path of the wheel. Let us assume that the distance from center to center of the sleepers at the fishjoint is 19.69 ins. and that the bending of the surfaces of the rails commences only at these; then if $\nu = 179° 20'$ the distance h (Fig. 2) is 0.059 in. The distance h_1 the wheel falls when the velocity is v inches per second is

$$h_1 = \frac{g}{2} \times \frac{(9.84)^2}{v^2}$$

h becomes $= h_1$ i. e., the wheel remains in contact with the rail surface while passing over the fishjoint when v is about 551 ins. per second; which is a speed of about 31 miles per hour. If v has a greater value, then $h > h_1$ and the wheel travels a certain distance without touching the rail; it first reaches the further rail a little beyond the joint at an angle somewhat more obtuse than 179° 20′, so that the effect of the impact is less than in the first case. No impact at all would take place if the wheel could travel on the straight line along the rail surface; this would happen in the case of $v = \infty$ which is an impossible case.

So far we have only considered the vertical stresses at the fishjoint; but the usual methods of jointing also appear unsatisfactory with regard to the horizontal stresses. This is shown conclusively by the fact that the nuts on the fishbolts continually work back.

These considerations lead us to recognize the inadequacy of the usual arrangement of fishjoints; the following question then arises:

Is it possible, and if so, how, to construct a perfect fishjoint satisfying all required conditions?

The above question is necessarily answered only in the negative. In order to obtain the desired object there must be no play. It would therefore be necessary to make the fishplates of such a shape that they would fit the rails perfectly, and that this perfection of fit should be constantly maintained. Several arrangements designed to accomplish the end in view will now be considered.

(1) The coefficient of ballast is the pressure per unit area producing a compression of the ballast of unit length.

REDUCTION OF DISTANCE BETWEEN SLEEPERS AT JOINTS.

Generally the reduction of the distance between the sleepers is one of the most efficient methods of increasing the strength of the superstructure. Its influence is specially favorable at the joints, as it diminishes the amount of bending of the rails and fishplates, which is the particular cause of the weakness of the joint. Unfortunately a certain minimum distance must be left to allow proper packing of ballast; with the customary shape of sleeper this minimum is about 10 ins. The French Eastern Railway has reduced this distance to 7.1 ins., and even to 5.9 ins. by cutting a chamfer 3.15 ins. wide at an angle of 45 degs. on the sleepers, except under the rails, at the edges facing each other (Fig. 3) so that the ballast can still be properly packed.

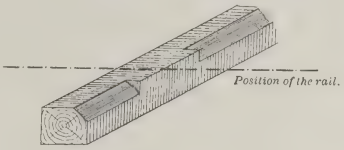


FIG. 3.

RÜPPELL'S HALF-LAPPED JOINT.

Rüppell's method consists in cutting away half the section of the rail (Fig. 4) over a length of 8.9 ins. at its end down to the center of the thickness of the web, which latter has a thickness of 0.709

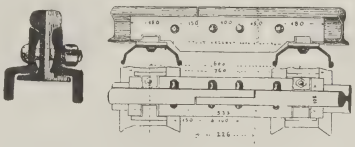


FIG. 4.

in. The half section of two rail ends so cut are lapped, so that they together again form a full section; inside and outside strong angular fishplates are used with four bolts; of these two pass through the lapped portion.

This arrangement has given up to the present good results even on lines with much traffic. The lapped portions of the rails have a slight relative movement to each other like that of the blades of a pair of scissors. The result is that the extreme ends are depressed a little below the surface of the adjoining lapped portion; the wheel thus changes from one rail to the other at the point where the tops of the two laps are of equal height. It is evidently a question of only very small movements of the rail ends. The fundamental principle of this joint is very good because it tends to meet the theoretical requirements. If it were possible to unite the two laps so firmly as to prevent any relative movement, the joint would be of equal strength to the rest of the rail. In spite of all these advantages we do not wish to consider the lap joint as the ultimate aim of attempts directed to the improvement of the fishjoint; it improves the fishjoint, but does not make it perfect. The necessary condition that the bolts securing the laps and fishplates should remain screwed up tight cannot be ensured, and if slacking takes place the conditions may become very unfavorable. In any case the lapped joint deserves much more attention than it has hitherto received.

The idea of a lapped joint has also been very carefully considered by Haarmann. Dr. Viëtor, in 1887, made an arrangement in which the section of the rail was designed with a view to the lapping of the ends. In this the web was not placed centrally, but shifted one-

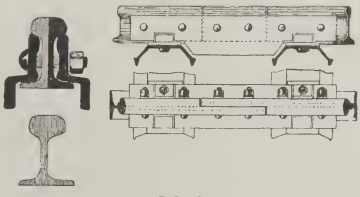


FIG. 5.

half its thickness to one side (Fig. 5). The lap is 9.84 ins. long; the full thickness of both webs are continued adjacent to each other for this distance.

BRIDGE FISHJOINTS.

The fundamental idea of this arrangement was already in practical use forty years ago. It seems a very evident idea to connect the two ties at the joint by a metal bridge supporting the rail ends which are secured to it. Recently this arrangement has again

come into use in America. Professional attention has been drawn to the method of Fischer, owing to its adoption on the New York elevated railroad (Fig. 6). Fischer fixes the bridge plate to each joint sleeper by two dog spikes which also hold the flange of the rail; the ends of the rail flanges are secured to the bridge plate by a pair of clip plates and a special bolt of ⌊ shape.

A necessary condition for the success of a bridge joint appears to be that the flange of the rail should be secured absolutely to the bridge plate. This condition cannot be satisfied; stresses occur which tend to lift the rail ends from the bridge, and others which tend to cant and twist the rail; altogether there is a strong tendency to separate the rails from the bridge and hence to loosen the fastening. It cannot be disputed that the important factor, the continuity on the surface of the rails, is preserved for a longer period than in the ordinary fishjoint; the only question is whether this advantage and the saving consequent thereon justify the increased expense of construction. On the Swedish railways the bridge joint, which was constructed with flat fishplates instead of clip plates, although giving fairly favorable results was again abandoned because the advantage gained did not compensate for its increased cost.

FIG. 6.

PROPOSALS OF DR. ZIMMERMANN.

Dr. Zimmermann has suggested certain arrangements of joints having considerable life both with side fishplates and with bridge fishplates.

In the fishjoint with side fishplates and wedge plates (Fig. 7). he considers the former rolled of such a section that there is a continuous wedge shaped space between the head of the rail and the fishplate, in which space pieces of packing can be placed which are small, of simple form, easily changeable and cheap to make. At the lower bearing surfaces the plates have bearing strips which ultimately can be replaced by packing pieces. An intimate contact between the rail head and the fishplate can be attained by tightening the bolts till the wear between the bearing surfaces has attained a certain amount. As the fishplates and wedge plates are capable of relative movement the space in the angle may be kept filled in the case of a given amount of wear of the bearing surfaces; thus is gained the advantage of a firm bearing with great possibilities of adjustment. The bolts are certainly subjected to a greater stress; but this could be readily met by the use of extra bolts. It is to be noted that a part of the pressure of the rail head is transmitted directly through the wedge plate on to the lower and the vertical portion of the fishplate. When a very considerable amount of wear has taken place it is possible that the lower part of the fishplate no longer does any work as it does not bear sufficiently against the rail; then moments may be produced which result in a rapid destruction of the joint. This particular form of deterioration takes place comparatively rapidly owing to the severe straining of the upper part of the plate.

FIG. 7.

Dr. Zimmermann himself therefore recommends that side fishplates should not be used. He thinks it better to use plates which utilize the broad lower surface of the flange of the rail, that is, to use a kind of bridge joint. A short piece of the rail turned upside down may be used as a supporting girder; it is connected with the foot of the rail by clip plates and bolts. An essential feature is that the rails do not touch each other over their whole length (Fig. 8); on the contrary, at the ends of the short rail and of the rails special packing pieces are to be placed and fixed to the bridge rail by riveting or otherwise. The thickness of these packing pieces is to be sufficient to allow for the free passage of the bolts; ribs on these packing pieces prevent lateral or longitudinal displacements of the rails. By the use of light side fishplates the construction could be still further strengthened against transverse stresses; however, the experiments made on the German state railways have shown that the use of such is superfluous.

JOINT WITHOUT FISHPLATES.

Pressel uses iron longitudinal stringers rolled out of plate, which have a width of 12.99 ins. to 17.72 ins. These stringers have transverse corrugations and the consecutive pieces are riveted together.

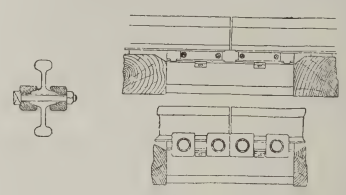


FIG. 8.

The rail, which is taken of strong section, is secured to the stringer by a special fastening, consisting of a chair and clip tightened by a wedge. The chair is riveted to the longitudinal stringer and has a steel wedge which presses at an angle of 45 degs. on a wrought iron clip taking against the web and flange of the rail; its tightening is effected by a steel key (Fig. 9).

The stringer is strengthened by the addition of a plate of great width and thickness; this plate acts locally as a longitudinal support; it carries two chairs, of which each has two pairs of wedges, and one chair with four pairs; the latter is at the joint. On it a short packing plate is held by a vertical peg, which supports the rail ends and limits, by means of a vertical rib, the expansion of the rails. The steel wedges at the joints bear against the wrought iron clip at an angle of 30 degs. For railways of a second or third order an arrangement of six or even four pairs of wedges is sufficient.

Pressel gives the following reasons for leaving out fishplates:

"1. The length of fishplates (even supposing intimate contact) is not sufficient to give resistance in case of unusually violent side impact at the rail end.

"2. Even with the most perfect methods of rolling it is not possible to obtain an accurate fit between the whole length of the fishplate and the head and flange of the rail. There can never be contact over the whole length of the fishplate, but only at a few odd points, which may be anywhere. Excessive stresses are unavoidably produced in the neighborhood of these points when the bolts are tightened; pressures of an injurious character are set up. More particularly is this the case in the fishplates through the vertical pressure at the joint. In addition the tightened fishplates tend to produce shearing at the head and at the flange of the rail, which leads to its destruction."

Pressel's joint construction undoubtedly possesses several more or less important defects, such as the necessary complication, the somewhat large number of parts, the low position of the keys, the unfavorable arrangement of the wedges, etc. Most of these defects are independent of the principle and may, in part, be surmounted practically. A defect inherent to the system is the use of a stiff support for the rail ends, i. e., the use of a "supported" joint. However, it is to be remembered that the rail is very securely fixed at its end, and consequently resists vibration of the rail ends in a vertical direction more powerfully. Nevertheless this vibration will not be entirely prevented and, although at a later period, the same phenomena will occur which have brought the bridge joint into disrepute.

Attention is due to Pressel's system, not on account of its method of execution, but because it pays due and proper attention to the fundamental principles. It is to be noted that Pressel did not consider the question of the joint by itself, but merely as part of the superstructure. It is further to be noted that he attaches primary importance, in this arrangement, to the solid attachment of the rail to the longitudinal sleeper which gives great resistance both horizontally and vertically; that is to say, he attempts to obviate the fundamental reason of all weakness at the joints, namely, the looseness of the rail ends. This has led him to the use of longitudinal stringers, which, considering the fishjoint alone, is certainly superior to the system of cross ties; for it removes the unfavorable conditions essential to two separate and independent sleepers at the joint. Finally it must not be forgotten that a certain power of adjustment at the joint seems advisable.

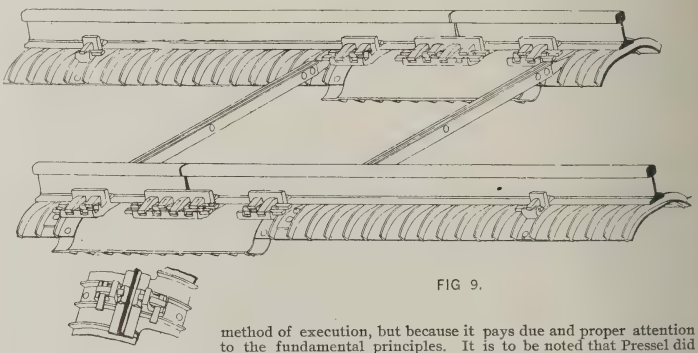


FIG 9.

THE FISH RAIL.

In the system where an additional rail is used for fishing, to which much attention has been drawn lately (*), the fishplate is also not considered as the principal part of the joint; nor is the truing of the rail surfaces left to the ordinary gangers. A joint made on this system (Fig. 10) has the following parts:

1. A beveled tie plate on each tie adjoining the joint.
2. An inner fishplate, which extends below the flange of the rail.
3. The fish rail proper.
4. A filler.
5. The parts necessary for securing the joint itself, and also those necessary for securing the rails to the ties.

The fish rail is not only the most important point; but also the most interesting detail of this system. It is placed on the outer side of the rail, and extends about 0.79 in. beyond the centers of the ties. It is secured to each tie by a screw spike. Its section agrees with that of the ordinary rail, with the following exceptions:

(*a*) The inner part of the flange is missing; it rests upon the outer flange of the rail proper by a projecting shoulder.

(*b*) The head of the fish rail has three bevels; one at each end, and one towards the outer side; by these bevels gentle slopes of ascent and descent are provided, as well as one towards the outside.

It is evident that such a fish rail can easily be made out of old rails or pieces of rails.

In Fig. 10 is shown the section of the standard type of the Prussian state railways, which has also been adopted by the Austro-Hungarian railway managements. According to this, the wheel, when the tire and the rails are quite new and properly adjusted, only runs on the main rails; the fish rail acts only as indirect support. Every stress of the main rail is transmitted by the filler to the fish rail, and through this to the ties. The conditions for resistance are consequently very favorable. If now by any chance the fish rail should not help to support the rolling load in this way, and if consequently the ends of the main rails should be bent to a more considerable extent, yet the wheel as in the first case, would not hammer. In this case it would be supported directly by the fish rail and carried by it over the joint. When the rail heads and the tires are worn the fish rail will always help to carry the wheel directly. In fact, if the wear of the rail head becomes considerable, or if, as may happen, its end is broken, the fish rail will carry the whole load.

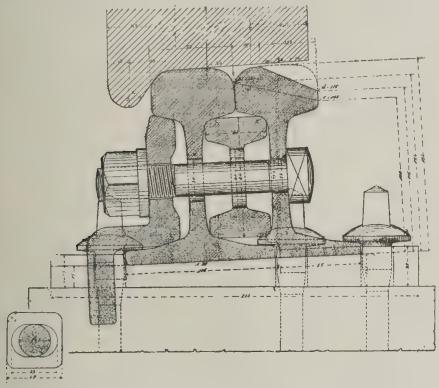


FIG. 10.

The results experimentally obtained—more particularly on a large scale on the Berliner Ringbahn—fully confirm this favorable view which was based on various theoretical considerations.

ECONOMIC VALUE OF IMPROVEMENT OF FISHJOINTS.

It seems evident that an efficacious improved joint cannot be made except at an increased expense as compared with the ordinary fishjoint. This greater expense is justified in one respect by the more comfortable and easy running, on the other hand by the great economic advantages which it affords.

In the first place we may mention the very considerable saving (which cannot as yet be expressed in figures) in the rails, sleepers, ballast and details both of the track and of the rolling stock. To this may be added the smaller amount of work required for the adjustment of the track. The latter item may attain a comparatively very high value which, more particularly on a large railway system, may affect the expenditure on maintenance considerably. Lastly the economy of traction, and consequently of fuel, must not be neglected. The more defective the arrangement of the joint the greater will be the sinking of the rail and of the wheel axles. Consequently more work is required (that is to say, the loss of tractive power is greater). It is employed in restoring the axles to their original level. Although the amount of power in a single case appears to be quite insignificant, yet if we consider the product of the large number of axles and joints which are affected the amount becomes very considerable.

FINAL REMARKS.

Our investigations allow us to draw the following conclusions:

1. It is an indisputable fact that the thorough improvement of joints is necessary.

2. It is not possible to effectively improve the joint by improving the separate details of the ordinary fishjoint.

3. Dr. Zimmermann's proposal to provide adjustability, and Pressel's to abolish fishplates and to provide a firm support are ideas which embody guiding principles and are worthy of careful consideration.

4. Rüppell's lapped joint and the fish rail are forms of construction which show noteworthy progress both from the theoretical point of view and from the practical experience hitherto obtained.

(*) A prize of about $750 (3000 marks) was recently awarded to this system by the "Verein deutscher Eisenbahnverwaltungen."

Street Railways of Illinois and Their Franchise Conditions.

During a hearing recently given at the State Capitol of Illinois, upon questions of street railway legislation, a statement of the growth of the street railways in this country, their relation to the growth of cities and some interesting data upon the demand for lower fares was made by the presidents of several of the principal Chicago street railway lines. An abstract of this statement is given below:

To the Honorable Members of the Senate and House of Representatives of the State of Illinois:

The undersigned, directly representing the larger and more important street railway interests of this commonwealth, beg leave to respectfully address you on the subject of the bills now before your honorable bodies relating to the said railways, and to place before you certain facts and figures bearing upon the subject. It is well known that there is but little reference made in the statutes of the state to these corporations, and the laws pertaining to them are more of a general than direct character. It seems necessary, therefore, that an act should be passed which directly pertains to them, not only in their interest, but in the interest of the public.

We would respectfully call your attention to the fact that Illinois is the only state containing in its borders a great metropolis where the street railway corporations are not operated under charters giving to them a measure of protection for a long term of years. The street railroads of New York, Boston and Philadelphia, have charters which are perpetual, and in Brooklyn the charters run for one hundred years. The effect on the value of the securities in the two sections may exemplify the difference in the conditions, when we see that the "consolidated bonds," issued recently by the West Chicago Street Railroad Company, sold at a fraction below par, while the same kind of bonds issued by the Metropolitan Traction Company, of New York, sold at 15 per cent above par, and this in the face of the fact that the latter is capitalized proportionately for a much greater amount than the former.

That the street railway companies, particularly in the large cities, are of immense value to the people and to the property interests, goes without saying. Without them no city could grow to any large proportions. The extension of lines causes acres of prairie lands to become business and residence districts, increasing the value of land to an enormous extent. It is said these extensions increase the value of the railroad properties, but that is doubtful. There is no doubt, however, that for every dollar the railway properties might be benefited, the property through which the lines run is increased five-fold. It is a fact, not generally known, that the increase in mileage of the street car companies has tended to reduce the rate of earnings on their capital, for the increase in mileage requires a large increase of expenditures. The increased revenue derived from added mileage is invariably of so small an amount as to reduce the percentage of profit on the prior investment. It is the policy of the street railways, however, to make these extensions, and keep up with the contemplated improvements and growth of the vicinity in which they are located. Whether the managers of the street railway companies—particularly in Chicago—have accomplished this, we leave it to your honorable body to judge from the accompanying exhibits. And, we may say, that we have made these improvements and extensions depending on the justice of the commonwealth to give us reasonable protection for what we have done, and encouragement for future efforts in the same direction. Although comparatively a young city, Chicago contains a much greater number of miles of street car track than any of the Eastern cities. It has double the mileage that New York has, and the inequality will probably continue to grow from year to year.

In considering this subject we would respectfully suggest five points as worthy of your serious deliberation:

First.—The necessity of further legislation regarding street railways.

Second.—How shall they be governed?

Third.—What should be the duration of their charters?

Fourth.—What rate of fare should they be allowed to charge?

Fifth.—What proportion of their earnings should the city or town in which a railway is located receive?

As to the first question, there can be but one opinion, and that is, that all corporations should have specific laws pertaining to their control and operation.

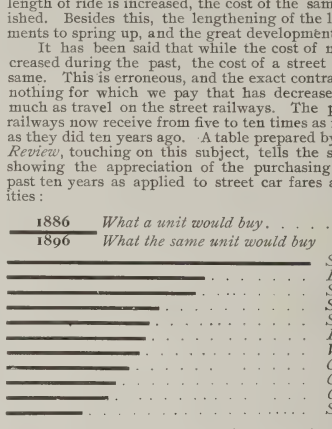
To the second, we would respectfully submit that experience ought to teach us that which is proper and right. This being an old question, it is not difficult to answer. Taking it for granted that those in control of the properties desire to encourage a growth of their patronage, it is but natural that they should do all in their power to please their patrons, and at the same time do a profitable business. The owners of the railways are the inevitable companions of their patrons, and the two cannot well be separated. So far it would seem that the companies can govern themselves better than they could be governed; but, as they are in the nature of state institutions—as we deem all corporations are—we feel it proper that the state should have them under its control. As the state does this in the case of steam railroads and warehouses, we see no reason to object to a commission of state officers acting in the same capacity in relation to the street railroads. We do not think the power to grant new ordinances should be taken from the City Council, but do believe that the regulation of all matters pertaining to the operation of the railways would be better in the hands of a few, who made such matters their active business, and were paid salaries therefor, than to be left in the hands of the many. We also believe that the city should have compensation for all new ordinances granted where the laying of street car tracks would be of value to the parties obtaining the privilege. Whether the laying of such tracks would be valuable or not would depend on their location, and this problem would solve itself when brought before the auctioneer. The laying of tracks and the occupancy of streets, in a location in course of development, is fraught with great expense to the railway company, without the probability of profit in the near future. But these grants are of some value, as the prospects for increase of traffic suggest. We believe it to be the wish of the people, however, that the value of new grants should be ascertained by a positive sale at auction, which would certainly determine their actual worth. The plan is in operation in New York, and always has—when any important route has been offered for sale—operated greatly to the advantage of the city. The only interest we have in the premises, however, is to have some course adopted which would free us from the charge of obtaining grants from the city for much less than they are really worth. We also believe the plan of selling at auction new grants to lay railway tracks would relieve the City Council of the charge, invariably made, that ordinances were being granted for a song which gave rights that were immensely valuable.

Answering the third question: "What should be the duration of their charters?" We believe the life of a charter should be perpetual, and here it seems proper to ask, what is a charter? It is the power which the state gives to its people to unite their capital to develop an industry requiring more money than could be commanded by one, or a few individuals. The right to form a corporation—which with its capital, consisting of the subscriptions of hundreds, and in many instances thousands of the citizens of a commonwealth—is one of the firmest of the foundation stones upon which our government rests. It is in this we find a marked difference between our own and that of the foreign countries. In the latter—particularly on the continent—with rare exceptions, the only place a person can invest his savings is in the government itself. If he does not choose to do this, he can hoard his money and hide it away. In our country, however, that one advantage of a free government offers itself to every man, woman or child who has thrift enough to save, to own a share in the great industrial institutions about them. In this way they become more closely identified with the country, its prosperity or adversity, and consequently have a greater interest in the common weal.

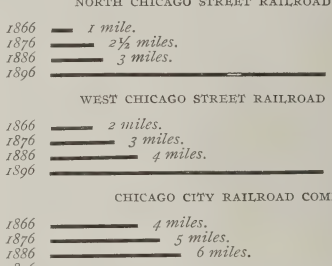
There are in the West and North Chicago Street Railroad Companies alone about 4000 owners, the great majority of whom own less than one hundred shares of stock. Fully one-fourth own not more than twenty shares. They, in a great measure represent the thrifty workman, artisan and merchant. Why should not an institution of this kind be operated in perpetuity, provided proper safeguards be thrown around it to prevent the possibility of it being conducted to the detriment of the people at large? It is a fact that a long franchise promotes a spirit for extensions and improvements, and naturally creates a more liberal feeling in the mind of the management. This fact is particularly emphasized now, especially since the motive power has been changed on all the street railways, and the amount of money necessary to be expended in a plant is more than quadruple what it was when horse power was used.

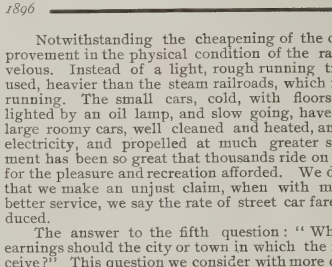
The fourth question is: "What rate of fare should these corporations be allowed to charge?" The price of a ride has by common consent, been placed at five cents, and this being the handy small coin of our country, it naturally remains as the standard. To reduce the fare by selling a quantity of tickets for a lump sum—say, six or eight tickets for a quarter of a dollar—has always proved a failure, so far as the object sought, viz., the advantage of the poor man, is concerned. The laboring man has but little money to spare, and experience warrants the statement that he seldom invests in tickets, even though such an investment would mean cheaper transportation for him. A critical examination has developed the fact that he fears the loss of his tickets, and also the unnecessary use of them. Those who benefit chiefly by the cheap ticket plan, therefore, are not the working people. But, aside from cheapening fares in such a manner, experience has taught that extending the length of the rides is by far the best and most satisfactory solution of the question, and at the same time is most helpful to the general public. As it would be inexpedient to make a charge per mile, the five cent rate is made to cover all distances. And here a result is attained which cannot but be satisfactory. It is seldom the poorer classes reside near the heart of the city, owing to the value of real estate in such localities; generally, they live near the outskirts, and thus it is that as the length of ride is increased, the cost of the same to them is diminished. Besides this, the lengthening of the lines causes improvements to spring up, and the great development in real estate.

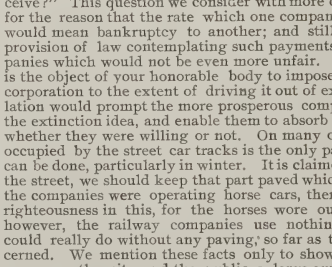
It has been said that while the cost of many articles has decreased during the past, the cost of a street car ride remains the same. This is erroneous, and the exact contrary is true. There is nothing for which we pay that has decreased in relative cost so much as travel on the street railways. The patrons of the street railways now receive from five to ten times as much for their money as they did ten years ago. A table prepared by the *Street Railway Review*, touching on this subject, tells the story by comparison, showing the appreciation of the purchasing power of money the past ten years as applied to street car fares and sundry commodities:


1886 What a unit would buy 100%
1896 What the same unit would buy
Street Car Rides 337.5
Bricks. 178
Steel Rails . . . 174
Silver 145
Sugar 137
Portland Cement 136
Wheat 134
Corn 131
Cotton 122
Coal. 118
Salt Pork. . . . 85

This phase of the subject will be found more fully illustrated, perhaps, by reference to the accompanying diagrams showing the purchasing power of a nickel in the way of transportation on three of the principal lines.







Notwithstanding the cheapening of the cost of a ride, the improvement in the physical condition of the railways has been marvelous. Instead of a light, rough running track, a girder rail is used, heavier than the steam railroads, which insures smoothness of running. The small cars, cold, with floors covered with straw, lighted by an oil lamp, and slow going, have been supplanted by large roomy cars, well cleaned and heated, and lighted with gas or electricity, and propelled at much greater speed. The improvement has been so great that thousands ride on cars in good weather for the pleasure and recreation afforded. We do not feel, therefore, that we make an unjust claim, when with much longer rides and better service, we say the rate of street car fare has been greatly reduced.

The answer to the fifth question: "What proportion of the earnings should the city or town in which the railway is located receive?" This question we consider with more doubt than any other, for the reason that the rate which one company could afford to pay would mean bankruptcy to another; and still we can think of no provision of law contemplating such payments by the several companies which would not be even more unfair. We do not believe it is the object of your honorable body to impose conditions upon any corporation to the extent of driving it out of existence. Such legislation would prompt the more prosperous companies to promulgate the extinction idea, and enable them to absorb the smaller concerns, whether they were willing or not. On many of the streets the part occupied by the street car tracks is the only part on which teaming can be done, particularly in winter. It is claimed that, as we occupy the street, we should keep that part paved which we occupy. When the companies were operating horse cars, there was a measure of righteousness in this, for the horses wore out the paving. Now however, the railway companies use nothing but the rails, and could really do without any paving, so far as their use of it is concerned. We mention these facts only to show that the street railways save the city and the public a large amount in paving and street work annually.

In summing up, we respectfully request not to be understood as asking for the passage of any bill, or set of bills, but simply pray that whatever legislation your honorable body may adopt, may give to the street railways a solid foundation, with such provisions as will encourage capital to be invested therein, to the end that the managers may feel warranted in continuing their extensions and im-

provements; that the people may continue to have as good, if not better, facilities for travel; and that real estate may be further benefited; and that the great population centers may be made to grow and be prosperous. Respectfully submitted,

CHAS. T. YERKES,
G. H. WHEELER,
C. L. BONNEY,
S. P. MCCONNELL.

The following statements relating to the same subject are also taken from a pamphlet issued by the Chicago City Railway Company:

TO THE PUBLIC:

We desire your patronage and believe that we will gain your approval after you have studied the conditions and surroundings of street railways of Chicago; and that you will not follow the intemperate and unfair advice of the ill-informed who blindly oppose anything that may be a benefit to a street railroad or to its patrons, simply because it is approved by street railway companies.

Fair play and justice to all parties concerned is desired, and the good sense of the people of Chicago will be invoked and the right attained by fair, impartial and truthful methods.

Are the street car companies the only persons who use the public streets for hire? What is the relation of teams and trucks of the merchants and express wagons and transportation companies to the public streets? Do the coal and lumber teams and express wagons, omnibuses and other conveyances for hire pay for the use of public streets?

Do any of these pave or keep in repair, clean or sprinkle any portion of the public property? While it is admitted that street railways should, for new ordinances, pay what is reasonable and proper for use of a street, and should perform their obligations in all pending contracts, and while it appears that the companies are willing to do something in addition to present obligations for the benefit of the city, it may be pertinently asked should the street car companies be picked out to bear the whole burden? Is it possible that some of the criticism of street car companies comes from persons or corporations who see an opportunity of shifting their burdens by exciting others to make drastic comment? The street car companies pave, repair, clean and sprinkle their right of way, and do not wear out the street. Do the other carriers for hire or pay wear out the street?

The extension of new tracks in the south division is always in advance of population and invites settlement of new territory and occupancy of unimproved real estate, and brings to the tax list an increased value of assessment. No new track extension pays expenses of operation till the new territory is built up. Such has been the fact in all new extensions since the organization of this company, and at present we are operating more than 25 miles of track at a loss of several thousand dollars per month. To assist the public, real estate owners and the growth of the city the street railways must and do keep in advance of population and settlement of new territory. Has this company increased the value of real estate?

In Brooklyn, New York, Boston, Philadelphia and Baltimore, as well as in many smaller cities outside of this state, the rights of street railways in the street extend to one hundred years or an indefinite period which is perpetual; and in Cincinnati recently by an act of the legislature of the state, the rights of the street railroads have been extended to fifty years under a "commission" and with provisions more liberal to the street railways than in the proposed legislation in Illinois, while in several small cities the rights are only for twenty-five to thirty years. These facts are worthy your attention.

The citizens of Chicago have heard from the public press for years the declaration that a "commission" should control the street railways, and have power to protect the abutters, assist the citizens and see to it that the city obtained its rights, and that new rights and extensions on streets should be given to the highest bidder. This plan is now proposed. It seems to be fair, protects every interest of the city, prevents injury to, and fraud upon, the abutter, establishes street railway legislation of which there is an utter want in the statutes of this state unlike all other states in the Union in that particular, and compels a larger revenue in this city, proportionately, than any other city in this country receives from street railways, yet objection is made because the street railways are willing to submit to it.

The street railways would like a "quiet title," like all investors or business persons, and for it are willing to comply with the exactions and burdens in the bills contained.

As suggested, for seven years now under contract between the city and the railways, the street railways will pay into the treasury of the city under the Humphrey bills over $4,000,000, or over an average of $600,000 each year, which, of course, without such legislation will not be paid.

Why this gratuity on the part of the street railways? Simply to "quiet titles" and settle unnecessary and frequent disputes and controversies, and to encourage investors and permanent improvements, establish a feeling of security, and be permitted without harrassing influences to conduct business and help the municipality and its people.

Will $600,000 extra contribution each year to the city help it, and benefit the tax payer? Why should hypocritical and captious objection be made to the city receiving this additional amount? It is claimed by some that a "new deal" between the city and the street railways must be made in 1903. Is there any good reason why the arrangement, if any is to be made, should not be made now when a gratuity of $4,000,000 results to the city? We think it will appear to any fair person that the compensation proposed is liberal.

So much misstatement and error has been promulgated by the press about street railways in other cities, and the people of Chicago have been the victims of so much humbug and deception pertaining to other cities, that we wish to bring to your attention a few facts regarding municipalities the most frequently cited. The cities of Baltimore, Cincinnati, Detroit and Toronto are selected because frequently mentioned, and with the most commendation and approval. The misstatements and conclusions about either of these cities are so viciously erroneous, and attended with such enticing humbug, that it seems as if the difficult task had been attempted here of "fooling all the people all the time," to the prejudice of this city and its street railways.

BALTIMORE.

The street railways of Baltimore are fortunate in having rights on the streets forever, and are not subject, in the matter of possession or fares, to the whim or caprice of legislation. This may horrify our opponents, but it is the fact. One street railway company managed this year, for the first time in six years, to pay its stockholders a dividend of 1½ per cent, which, of course, makes capital wild and enthusiastic to invest in street car business in Baltimore. Another company, substantially free of the obligation of the high percentage tax imposed within a limited territory as hereafter stated, also paid a dividend. The other companies of Baltimore have not yet paid any dividend. If the Baltimore street railways gave same service as Chicago City Railway Company, and paid their employes the same wages that are paid by this company, the city of Baltimore would receive no revenue from them, the bondholders no interest, the companies would not pay operating expenses, and would be in the hands of the receivers within one year. The trainmen of Chicago City Railway Company receive an average of 25½ cents per hour. In Baltimore the trainmen receive 14½ cents per hour; here laborers receive from $1.50 to $1.75 per day; there, $1.25 per day. Have the good people of Chicago thought once of the 12,000 men employed here by the street railway companies?

The burden of taxes against the street car companies of Baltimore is too onerous for that city (even considering the low wages) and the natural result follows, to wit: very low, even pauper wages, poorer service and accommodation to the public, and upon the whole less revenue to the city. There are several street railway companies in Baltimore and the law is so drawn that the exaction of taxes imposed upon the companies in various parts of the city, result in less revenue to the municipality than that proposed in Chicago.

The taxation of and exactions against the companies in different ways amount, in a very small or limited area or space of Baltimore, to a large percentage of the gross receipts. This looks immense on paper and in quotation marks, but the area is so small that the exaction is not as valuable to Baltimore as it seems to be to "that committee" here which fails to tell the truth, and has attempted to deceive the public.

Nine per cent of gross receipts is exacted in such small and limited space or area of Baltimore for parks, but the exactions of the proposed bills against the street railroads will be greater here and result in more benefit to Chicago, than those in Baltimore. The several companies operating outside of such small territory, where the tax burden is very light, combining or operating within such small space, produce for the city various amounts, the highest being 6 per cent of gross receipts, others paying 2 per cent of gross receipts, while others produce an insignificant percentage, and some pay nothing.

The advertised advantages of the Baltimore example are mythical, and are simply a halo around a great humbug. If the wages of Baltimore prevailed here there would be a saving to this company of over 9½ per cent of its gross receipts, or over $450,000. The laboring men and employes of the street railways of Chicago will soon see their interest in the matter.

CINCINNATI.

It seems that last year the legislature of Ohio adopted a bill or passed an act which is similar to the Humphrey bills. By it the rights of the companies in the streets were extended fifty years, a "commission" given great authority in the premises, the rate of fare fixed at five cents for twenty years, with right to change rate of fare at the end of that time, and every fifteen years thereafter, if the rate can be agreed upon, and if not then the question of fairness of rate, etc., shall be left to a court having equity jurisdiction on the application of the company.

Upon its face, under the Humphrey bills of Ohio, the street railways of Cincinnati appear to pay for all kinds of taxes, including car license, about 8 per cent of their gross receipts. Any one seeking accurate information as to receipts, expenses, car license, etc., of the Cincinnati street car companies, may have difficulty (which cannot arise under Illinois Humphrey bills) but the percentages can be easily ascertained.

The Cincinnati companies are not obliged to pave or keep in repair any part of the street—are not obliged to pave or repair the street, inside, outside, or between its rails.

Again the wages of trainmen in Cincinnati are 16⅔ cents per hour. This company pays an average of 25½ cents per hour. If the Cincinnati wages prevailed here there would be a saving to this company of nearly 7½ per cent of its gross receipts for the year 1896, or over $350,000. Are you ready to listen to denunciation

without reason, to rhetoric which is only for noise and effect, and to declarations made without thought, when you consider the foregoing suggestions? If the Chicago City Railway wages prevailed in Cincinnati the cost of train service of its street railways would be increased 50 per cent with the result there that much less revenue would be obtained and the capital invested receive very little if any return. In Chicago with engineers, firemen, depot men, eight hours is a day's work. In Cincinnati such men work ten hours. From any standpoint the proposed legislation here is more helpful and beneficial to the people of Chicago and the city itself than that of Cincinnati to its people.

DETROIT.

The relation of Detroit to its street railways has so long been used by the public prints in this city as a profitable hint to Chicago and a "fearful example" to street railways in general, that it seems cruel to expose the fraud. The whole matter from start to finish has been clap trap and humbug. There are (or were) two street railway systems in Detroit, one has recently begun to operate the other to save it from bankruptcy. The revenue obtained by the city from these roads is very small. One (the old company) pays 2 per cent of gross earnings together with general taxes, which amount to 1 per cent of gross earnings, neither company paying license fee. The other company, because of its adopting the three cent fare delusion was especially favored and excused from paying any percentage of its receipts or from paving or repairing any portion of the street. For this kind of improvement the people are taxed, and were only entitled to ride a very short distance for three cents, and to go farther paid more for a transfer.

The rights of these companies on some streets are for thirty years and on others perpetual, but the amount of the revenue to the city was not the strong point. There is more humbug and delusion when low fares are advocated, so the new company, agreed to carry passengers for three cents each. The result was competition, reduction of fares by the old company, loss of revenue to the city, which was low at the best, bankruptcy of the new company and no profit to the old, and while their substance was consumed in this profitless and absurd competition, the public was poorly served.

No dividends were paid by either company, and the capital of Detroit goes elsewhere than into its street railways. The new company to save itself from bankruptcy closed up its power houses, discharged its employes, and turned its track and cars over to the old company to operate so as to protect its bondholders as the operation of both systems from one power station and by one set of employes saves enough to pay the interest on the new company's bonds. The systems do not transfer to or from each other and considerable traffic is obliged to pay more than five cents. The old company has returned to five cent fares, except it still sells six tickets for twenty-five cents, which should be abandoned.

Thus, has the low fare episode of Detroit ingloriously ended. The merchants, business men and citizens of Detroit would now be benefited by changing the new company's ordinance or contract so that there might be one rate of five cents with general transfers as on the systems of Chicago.

Although there is humor attending the Detroit experience, and the Detroit street car bubble has burst, there is a moral manifest, which any fair minded citizen can see, and an object lesson is here learned by study of the history of Detroit street railways for the past four years. No benefit resulted to Detroit or its citizens, and the companies were less efficient. Besides the revenue and advantage to the municipality are so insignificant that the whole episode is ridiculous. Low fares and liberal revenue for use of streets do not go together.

TORONTO.

We are curious to know what American city would submit to the arrangements in vogue in Toronto, even if our constitution permitted. The rights of the only street railway company in and for Toronto are established and defined by an act of parliament of the Dominion of Canada, and although "home rule" is protected and recognized in the proposed Illinois legislation, there, the act of parliament is supreme and paramount.

The company paid the City of Toronto for 1896, about $140,000, being obliged under the grant of parliament to pay 8 per cent of gross receipts, together with $800 per mile trackage, the amount paid for this latter item in 1896, being $60,000, although the company is operating 88 miles of single track.

While on its face, looking alone at the revenue received, the amount paid by the company is large, yet a slight analysis, and a contemplation of the favors conferred upon the company, and its many advantages over the street railways of this country, will convince any one that the street railways of Chicago would be glad of an opportunity to comply with the obligations and burdens, if they could avail themselves of the benefits, advantages and favors of such an act of the legislature.

Under our constitution such a law would be inoperative, and is not in compliance with our system of government, but if you are fair minded you will say that the favors measured by the exactions are great, and the payments small when compared with the advantages. Look at the benefits and favors.

First.—By the act itself the street car company has exclusive right in and to any or all streets in the city. No rival or competing line can use or occupy any street, whether the favored company has a track in the street or not. The right of exclusion is absolute, the dominant company being secure in its monopoly, and beyond the influence of harrassing and whimsical interference.

Second.—Such exclusion and peaceful right is for thirty years, and the company can extend and build its track into and along the streets whenever it wishes, without let or hindrance. No threatened rival company can sandbag or molest it. These favors are worth something.

Third.—The act of parliament further provides that the rate of wages to employes shall not exceed fifteen cents per hour, and as the Government of Canada dictates the wages, it must protect the schedule, and of course guarantees against strikes. How long would the American citizen submit to such interference with his liberty?

Fourth.—The company does not pave or repair any part of the street and is not compelled to do any cleaning or sprinkling, although it does assist to clean and sprinkle some parts of the streets. The paving and repairing of paving by the street railways of Chicago constitutes a large expense, from which the Toronto company is relieved. The city of Toronto paves the entire street, concreting beneath and around the tracks without expense or cost to the company, and maintains the entire street without cost or expense to the company.

Fifth.—No passes are issued by the company to any person or government or public officials. They are, further, by law protected from this item of expense, which in Chicago is very large.

Sixth.—This company was, during the last year, further favored by the Government returning to it the duty or import tax on the rails used in the construction of its tracks which amounted to $56,000.

Now, contemplate the foregoing advantages and benefits to the company and you will say at once, Toronto arrangements will not do for Chicago. The companies here would gladly avail themselves of them if they could be conferred with binding force. In Toronto when tracks are to be laid in streets, the city is notified and proceeds at once to make substantial concrete foundation and lay the pavement. The company lays down its rails in the place prepared by the city, whose officials cause the pavement to be made around and along the rails. The company receives the benefits. The first laying of the pavement is by the city without expense or cost to the company, and is an immense saving in cost of construction of track. Thereafter the city, without cost or expense to the company, maintains and repairs the whole pavement, including the right of way.

We wish to add a word about low rate of street car fare. It seems hardly necessary to enter into extended argument or illustration, because from actual experience in every city where tried in this country, the attempt to reduce fares below five cents has been a failure, unfair and disastrous to the companies, and prevents revenue and compensation to the city. Low fare and high revenue for city cannot exist together. For your information please read and consider the dispassionate article headed "Cheapness of Municipal Transportation in America" published in the STREET RAILWAY JOURNAL, for July, 1896.

What the street car companies want is fair dealing and judgment after knowledge of the facts. The sucurity holder should be protected, the city's rights recognized, and the corporation treated with honesty.

Respectfully submitted,

CHICAGO CITY RAILWAY COMPANY,
By G. H. WHEELER, President.

European and American Operating Conditions.

An interesting pamphlet entitled "A Comparison of Street Railway Conditions and Methods in Europe and the United States," has recently been written and published by P. F. Sullivan, general manager of the Lowell & Suburban Street Railway Company, of Lowell, Mass. The information in regard to European railways was collected by Mr. Sullivan during a recent trip to Europe in which he visited the United Kingdom, France and Germany. In his report he describes carefully the principles of fares, management control in two typical cities, Glasgow and Berlin, also in Paris. He makes the following interesting.

Comparison between American and European Methods.

I will endeavor to show:

First, that the rates of fare in Europe are actually higher and not lower than the rates of fare in the United States, and when the earning capacity of the people is considered, that they are relatively higher still.

Secondly, that the principle of charging a distance rate works injuriously against the laboring and artisan classes, the very classes that street cars are chiefly intended for; that it has resulted in such crowding, such density of population as to cause the municipalities the greatest concern; upon which they spend as much if not more to regulate than is received from street railway franchises; and that such a condition, with respect to density of population, is not known in the United States because of superior street railway facilities.

Thirdly, that under the conditions which obtain in Europe with respect to high rates of fare, low rates of wages and prices, density of population, low mileage and therefore low capital invested, and owing to the protection which capital receives, street railway investments are more desirable and are better than street railway investments in the United States.

RATES OF FARE.

The prevailing general opinion in the United States is that street car fares in Europe are two cents regardless of distance, and that because of this fact, together with the fact that some of the

companies in the larger cities make money, the five cent fare generally prevailing in this country should be reduced. I have shown above what the rates are and such rates prove that it costs more than two cents for a general ride. In November I paid six cents for a ride in Glasgow, and in December ten cents for a ride in Berlin, a longer ride than either of which I could regularly obtain for five cents in any city of Massachusetts; and in neither city, in fact in no city in Europe, with the exception of Paris, are transfers issued.

When we look at a car of the West End Street Railway Company and see all seats occupied and a few persons standing, we are led to think that such a condition of things represents a large income. We do not stop to consider how long some of the passengers rode in that particular car, nor do we further consider that in the morning most cars are comparatively empty going in one direction and in the evening comparatively empty going in the other direction; and that there are many trips the receipts of which do not pay the actual wages of the conductor and motorman. What is true of the West End Company is true of every other company in the State, The West End Company averaged for the fiscal year ending Sept. 30, 1896, to carry fewer than seven persons per car mile. How then can we account for thirty or forty persons that we see so frequently upon one of that company's cars? It means that if you divide thirty or forty by seven, they averaged to ride $4\frac{3}{7}$ miles, or $5\frac{5}{7}$ miles and when we know that many ride a longer distance than that for five cents we can account for some who ride shorter distances. If those passengers paid five cents for limited distances of about 1 mile or so, the West End Company would then average to carry instead of seven persons per mile at least thirty persons per mile. You will then account for the fact that Glasgow cars averaged to carry over eleven persons per mile in its fiscal year as against seven by the West End cars. From investigations and comparisons made in the last two or three years I find that the rate of fare in this state averages between 1 and $1\frac{1}{4}$ cents a mile.

The above five cent rate of fare is paid principally by laborers and mechanics who average between $1.50 and $2.50 a day, as against a rate of wages for the same classes averaging between seventy-five cents and $1.25 a day in Europe; and assuming that the American pays twice the average rate, or $2\frac{1}{2}$ cents a mile, he pays from one-sixtieth to one-hundredth part of his wages, while the European pays from one thirty-seventh to one sixty-second part of his wages. In other words, a European gives twice as much labor as an American for a car ride. And when it is remembered that every American city and town which changed from animal to mechanical traction extended its lines and in many instances nearly doubled the length of ride without increasing the rate of fare, the additional advantage is apparent.

This point is so well covered editorially by the STREET RAILWAY JOURNAL in its issue of July, 1896, that I have taken the liberty to quote it in full.*

Similar statistics to those given in that paper are presented below for Glasgow and Berlin.

CITIES.	Approximate Population. 1890.	Track Mileage.	Longest ride for 5c. cash fare. Miles.	Transportation rate per mile.
Glasgow, Scotland, fare 6c. .	840,000	73	5.37	.1173
Berlin, Germany, fare 10c. .	1,800,000	180	7	.1428

Density of Population.

GLASGOW.

In "Municipal Government in Great Britain," we find the following statistics relative to Glasgow:

"The density of London according to the census of 1881 was fifty-one to the acre while that of Glasgow was eighty-four, which was increased to ninety-two by the census of 1891, the annexed suburbs not being included. The average density of sixteen of the twenty-four sanitary districts moreover, is above 200, and the average density of five districts is 500. Localities are not few where single acres contain a thousand or more people. The tenement house is almost universal. The best as well as the worst of the laboring class, and a large majority of the middle class live in the 'flats' of stone buildings three or four stories high. In some cases two or three hundred people use a common staircase and much greater numbers may be found using common passageways, or 'closes,' as they are called in Scotland. In 1891 there were 100,000 people living in one-room houses, and nearly 264,000 were in two-room houses, this class of dwellers constituting 47.5 per cent of all the people within the city limits at the time of the census. A population thus housed might well give employment to an army of sanitary inspectors. 'Small as these abodes are, great numbers of them take lodgers in addition to the regular family,' DR. Russell, the medical officer remarked, 'Nor must I permit you, in noting down the tame average of fully three inmates in each of these one-apartment houses, to remain ignorant of the fact that there are thousands of these houses which contain five, six and seven inmates, and hundreds which are inhabited by from eight even to thirteen."

The effect of such living upon the public health is considered of such importance that the apartments are "ticketed" to show how many persons may lawfully live in each, and fines are imposed for violations.

It may be noted here that the percentage of one-room dwellers decreased in the periods between 1871 and 1881 and between 1881 and 1891. It may be interesting to note in that connection that Glasgow had no street railway accommodations in 1871, when its population was 478,000; that from 1871 to 1881 it built and operated 40 miles of tracks and between 1881 and 1891 17 miles additional It is, therefore, a fair inference that transportation facilities had something to do with the above healthful change.

The effect of street railway accommodations upon density of population may be further shown by the impartial testimony of Messrs. Young and Clark, present general manager and engineer respectively of the Glasgow street railways. In September and October, 1896, they visited the United States and Canada as a committee from the government of Glasgow to investigate American street railways. They visited as follows: New York, Brooklyn, Jersey City, Staten Island, Philadelphia, Baltimore, Washington, Pittsburgh, Cincinnati. Chicago, Detroit, Cleveland, Buffalo, Niagara, Toronto, Montreal and Boston. In a very able report presented by these gentlemen Dec. 9, 1896, they spoke as follows (page 30):

"We never were prouder of Glasgow than when we heard of the high place assigned to her as a municipality by the Americans. But we have not served twenty years in the Health Department, and been acquainted with 'life in one room,' without knowing Glasgow's blemishes—and they are common to all of our older cities. One great city improvement scheme has been carried out in our city, and another is now being favorably considered. In Glasgow as it was five years ago there was a population of 565,714 on an area of 6111 acres, giving ninety-two persons to the acre, or 58,880 to the square mile. In the present Greater Glasgow, apart from the adjoining, but still separate burghs, we have a population of 705,000 on an area of 12,311 acres, giving fifty-seven persons to the acre, or 36,480 to the square mile. When the four separate burghs now served by our tramway system are included, we have a population of 841,000 persons on an area of 14,661 acres, which also give fifty-seven to the acre, or 36,480 to the square mile. No American city, with the exception of New York, is half so densely populated. No one wishes our citizens to continue so closely packed as they now are. How are they to spread out? In our humble opinion and judging from what we have been privileged to see in America, the most powerful instrument which lies to the hands of the municipality for effecting this purpose is the best and cheapest possible tramway service radiating from the center of the city outwards in every direction.

"Such a system must be safe, rapid as far as consistent with safety, elastic as to speed, clean, comfortable and attractive, flexible enough to apply to all routes and m et all contingencies of street traffic, and of course, as cheap as possible; and it would be all the better if each route had its suburban attractions in the shape of a park for music, and the usual facilities for amusement and recreation generally. Let us sufficiently as you give cheap and rapid transit, which will enable all sorts and conditions of people living at a distance to travel comfortably to and from their work in the city, so surely will houses to accommodate them be built on cheaper ground—meaning cheaper rents—and with healthier surroundings."

BERLIN.

In volumes 17 and 20 of Berlin statistics of 1893, by Herr R. Bodkh, chief statistician of the city of Berlin, we find statistics which are very ably described in "Municipal Government in Continental Europe," as follows:

"In 1885 it was found that 73,000 persons in Berlin were living in the condition of families occupying a single room in tenement houses; 382,000 were living in houses (I mean by 'house' the distinct apartments of a household) of two rooms; 432,000 occupied houses of three rooms; and 398,000 were quartered in the luxury of houses having at least four rooms. It was found that although the one-room dwellers were only one-sixth as numerous as the three-room dwellers, their rate of mortality was about twenty-three times as high, and the actual number of deaths among them was four times as great. Compared with the dwellers in houses of more than four rooms, the mortality of the one-room dwellers was at a thirty times greater rate. In a total population at that time of 1,315,000 the 73,000 people who lived in one room tenement quarters suffered nearly half the entire number of deaths. Their death rate per thousand for the year was 163.5, or about one-sixth their entire number; while the two-room dwellers sustained a death rate of only 22.5, the three-room dwellers escaped with the marvelously low rate of 7.5, and well to do people who had four or more rooms for their household suffered by death only at the rate of 5.4 per thousand of population.

"I am of the impression that the relation of mortality in cities to the character of the housing of the people was never before shown with such frightful distinctness as in these Berlin statistics which were compiled and published in 1885. We are wont to regard an annual city death rate of about twenty per thousand of the entire population as normal and satisfactorily small. We have not, however, become accustomed to the minute analysis of such a rate which might show up of rates for different classes varying from three or four per thousand to 200 per thousand. Half the mortality of the Berlin one-room dwellers occurred in households where five or more persons occupied the one enclosed space.

"Berlin's population as yet is almost wholly housed in tenement or apartment buildings. The number of households or distinct housekeeping establishments was in 1890 about 367,000 and these were included in some 21,600 buildings. The average was about seventeen families under each roof, comprising about seventy-five persons. Including the Emperor and his nobles and all the rich families of Berlin, there were only about 2200 households out of 367,000 that had rooms on more than one floor; and of the 2200 nearly 1400 were connected with business rooms. That is to say, the 1400 families had a living room or two 'back of the shop' and some more space upstairs. Fewer than 600 families had private houses totally separate from business uses for their own individual occupancy. Not one family in 600 in Berlin lives in what Americans call a 'house,' as distinguished from a 'flat' or an apartment in a tenement building. The average size of Berlin's tenement buildings has been increasing materially. The buildings that shelter less than about forty people were not in 1890 so numerous by one-tenth as in 1880. Those occupied by from fifty to one hundred people had increased about 40 per cent in number, while those that house from one hundred to 300 people had increased from 50 per cent to 300 per cent, the increase being more rapid according to size. About half the inhabitants of the city now live in buildings containing not fewer than one hundred people. Such a system has its advantages and its disadvantages. It makes the distribution of water and gas easier and renders perfect sewer connections more feasible. Everything depends upon the question whether or not the building is a proper one of its kind. In 1885 about 120,000 Berliners lived in cellar or basement rooms. The actual number of such subterranean dwellers was about the same in 1890, but the relative number had decreased somewhat. It is the policy of the authorities to discourage or forbid, as rapidly as possible, the occupancy of unwholesome basements."

COMPARISON BETWEEN AMERICAN AND EUROPEAN CITIES.

That the foregoing instances of deplorable density of population are not isolated may be seen by glancing in columns on next page at the figures given for Manchester and Birmingham, representative British cities, Paris and Lyons, representative French cities, and Berlin and Hamburg, representative German cities. It will be seen that the cities of Europe and the cities of the United States form two distinct classes with respect to density of population:

*See STREET RAILWAY JOURNAL, July, 1896, p. 419.

CITIES.	Population.	Acres.	Population per acre.
New York	1,851,060	37,056	49.95
Chicago	1,700,000	116,480	14.6
Philadelphia	1,047,000	82,560	12.68
Brooklyn	1,053,398	44,800	23.29
St. Louis	644,000	40,000	16.1
Baltimore	613,965	26,880	22.8
Boston and suburbs served by West End St. Ry.Co.	782,859	65,192	12
Cleveland	368,895	20,480	18.01
Buffalo	360,000	26,880	13.4
Detroit	280,000	17,280	16.2
Glasgow	840,000	14,661	57.3
Manchester	520,000	12,911	40.2
Birmingham	500,000	12,365	40.4
Paris	2,500,000	19,200	130.2
Lyons	416,000	10,880	38.2
Berlin	1,800,000	17,500	102.8
Hamburg	600,000	19,200	31.2

The foregoing list of cities and the figures given in connection with them prove a lesson in themselves. New York City is an exception to American cities, regarding density of population; yet a study of it will explain it more clearly. New York within its municipal boundary can grow in only one direction, viz., north, and the greatest growth of New York, in what may be called Greater New York, is toward Brooklyn, Long Island and New Jersey. New York proper then, may be compared to old Glasgow, in which exists at present, a population of 565,714 in 6111 acres or ninety-two persons an acre. The figures prove beyond question that the conditions are not the same with respect to population in European cities as in American cities. In European cities, there is a dense population crowded into very small space; no suburbs as there are in this country, and consequently a smaller track mileage, therefore less capital invested, and greater population per mile than exists here. Under such conditions is it any wonder that street railway companies in Europe are profitable investments?

DENSITY OF POPULATION AND ITS EFFECT UPON RENTS.

The matter of cheaper rents referred to above bears important relation to surface transportation. This is best illustrated in the city of Berlin. Owing to the graded fare and the low rate of wages, suburban residence is beyond the means of the masses. They are therefore compelled to reside near to their places of employment. This leads to demand for apartments or tenements in the central portion of the city. The effect is that rents are abnormally high. How this item compares with American tenement property may be learned when we know that an average working man would pay all of his earnings for two rooms on the first floor front of a tenement building, and would pay the income of 125 days' labor for two rooms of the third floor of a court in the rear of the same building, while an average working man in any of the suburbs of Boston would have a five or six room tenement or cottage with modern conveniences and light and air, for which he would pay the earnings of from eighty-five to ninety-five days' labor. Assuming then that the American wage earner rides to and from his labor every working day, and that the European wage earner does not ride at all, it is clear that the former is still better off even viewed from a pecuniary standpoint only.

COMPARISON OF ACCOMMODATIONS.

Having shown that the conditions affecting street railways are not the same on both sides of the water we come to the next point —comparison of accommodations. They are as follows:

CITIES.	Population.	Miles Track.	Population per Mile Track.
New York	1,851,060	458	4,042
Chicago	1,700,000	595	2,857
Philadelphia	1,047,000	462	2,266
Brooklyn	1,053,393	393	2,680
St. Louis	644,000	335	1,922
Baltimore	613,965	225	2,728
Boston and suburbs	782,839	290	2,700
Cleveland	368,895	269	1,371
Buffalo	360,000	143	2,517
Detroit	280,000	202	1,386
Paris	2,500,000	184	13,587
Berlin	1,800,000	180	10,000
Glasgow	840,000	73	11,507
Liverpool	600,000	60	10,000
Manchester	520,000	50	10,400

In the foregoing figures the elevated railroads of New York, Brooklyn and Chicago are not included, therefore these cities should properly be not included; and should they be omitted we find that seven representative American cities have an average population of 2127 persons, while the five representative European cities have an average population of 11,099 persons per mile of track. In other words, the people of American cities are accommodated on an average in excess of five times better than are the people of European cities. When we take into account, therefore, the pro rata rate of fare and the limited track mileage, is it any wonder that the people of European cities are crowded into buildings in a condition of grave menace to the public health, and is it any wonder that in American cities there are so many individual houses with an abundance of light, room and air?

But it may be urged that the American cities have too many miles of track, that the European cities have about enough; that they are satisfied with the accommodations, and that the people of the latter are satisfied with their conditions of living and do not need suburban houses. If one would say that the American cities have too many miles of track for the investors it would be right, for the greater amount of track and therefore of capital invested the less return can be obtained from the investment; but that the American public does not think that there are too many miles of track, too many accommodations, may be evidenced by the fact that the public is always petitioning for more tracks and more cars; and the people have never accused street railway companies of providing too many cars. In European cities, on the other hand, the public authorities deplore their transportation facilities and are trying to improve them. It was shown in the case of Glasgow, when the municipal authorities gave easier terms and conditions to the lessees so that additional accommodations might be obtained in particular localities. It is also true of Berlin.

ADDITIONAL CITIES OF THE UNITED KINGDOM.

The following list of cities shows that the lack of accommodations in the few larger cities is general throughout the country:

CITIES.	Population.	Miles Track.	Population per Mile Track.
Bradford	216,400	21	10,304.8
Bristol	221,600	18	12,311.1
Cardeff District	129,000	2.33	55,364.8
Leicester	174,700	9	19,411.1
Newcastle and Gosworth	186,300	13	14,330.8
Nottingham	213,900	10 25	20,868.3
Sheffield	324,300	9	36,033.3
Sunderland	131,000	5	26.200
Aberdeen	109,800	10.25	10,712.2
Dundee	153,000	7.25	21,103.4
Edinburgh	256,400	13.5	19,000
Belfast	256,000	20.	14,800

The above list shows an average of 21,703 persons per mile of track against an average of 2558 in all the cities of Massachusetts except Boston and cities accommodated by the West End Street Railway Company. In fact the exception in the United States is the rule in Europe viz., that there are few cities under 50,000 population which have no street railway facilities, and very few suburban towns which are not connected by tracks with a city or with other towns, while in Europe very few of such cities or towns have any street railway accommodations.

If anything further were needed to show the difference in accommodations on both continents, it may be noted that the United Kingdom in 1895, with a population of 40,000,000, had 982 miles of street railway tracks and in round numbers $70,000,000 invested; while the state of Massachusetts alone had 2,500,000 population, 1368 miles of street railway tracks, and in round numbers $60,000,000 invested.

MUNICIPAL OWNERSHIP.

A few words regarding municipal ownership and operation of street railways may not be out of place here. The impression intended to be conveyed by its advocates is that there is a universal demand for such a change in Europe, but the facts do not warrant any such conclusion. It is true that ways and means are discussed at present with a view of adopting policies at the expiration of present contracts. All the street railways in the United Kingdom were constructed and are operated under the general Act of 1870, and as all contracts were made for periods not less than twenty years, they have expired or are about to expire within a few years. Glasgow has acquired its own plant and London is attempting to purchase the rights and property of a few small companies. In London, however, the acquisition is not for the purpose of operating the railways, but in order that contracts may be made which will remove the objections to the present unsatisfactory service.

Huddersfield and Leeds are referred to as cities which own and successfully operate their own plants. Huddersfield is a city of nearly 100,000 population and 20 miles of track, an average of 5000 persons per mile greater than the average of any city in the United States. The city acquired the street railway property in 1891 and up to 1896 it has just about paid the interest at less than 3 per cent on the investment since the acquisition. In one year a tax of 2½ per cent was added to the general tax to help pay the deficiency of the street railway department. Leeds has a population of 368,000 and acquired the ownership of the tracks of the street railway company in 1894. It is too early yet to look for results, but we shall hope that the municipality will succeed better than the late stockholders, who lost $392,095 out of an investment of $800,000.

Birmingham, one of the most progressive and best governed cities in the world, with a population of nearly 500,000, does not take kindly to municipal ownership and control. At a meeting of the City Council of that city, held July 7, 1896, after a very full discussion upon the report of the Public Works Committe, it was voted to extend the present lease for a period of twenty-one years to a syndicate represented by gentlemen, one from Toronto and one from Montreal. The following quotation comes nearest to expressing the business sentiment of England: "That the opinion of competent judges is that the lines, etc., should rest in the local authority, but the working be left to private enterprise, and that this would be a just settlement of the question."

I stated previously that the conditions with respect to density of population were such as to cause the municipalities to spend more than they received from street railway franchises. This is illustrated in the case of Glasgow. In that city it has been decided that the public safety and health could best be protected by having all common entrances to dwellings and stairways cleaned and lighted by the municipal authorities. These items alone cost the city in the last fiscal year $130,064.

STREET RAILWAYS AS AN INVESTMENT IN BOTH COUNTRIES.

Street railways in Europe in their relation to public accommodation are about in the same condition as they were in the United States twenty years ago; therefore there is need of improvement. To bring about improvement, however, will require a revolution in rates of fare, for in order to get people to and from the suburbs cheaply, the fare must be brought within their income, but that cannot very well be done owing to the conditions which prevail. There is, as shown above, a very large population to be accommodated, and that fact insures good business; for it is safe to apply to European cities the same general principles as are applied to American cities, viz., that large cities are better than small ones, owing to a larger population.

CAPITAL INVESTED.

Owing to prices of material, rate of wages, and local conditions, it will require less capital to perform the same work in Europe than in the United States. For instance, Glasgow street railways have invested $3.48 for each person in its population, Berlin, $5.25, Boston, $33.72. In the one item of cars alone to accommodate about the same population, Glasgow has $249,740 and Boston $5,510,544.66 invested. The interest on the capital invested in street cars of the West End Company alone, at 6 per cent per annum, would be $330,622.68, an amount greater than the whole capital invested in street cars in the city of Glasgow. But it may be asserted that the West End Company is overcapitalized. That is hardly so, for among the twenty-four largest and leading street railway companies of the United States the West End Company has the lowest capital invested per mile of track, while it is second in amount of track.

RATES OF WAGES.

The rates of wages are so low in Europe (although the rate of wages paid by the street railway companies is higher than the general rate prevailing elsewhere) that the cost of operation is reduced to a minimum. The scale of wages in Glasgow, adopted in September, 1897, is higher than that in Berlin. Hostlers receive from $0.83 to $0.87 a day; laborers, $0.95 to $1; condnctors and drivers, from $0.85 to $1.12; all per day of ten hours' duty performed. The total receipts of the Glasgow Street Railway from all sources for the last fiscal year were $1,671,891; of Berlin, $3,890,201.50; while the amount of wages paid by the West End Company was $3,842,230 without taking into account wages paid to contractors for track renewal, etc., an amount nearly equal to the total Berlin receipts and more than twice the total Glasgow receipts. If the West End Company, therefore, paid the same rate of wages as is paid in Europe, it could afford to pay $2,000,000 per annum for its franchises and still maintain its dividends.

PROTECTION TO CAPITAL.

The street railways of the United Kingdom are constructed and operated under the General Parliamentary Act of 1870. That Act in practically its present form has been the basis upon which all contracts and franchises were made and granted. Those who invested their capital, therefore, knew with reasonable certainty what the conditions would be with respect to legislation during the existence of the contracts. Inasmuch as petitioners are compelled to pay all parliamentary expenses, which usually reach the sum of about $20,000, there are very few changes in local affairs. The same situation with respect to changes exists in Germany. The financial departments of municipal governments are skilled in all matters relating to finances, so that when the government and those seeking a franchise meet, both parties are fully informed, and the result is usually satisfactory to both parties. After contracts are signed, there is no disturbance. How different in the states! Capital is invited to embark in an enterprise, the public is enthusiastic in its applause, and in a very few years the same public is clamorous against the particular investment which it fostered and encouraged.

TAXES, ETC.

Street railways in Europe pay no taxes upon the capital invested in tracks. In Massachusetts, in addition to paying the local tax, they pay a tax into the state treasury upon the net capital invested, and said net capital is represented by all items of investment. Glasgow paid in the last fiscal year for all taxes $23,072, and the West End Company $338,996.

SUMMARY.

It therefore follows that the conditions and accommodations are not the same in Europe as in the United States, and that the people of the United States could better afford to subsidize the street railways to maintain the present conditions at any price, and that the European cities have a grave problem on hand to obtain the same conditions as obtain in American cities.

Electric Railways in Argentina.

The construction of the new electric railway system of La Capital Company, Limited, at Buenos Aires, is being pushed forward rapidly by that company, and operation, it is hoped, will be commenced in the early future. This company's system includes some 20 miles of track traversing some of the most important streets of the city and forming a means of communication between the middle of the city and some of the most populous suburbs.

The power station will be equipped with three vertical compound Ball & Wood engines of 350 h. p. each directly coupled to 300 k. w. Walker generators. It is estimated that two of these units will be sufficient to supply current to all the cars that will be in operation on the line at one time, so that one unit can be kept as reserve in case of accident to either of the other sets. The boilers will be of the Stirling water tube type, four in number, and of a capacity of 330 h. p. each. They will operate under a working pressure of 140 lbs. to the square inch. Green economizers and Conover condensers with compound pumps will be employed. The power house, which is of steel, is being erected by the Berlin Iron Bridge Company, and is designed for an ultimate capacity of 20,000 h. p. The rolling stock will consist for the present of forty-two double deck cars now being built by the J. G. Brill Company, and mounted on Brill trucks. They will be equipped with two G. E. 1000 motors each.

The track construction is most substantial. Johnson 9 in., 90 lb., grooved girder rails are being used. The rails will be bonded with a special type of bond, the invention of E. T. Birdsall the engineer of the company. This bond was illustrated and described in the January issue of the STREET RAILWAY JOURNAL. The feeders in the business district will all be underground. Wyckoff wooden, creosoted ducts will be used, and the feeders will be of the standard Habirshaw type except that there will be no lead coverings. The poles will be both wooden and iron, the latter being supplied by Morris, Tasker & Company. H. W. Johns overhead appliances will be employed.

Elevated Trains and Electric Cars on the Brooklyn Bridge.

The elevated railroads and surface systems of Brooklyn are proposing to operate through cars over the bridge to New York. The plans of the companies interested have not yet been entirely decided upon, but the proposition of the elevated railroad companies at present is to equip each one of their cars with a grip, and one car of each train with an electric motor, making the trains similar in equipment to those used at present on the cable railway of the bridge. The trains will then be delivered at the Brooklyn terminal to the bridge authorities and will run across the bridge by cable power on the present tracks and will be switched and returned from the New York end in the usual way. If this plan should be followed out and the present steam equipment of the Brooklyn elevated railroads be retained it will, of course, compel the trains on those roads to draw one idle electric equipment over their entire routes. It is possible, however, that if the plans should be consummated either the roads will be equipped with electric power or some means be adopted by which the electric motors can be thrown out of gear with the car axles.

In connection with these plans, the surface companies are proposing to equip one track on each of the present highways and run through cars to New York. In this case an elevated loop will probably be built at the New York end, connecting the tracks on one highway with those of the other.

Still another proposition is to connect the Manhattan Elevated Railway in New York with the Bridge tracks, thus giving through trains from the New York elevated system to the Brooklyn elevated system.

Through Trolley Party Cars from Paterson to Coney Island.

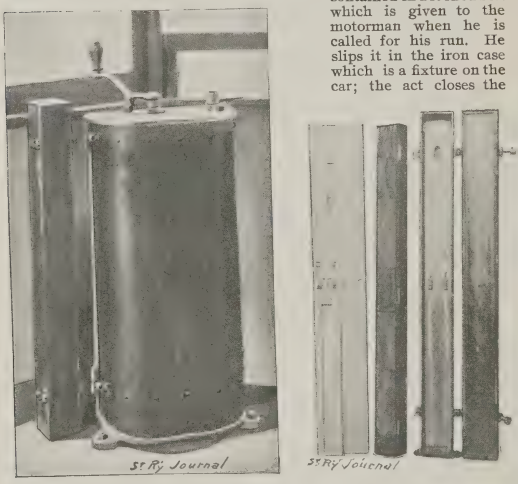
The authorities of the Brooklyn Heights Railroad Company and the Consolidated Traction Company, of New Jersey, are proposing the equipment with tracks of some of the Brooklyn and Jersey City ferry boats whereby cars from either system can be transferred to the lines of the other company. If this is carried out it will enable through trolley cars to be run from Brooklyn to any part of the Oranges or from any of the cities reached by the Consolidated Traction Company to Coney Island. Owing to the traffic arrangements between the Paterson Railway Company and the Consolidated Traction Company, of New Jersey, cars under this arrangement could be run from Paterson to Coney Island, a distance in a straight line of about 30 miles.

SCIENCE · ENGINEERING · INVENTION ·

A Current Recorder for Motor Cars.

The waste of power by careless motormen, especially on large roads, is well known, but heretofore effective methods of stopping this waste and the repairs incidental thereto have not been forthcoming. J. R. Cravath, formerly electrical editor of the *Street Railway Review*, has developed and placed on the market a simple appliance intended to cause all the motormen on a road to be careful all the time and which promises to meet the long felt want. It consists of two parts, a recorder which is furnished to each motorman and a recorder case which stands on the platform, or other suitable place, and in which the recorder is placed when the car is in service. The recording device comprises a strip of alloy which melts at a low temperature, and a German silver wire in the main car circuit.

The alloy strip is held vertically above the horizontal wire, the wire being of such cross section that when the current operating the car rises above a reasonable amount the heat generated in the wire will cause it to melt its way through the alloy strip. The amount of strip melted through per trip or per car mile is used as a measure of the comparative efficiency of the various motormen in the same service. The recorder is contained in a locked box which is given to the motorman when he is called for his run. He slips it in the iron case which is a fixture on the car; the act closes the



RECORDER BOX CLOSED AND OPEN.

car circuit through the recorder; until the recorder is in place the car circuit is open and the car cannot be run. At the end of the day the motorman turns in his recorder to the office clerk. The clerk unlocks the recorder box, measures the strip melted, puts in a new strip if necessary and the recorder is put in the "outgoing" pile. Alloy strips that are melted through are turned back as scrap, and the cost of the strips is very low.

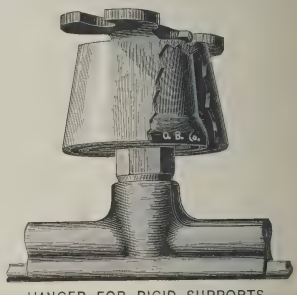
The saving effected by the recorders has been demonstrated on the Chicago General Railway. A series of tests before and after the recorders were put on the road (six out of seven cars being equipped) showed 9 per cent more power required to run the road without the recorders than with them. The maximum power station load was cut down materially also. The recorder is low in cost, cheaply installed and can be operated by employes already in service; its use bids fair to make possible a marked economy in operation and to check a hitherto uninterrupted waste of money.

Trolley Wire Hanger for Rigid Supports.

It will undoubtedly be a matter of considerable interest to those operating electric railways, under conditions necessitating the support of the trolley wire to a rigid superstructure, to know that they can obtain a device especially adapted for this purpose, and which is so constructed that the vertical height required by the hanger has been reduced to a minimum. This hanger is also of such a design that it possesses great mechanical and electrical strength. It is manufactured by the Ohio Brass Company, and is illustrated herewith.

It is very important for the successful operation of any electric road, that the trolley wire be held securely in its suspended position and thoroughly insulated, and it is these two requirements, with which the hanger shown is made especially to comply. By referring to the cut it will be seen that the insulation is guarded against accidental blows of the trolley wheel, and protected from moisture dripping from the overhead structure, by a metal covering which partially envelops it, and the trouble usually arising from surface leakage of the current, due to a deposit of conducting material on the outside of the insulator, has been avoided by the novel form of construction used. The body of insulation is made with two $\frac{5}{8}$ in. steel studs projecting from the upper and lower faces respectively, and is held in place in the casting by means of the upper stud which threads into it, and which is prevented from unscrewing by means of a small set screw arranged for this purpose. The lower stud serves as a means of attaching the various styles of ears and clamps to the hanger, and when so required can be varied in size to fit those which are tapped out for $\frac{1}{2}$ in. or $\frac{7}{8}$ in. studs.

The trolley wire clamp, shown in connection with the hanger body, consists of two jaws of bronze metal, hinged on an interlocking pin, which passes through the enlarged head of the stud bolt. The clamping effect is secured by screwing the cone shaped nut down on the stud bolt, which spreads the upper part of the jaws apart, thus securely gripping the wire. The stud bolt in the hanger body is threaded right handed and that in the clamp left handed. This arrangement allows the clamp to be either loosened or tightened on the wire by turning the cone shaped nut in the proper diection. To facilitate this operation, the nut is made hexagonal in shape on its upper end, and a small open end, drop forged steel wrench is supplied with the hangers and clamps, of the proper size to fit it. This permits a longitudinal adjustment of the trolley wire without removing it from the clamp, which is found to be frequently necessary when cutting in or taking out slack. The great objection to mechanical clamps, that of causing the trolley wheel to spark when passing over them, has been overcome in this style, without, as in former cases, sacrificing the strength of the clamp, and when used in combination with this hanger body has been found eminently satisfactory.

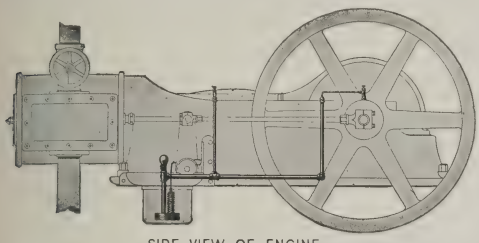


HANGER FOR RIGID SUPPORTS

THE Santa Ana & Orange Motor Company, of Santa Ana, Cal., is employing a new type of steam dummy car in which the machinery is placed in the center of the car. In one form the engine shaft is directly connected with the car axle by means of rubber belts. In a new type sprocket chains will take the place of the rubber belts. The exhaust is passed into a sheet iron box under the car, muffling the noise. The cost for operation is said to be extremely low.

Automatic Lubrication.

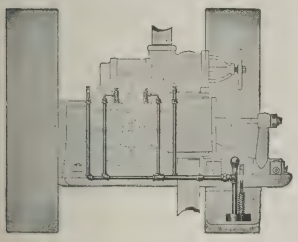
The accompanying cuts illustrate the system of automatic lubrication, which is applied to the American-Ball engines, now being built at Bound Brook, N. J. The characteristic features of this system include a positive circulation of oil from an external storage



SIDE VIEW OF ENGINE.

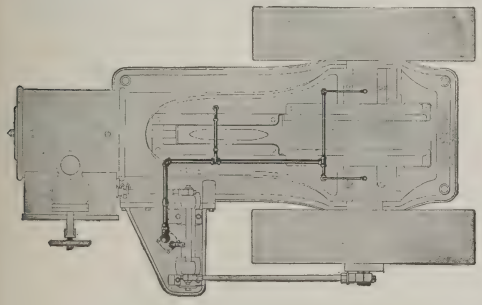
tank into which the oil is strained on its return from the engine frame, and an entire separation of the water from the oil, by means of a tight bulkhead near the cylinder end of engine frame. The chamber thus formed collects the water dripped from piston rod, and discharges it through a suitable drip pipe, while the steam escapes at the top of the chamber, which is open to the air.

A simple pump placed in the storage tank, and actuated from the rockshaft, circulates the oil through suitable pipes and discharge nozzles, to the stationary working surfaces, from whence it flows by gravity or centrifugal force to the crank pin and crosshead pins through oil holes and channels, provided for that purpose, and thence by gravity back to the storage tank, on entering which it passes through a fine gauze strainer located in



END VIEW OF ENGINE.

the tank. To insure an abundant supply of oil at the discharge nozzles, the pumping capacity is made to exceed the maximum requirement, and the surplus oil escaping through a relief valve falls back into the storage tank. To provide against possible de-



PLAN VIEW OF ENGINE.

rangement of the pump, a gravity receptacle is arranged to be instantly attached to the system, as an emergency supply.

A liberal supply of oil fed automatically to the working parts of an engine, contributes wonderfully to smooth, quiet running, and relieves the engineer from the drudgery of watching and refilling a lot of oil cups.

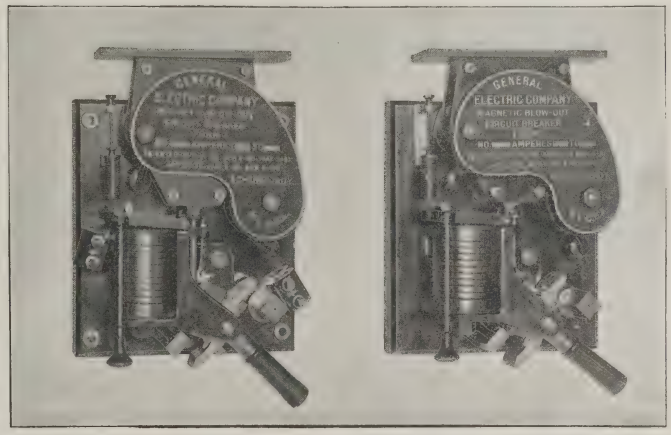
New Automatic Circuit Breaker.

The well known automatic circuit breaker of the General Electric Company, known as form K, for heavy currents, is now followed by one for use with smaller currents, i. e., for 100 to 500 amps. It is known as the form L and, as with the K, may be used on any potential up to 750 volts.

The deleterious effect of arcs on unprotected contact parts destroys in a short time their usefulness, introducing a serious problem on all circuit breaking apparatus, and the greater the voltage and current the greater the difficulty presented in handling arcs. To eliminate the destructive effect of arcs on contacts the magnetic blow-out principle was applied, and by this a means is provided for destroying the arc at the moment of its formation. The addition to a station thus equipped of a tripping device to open the circuit as soon as a predetermined current flows, gives an automatic circuit breaker unsurpassed for reliability and convenience.

The form L circuit breaker is substantial in construction and compact in form. It is mounted on a slate base, 11 ins. × 12½ ins., and the maximum overall measurement from the back of the base is 6 ins. It can be provided with either front or back connections. Its action is similar to that of the form K circuit breaker, adopted so widely in power stations for use with heavy currents. The current passes through built-up leaf contacts to the tripping coil, the armature of which actuates the tripping device. An adjustable tension spring holds the armature away until sufficient current flows to overcome its pull, drawing the armature to the magnet coil.

The leaf contacts are held normally against the main contact blocks. When the tripping armature is drawn to its magnet, the main



FORM L CIRCUIT BREAKER—FRONT AND BACK.

contact is released and the circuit instantly opened by the action of the main spring. To prevent arcing at the main contact, the current is shunted through a secondary contact plug protected by the blow-out magnet. This plug is not withdrawn until after the leaf contacts have left the contact blocks, and all tendency to arc, therefore, is confined to this point, where the magnetic action prevents it from doing damage. The blow-out magnet and secondary contact are in series with each other, but are connected in multiple with the main contact. Owing to their high resistance practically no current flows through them until the circuit through the main contact is opened, when they take the whole current, creating the magnetic field and extinguishing the arc independently and apart from the main contact.

The marked rating of a circuit breaker, as 100-500, indicates the lowest current that will automatically open the circuit and the maximum normal current carrying capacity. The circuit breaker is set to open at any desired current from its lowest rating to 50 per cent in excess of its highest rating, by adjusting the calibrating spring of the tripping armature. An indicator on the adjusting stud registers with well spaced marks on a brass scale, showing the current at which the circuit will be opened.

The handle of the form L circuit breaker is removable, but is automatically locked in place so long as the circuit remains closed. It can be removed only when the circuit breaker is open. Moreover, when the handle is removed the circuit breaker cannot be closed. This interlocking device allows feeder circuits to be kept open at the will of a single operator, avoiding to a large extent any accidental closing.

Although automatic in action and capable of carrying safely the currents within their rating and of opening the circuits on heavy overloads and short circuits, circuit breakers should be given a reasonable amount of care and attention to insure satisfaction with continued use. By regarding this injunction the life will be very much prolonged.

A Convertible Car.

Most, if not all, of the different convertible cars for summer and winter use which have been put upon the market have depended for their construction upon either one of two principles. One method has been to construct a side aisle car with low side rails and panels and deep sashes. In summer the sashes are removed, the entrances being on the platform as when the car is used as a box car. The other method has been to make the entire sides detachable. When this is done the panels and sashes are usually attached to the posts by screws. An open car made in this way is very similar to an ordinary open car, the style of which is generally more popular than that of the open car made in the former way, but the rattle of the car is apt to work the screws which hold the side panels loose, while the labor of attaching the sides to the posts is usually quite considerable.

The accompanying engravings illustrate a new type of convertible open and box car recently invented by James A. Trimble, the well known car manufacturer, and manufactured by the Brooklyn & New York Railway Supply Company. By this car it is claimed the defects of former convertible cars are avoided. The sides of the car are detachable, but not in the usual way. The side posts are provided with the usual groove reaching to the floor, in which the curtain fixtures slide, when the car is used as an open car. When the car is changed to a closed car, wooden strips, projecting about 1 in. from the post, are inserted in these grooves, metal strips are screwed on each side of this strip and cover the joints between the sash and side post. This permits the sliding of the sashes in place without the removal of any screws. The lower panel can then be slid into place in a similar way. The work of doing this is necessarily very simple and can be performed by two men who can change an open car to a box car and *vice versa* in twenty minutes.

FIG. 1.—CONVERTIBLE CAR.

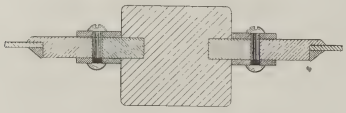


FIG. 2.—SECTION OF POST.

The seats are arranged crossways with a center aisle, but when used as an open car the space in the aisle can be filled by an auxiliary seat, making longitudinal seats all the way across the car, if desired. The side step or running board, can then be used.

The engraving of Fig. 1 shows the method of changing an open to a closed car and Fig. 3 shows the side of a side post with groove.

An Automatic Brake Handle.

This handle is an improved ratchet brake handle, having in combination with a simple, reliable ratchet a positive and efficient trip or release mechanism which enables the motorneer at all times to retain his hold upon the brake, thus keeping his car always under absolute control. This feature, as is well known by railway men, is of the utmost importance, especially where passengers are allowed to ride on the front platforms. The ratchet is very simple; it contains no spring, the dog being actuated alone by gravity. It is absolutely impossible to accidentally trip the handle when applying the brake.

After a two months' trial the Waldran automatic brake handle has been adopted on all the cars of the St. Louis & Kirkwood Railroad.

Variety Wood Worker.

The machine herewith illustrated is manufactured by J. A. Fay & Company, and is one combining the functions of the horizontal surface dressing ordinarily used in hand planing and variety wood working machines and a vertical surface dressing attachment, by which two surfaces can be operated upon at the same time in squaring up. It will rabbet and face inside blinds, joint, bevel, gain, chamfer, plow, make glue joints, square up car posts, raise panels, either square, bevel or ogee, stick beads, work circular moulding, rip, cross-cut, tenon, bore, rout, rabbet and edge door frames, etc.

The tables are of iron, each 40 ins. × 19½ ins., and have independent vertical and lateral adjustments, by means of the hand wheel at the working end of the machine. All the different functions of the machine are secured by the use of two tables, thereby effecting a saving of time in making the adjustments. The tables are made with grooves to receive the gaining frame, and are made continuous by filling pieces connected with them when so used. For sawing, a short supplemental table is inserted between the other two, making a continuous saw table.

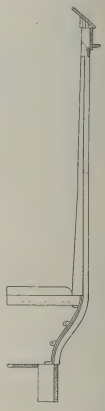
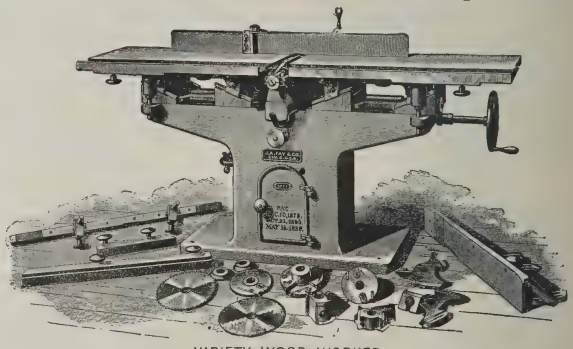


FIG. 3.—SIDE POST.

The horizontal arbor is of steel, $1\frac{7}{16}$ ins. diameter, and revolves in bearings supported on the column. The bearing on the front side of the machine is planed in a seat, the height of which to the center of the arbor is equal to one-half the diameter of the largest head to be used. It is readily detachable for the purpose of substituting different heads. The vertical arbor is of steel, $1\frac{3}{8}$ ins. diameter, and arranged to be dropped below the line of the table, by removal of the head and operating a screw which supports the vertical spindle frame. The head on this arbor is of steel, slotted on all four faces, and it, with the arbor, is so arranged that its cutting surface is in line with the end of the horizontal planing head, so the full limit of the knife on both surfaces can be used.



VARIETY WOOD WORKER.

Electro-Pneumatic Brakes.

The Western Railway Company, of France, has recently made interesting experiments between Paris and Nantes with a new system of continuous brake, invented by Chapsal. It consists of the operation of all of the air brake valves by the use of electricity. By this means all the brakes are operated simultaneously upon the whole length of the train, in order to avoid the troubles arising from the sole use of the air. The results are said to be highly satisfactory.

New Electric Motor.

It will be remembered that the first street railway motor which was constructed of steel and entirely enclosed was designed and placed on the market by the Steel Motor Company. That it was the pioneer in progression is evidenced by the fact that nearly all motors manufactured now for street railway purposes are of steel. The company now invites the attention of the street railway managers, and others interested, to its new motor which it is now prepared, after exhaustive and most satisfactory tests in actual service, to offer to purchasers.

The new motor, which is designated as No. 22, is constructed entirely of steel. It is cylindrical in form, and is water and dustproof as indicated in Fig. 1. It is of the four pole field type, each pole having its individual field coil. Owing to the superior design of the motor, which is compact in every respect, it is claimed to be lighter for a given output than any heretofore produced.

The poles are of laminated wrought iron with serrated face. The increased mechanical strength and efficiency resulting with this form of construction will be apparent. It will be observed from Fig 2 that the lower half of the field frame may be dropped down and that the armature may be retained in either the lower or upper half at will, permitting easy access to all parts when desired.

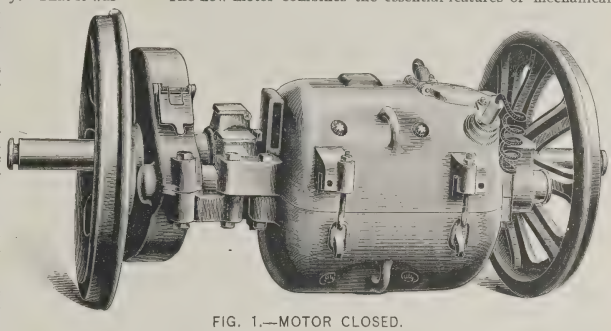


FIG. 1.—MOTOR CLOSED.

The armature is of the well known drum type as shown in Fig. 3, and is simple in construction. It contains a smaller number of slots than any armature manufactured, and only one coil, which is thoroughly insulated with special material and is waterproof, is inserted in each slot. It will be of interest to know that but one-third of the time necessary to rewind other armatures of a similar character is required. This factor of saving in labor, coupled with the fact that there are times when armatures are required to be repaired in the shortest possible time, is of such obvious consequence that its importance will be fully realized. Careful attention has also been given the matter of ventilation. The core is hollowed to prevent sparking at excessive loads and to provide means for circulation of air to effect the important feature of cooling.

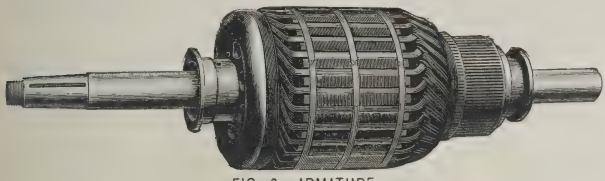


FIG. 3.—ARMATURE.

The commutator is of the usual undercut bar type and is simplified by the small number of bars used. The armature leads and commutator bars are tinned for electrical connection, and the use of solder is avoided. The field coils are interchangeable. They are wound on special forms and are thoroughly insulated with special material of such a character that deterioration in ordinary service is prevented. The brush holders are identical and interchangeable. They are independent of each other and their position on the commutator is fixed. No adjustment is necessary and they may be removed or replaced without opening the motor.

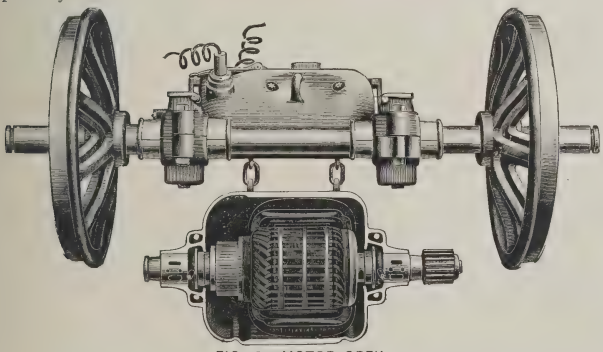


FIG. 2.—MOTOR OPEN.

The axle bearings are interchangeable and the grease pockets on top are supplemented by oil chambers in the caps beneath from which the axle is lubricated by woolen waste. The oil is introduced through a vertical pipe. The armature bearings are also interchangeable and project outside of the motor frame, providing a ready means for slinging the armature when removing or replacing it. Oil wipers are provided which effectually prevent oil or grease from getting into the motor, all surplus lubrication falling to the ground through openings between the motor frame and bearing brackets.

The new motor combines the essential features of mechanical strength and rigidity. The Steel Motor Company has succeeded in minimizing the number of parts and has made the parts interchangeable where it is possible to do so, knowing that these points will be thoroughly appreciated by those who have in their charge the care and inspection of motors. The new motors are manufactured in sizes from 25 h. p. up to 100 h. p. capacity. The smaller sizes are adapted to city service, the larger to interurban, where heavier work is demanded. Particular attention has also been paid to the growing demand for motors for elevated railways, and some of the larger sizes are especially designed to meet the requirements for this service.

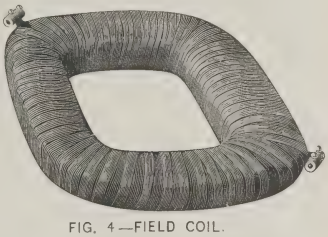


FIG. 4.—FIELD COIL.

The motors are arranged for nose, yoke, and side bar suspension.

Changes in Hannibal, Mo.

The plant of the Hannibal (Mo.) Street Railway Company was purchased last month from its former owners, Doyle & O'Hern, by a syndicate of Eastern capitalists, represented by D. Thomson, of Ithaca, N. Y. The purpose of the purchasers is to greatly enlarge the plant. A new car house and new power house will probably be erected and additional power station capacity of about 300 h. p. will be installed. The track will also be rebuilt and a number of new cars will be added. It is also proposed to install a pleasure park and extend the line in a number of directions

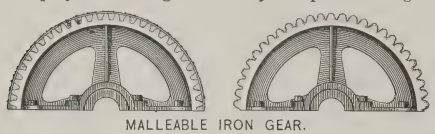
Mr. Thomson, who will have charge of the new company, was formerly manager of the Ithaca Railway & Electric Light Company and has been engaged in the electrical business for twelve years. He is a brother of Professor Elihu Thomson, of Lynn, Mass.

A New Malleable Gear.

The Western Gear Company is placing on the market malleable gears which are entirely free from blow holes in the teeth and in which the teeth are formed by a new process, giving results which are claimed to be almost equal to steel. Fig. 1 shows the form of blank that is used in making gears where the teeth are cut out of a solid rim, the darkened space between the teeth and around them shows the amount of metal removed in cutting the teeth in the blank rim.

Fig. 2 illustrates the method used by the Western Gear Com-

pany, when the teeth are formed in the casting. In cutting this gear it is only necessary to remove a small amount of metal from around the cast tooth and the structure or grain is left undisturbed. The company claims that gears made by this process will give at



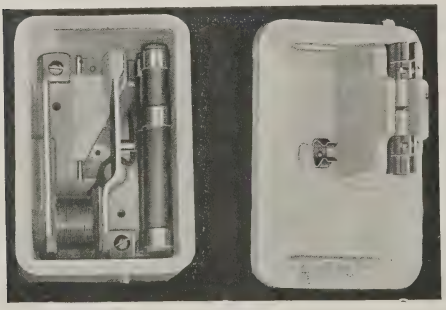
MALLEABLE IRON GEAR.

least 25 per cent longer service than those made by the ordinary methods, for the reason that the metal flows much closer in the teeth than in a solid rim, and the teeth are also more perfectly annealed. It is also claimed that these gears will show almost the same results as those obtained from steel gears, since they are made from a special mixture containing a very large percentage of steel.

Magnetic Blowout Lightning Arrester.

In order that lightning arresters may be effective in conducting away high potential discharges generated in overhead lines by atmospheric disturbance, they must have less resistance across the spark gaps than the apparatus to be protected. Railway armatures are usually constructed with insulation that will stand a high potential test of approximately 3000 volts, and very often lightning arresters are used that require from 8000 to 10,000 volts for the current to pass across gap the spaces in them. It is easily seen that arresters having long gap spaces are likely to fail to protect electrical machinery.

In the new arrester for 500 volt, continuous current work, known as type N-D, recently designed by the General Electric Company, the spark gap which separates the overhead line connection from the ground connection is only $\frac{1}{32}$ in., and 2000 volts only are required for the electric current to bridge this gap. After the passage of the high voltage current, if there were no means of rupturing the arc, a short circuit would be maintained and the lightning arrester would be completely destroyed. In this arrester, the gap is placed in a strong magnetic field, which tends to force the arc from the field and rupture the current. It is the same principle employed for rupturing arcs in circuit breakers and car controllers.



MAGNETIC BLOW-OUT LIGHTNING ARRESTER.

In order to limit the current, a low non-inductive resistance is placed in circuit. The spark gaps are mounted on the cover and may be easily removed from the circuit for inspection and adjustment. In the station type all the metal parts are contained within a substantial porcelain box. For line use, the arrester is placed in an iron case in a wooden box.

Arresters of similar type have been used for the past two years with great success, and this perfected type has now been adopted as standard by the General Electric Company.

Compressed Air Motors for Elevated Railroad Service.

The accompanying engraving shows a new compressed air locomotive recently built by the American Air Power Company for the Manhattan Elevated Railroad Company of New York. The locomotive will be put in operation within a few days on the Sixth Avenue division of that company and will operate between Fifty-eighth Street and Rector Street.

The wheels are 42 ins. in diameter; the dimensions of the cylinder are 13 ins. in diameter by 20 ins. stroke, and the storage reservoir has a capacity of 175 cu. ft. This, it is estimated, will allow the locomotive to make the round trip between Rector Street and Fifty-eighth Street with 20 per cent reserve. The reservoir is composed of Mannesmann tubes with a diameter of 9 ins. and having various lengths, from 14 ft. to 20 ft. 6 ins. The thickness of the tube is 9 ins. The tubes are rolled from solid ingots according to the regular Mannesmann process.

COMPRESSED AIR LOCOMOTIVE FOR NEW YORK.

The air is stored in the reservoir at 2000 lbs. pressure. It is used in the cylinder at 200 lbs. pressure with cut-off at $\frac{1}{10}$ stroke. In passing from the reservoir to the cylinder it traverses the usual hot water reheater and enters the cylinder at a temperature of from 200 to 300 degs. The water is kept heated by a small coal fire. But little fuel is required to maintain this, as will be appreciated when it is stated that only an ordinary scuttleful of coal is carried by the engine.

A novel feature of the engine, as will be seen, is the location of the cylinder. This is directly under the cab, giving a short lead for the heated air. The valve mechanism is extremely simple and can be seen in the engraving under the cab. It is operated by the wheel which can be seen through the window of the cab. The weight of the entire locomotive equipped is 47,000 lbs. The power station will be located at 100 Greenwich Street.

Coupler for Interurban Cars.

The accompanying engraving illustrates the No. 7 automatic coupler of the Fitzgerald-Van Dorn Company. This has been recently brought out by Mr. Van Dorn for the large interurban cars now coming into special favor. It has several special features, including an air hose support on the side of the drawhead. The No. 7 is a size between the No. 5 coupler and the sizes on the elevated roads of Chicago, and is now a standard on the Washington, Mount Vernon & Alexandria Railroad, of Washington, D. C. It couples automatically to the No. 5 and has the same sized pin and links. All of the late couplers of this company are machine fitted. This assures every one being absolutely perfect.

COUPLER FOR INTERURBAN CARS

STREET RAILWAY NEWS

New Grip for Broadway Cable Line.

An improvement has recently been adopted by the engineers of the Metropolitan Street Railway Company, of New York, for enabling its cable cars to pass around the Fourteenth Street curve at a slow speed. The improvement consists in the employment of a small projection or clasp on the outside of the jaws whereby the grip on the cable can be relieved somewhat without allowing the cable to slip from the grip.

Mechanics' Fair in San Francisco, Cal.

The thirtieth industrial exposition of the Mechanics Institute of San Francisco will open Aug. 17 and close Sept. 18. Considerable space will be devoted to electrical exhibits, and power for machinery will be supplied free to exhibitors. Space, water and lighting will also be free to exhibitors. The fair will be held in the Mechanics Pavilion, two stories in height and covering a large block in the vicinity of the City Hall in the heart of the city.

Extension of B. & O. Electric Service.

The electric service of the Baltimore & Ohio Railroad Belt Line, which has heretofore extended from the power house, corner of Howard and Hamburg Streets, to the Mount Royal Station, Baltimore, has been completed to Waverly, a distance of 2 miles. Hereafter freight trains will be drawn to that point by the powerful electric locomotives. The object of the extension is to do away with the smoke nuisance in the Annex, and also to enable rapid transit over the heavy grades which lie between North Avenue and the York Road.

The Tennessee Centennial Exposition.

The Tennessee Centennial and International Exposition will open at Nashville, May 1, and close Oct. 30, and will celebrate the one hundredth anniversary of the admission of Tennessee into the Feneral Union. The exposition is planned on very broad lines and will be the largest held in this country since the World's Fair at Chicago. The amount already expended and to be used on the exposition will be upwards of $1,200,000, and among the buildings will be Machinery Hall of about 50,000 sq. ft., the Transportation Building of 50,000 sq. ft., and Commerce Building of 250,000 sq. ft. Railroad tracks will be run through Transportation Building and in it will be shown the latest developments in the line of locomotives and rolling stock for street and steam railroads. The Foreign Department to which a large space is devoted will be located in Commerce Building.

Street Railway Charters in New York.

Parties opposed to the status quo in New York street railway matters have resurrected an apparent flaw in the charters of the Sixth Avenue and Eighth Avenue Railway Companies, by which it is claimed that the city of New York has the right to purchase these roads at any time by paying the cost of construction and equipment plus 10 per cent. Under color of these provisions of the charter it sought to prevent their equipment by the underground conduit electric system now in contemplation by the Metropolitan Street Railway Company, the lessee of the two companies named, and certain parties have made an offer to the city to practically assume this privilege to purchase and to pay it a large bonus over and above any price which the city may have to pay. It appears, however, that the city has no authority to purchase or operate these roads under existing legislation, and a bill has been introduced in the New York Legislature authorizing the city to purchase any street railroad or railroads where it may have reserved rights to do so, to pay for them with the proceeds of city bonds, and to lease them to the highest bidder for a period of twenty-five years.

Pending Street Railway Legislation.

The Mackey bill, permitting traction companies to carry freight and merchandise, has been favorably reported in the Pennsylvania Legislature, and the Hoy bill conferring upon them the right of eminent domain also came out of committee with favorable recommendations.

The Humphrey bill now pending in the Illinois Legislature to extend street railway franchises in the state fifty years and provides for a tax upon its gross earnings. The bill has been passed by the Senate by a vote of 29 to 16. It has been bitterly opposed, particularly in Chicago by the Municipal Reform Association.

Union Loop Elevated Railway in Chicago.

Work on the connection between the Metropolitan Elevated Railway in Chicago and the Union Loop is now almost done. The structure is finished and only the ties and rails remain to be laid. The loop structure is almost complete and the track will be down within a short time. The Van Buren Street stations are yet to be built, but it is the intention to begin using the loop as soon as the rails are down and electrical conductors in place. It is expected that the Metropolitan and Lake Street trains will be operated around the four sides of the loop by June 1. It will be considerably later before the Alley "L" connections can be completed. The power house walls are up, but it will be three months before power can be furnished from this source.

Compressed Air Motors in Washington.

The Eckington & Soldiers' Home Railway Company, of Washington, D. C., has in operation one of the Hoadley-Knight compressed air motor cars. The car carries the air under a pressure of 2000 lbs. per square inch in thirty-four reservoirs, and all machinery is located under the car. Mr. Schoepf, the receiver of the Eckington & Soldiers' Home Railway Company, states that the results have been so satisfactory that fifteen cars have been ordered and also a compressor.

Mr. Schoepf is quoted as saying that "No disinterested observer who has watched the tests over the Eckington lines that have been conducted for some time past can have any other than my own opinion about the reliability and success of compressed air for street car propulsion."

Meeting of the Metropolitan Street Railway Club.

The Metropolitan Street Railway Club, which is an association of the employes of the Metropolitan Street Railway Company, of New York, held one of its enthusiastic bi-weekly meetings on Saturday, Apr. 24, at the Club rooms at the Fiftieth Street car house, and listened to an admirably clear and intelligent discussion of the company's new conduit work, by L. J. Hirt, formerly assistant chief engineer of the company, who is now in Boston looking after certain interests for William C. Whitney. Mr. Hirt's lecture was illustrated by a stereopticon, and the entire construction work involved in cable and electric conduits was carefully explained in such a way as to make it possible for gripmen, conductors and heads of departments other than operating to thoroughly understand the "why of it," in the matter of rules for the operation of the road.

Just before the lecture commenced Mr. Hirt unveiled a fine full length oil painting of H. H. Vreeland, president of the company, and after a telling speech concerning the "fair and square" methods of a man who admittedly stands closer to the hearts of his employes than is often found in steam or street railroading, proposed three cheers for Mr. Vreeland which were given with right hearty goodwill. Mr. Vreeland was then called for and spoke briefly of his appreciation of the honor conferred upon him. This picture of Mr. Vreeland was painted and placed in the club rooms at the urgent request of the employes and at their expense.

At the close of Mr. Hirt's lecture a musical entertainment was provided, as is usual at the meetings of this most flourishing club

Change of Ownership in St. Louis.

It is reported that a controlling interest in the stock of the Missouri Railway Company, of St. Louis, has been bought by parties interested in the Lindell Railway Company and represented by Edwards Whitaker president, and Charles D. McLure. About $2,000,000 are said to be involved in the transaction and the price at which the transfer is made is said to $165 per share, par $100. By reference to the map of the St. Louis street railway system opposite page 580 in the STREET RAILWAY JOURNAL for October, 1896, it will seen that the Missouri Railway Company's system is a valuable property for the Lindell Railway Company to acquire, and a serious one for them to have as a competitor. It is said that negotiations for the purchase of the Missouri lines by an outside syndicate have been going on for same time, and that this final sale was brought about in order to prevent the complication of the street railway situation in St. Louis by the entrance of other capitalists.

Progress on the Boston Subway.

The financial report of the engineers of the Boston Subway shows that up to Feb. 27, 1897, the amount expended by the Commission for construction work was $2,774,282.28, of which amount $750,000 was for real estate, the remainder for construction, engineering and administration. Besides this there are outstanding debts for real estate and construction of about $300,000.

The work on the subway is being so arranged that the southern part of it can be put in operation before the whole is completed. This will relieve the traffic on Tremont Street south of Park Street. The number of cars passing in both directions on Tremont Street between Park Street and Boylston Street during twenty-four hours amounts to 7500, and reaches a maximum of 440 during one hour of the day, making a headway of only sixteen seconds. It at present takes about twelve minutes for a car to run from Park Street to Charles Street. It is estimated that when the subway is in operation the time required will be less than five minutes.

Heavy Electric Railroading.

The plans for the equipment of the suburban lines in Chicago of the Illinois Central Railroad Company have not yet been fully determined upon, although the engineers of that company have decided to equip certainly a portion of their line with electric power. The third rail will be used, and the rolling stock and general construction will be very similar to that on the Nantasket Beach division of the New York, New Haven & Hartford Railroad Company. It is stated that several other important systems in Chicago are contemplating the installation of a similar equipment, but will probably wait until the completion of the Illinois Central equipment before taking steps in the matter.

The branch of the New England Railroad Company between Hartford, Conn., and New Britain, upon which electric construction was commenced some time ago, has been completed, and the company expected to commence operations about May 1. This line is controlled by the New York, New Haven & Hartford Railroad Company, and the construction is patterned after that on its Nantasket Branch.

An Important Elevated Railway Contract in Chicago.

Frank J. Sprague is again to become a power in the electric railroad field. The Chicago & South Side Rapid Transit Company of Chicago (the "Alley L") has retained him as its consulting engineer and awarded him the contract for the entire motor truck equipment and controlling apparatus of the 120 electric cars which are to replace the steam cars at present in service. It was the original intention of the company to build electric locomotives for hauling the ordinary passenger cars, but on consultation with Mr. Sprague it was determined to approve the ideas which he has held from the beginning of electric traction as to independent motor equipment of cars. By his plan it will be possible to make up trains of any number of cars for different periods of the day and night without involving the expense of separate locomotives.

Mr. Sprague has recently devised a system of motor control for electric railway trains based on the plan used in his electric elevators. Each car will be equipped with motors and controllers and can be operated separately. In making up these cars into trains one motorman at the head of the train will control all the motors of the train by a single piece of mechanism.

Mr. Sprague is intending to purchase for the Chicago equipment motors and trucks of standard makes from among the prominent companies manufacturing them, and specifications will be issued and subcontracts awarded about June 1. Sargent & Lundy are the company's local engineers in Chicago and are in entire accord with Mr. Sprague in his novel plans for the equipment.

In this connection it is interesting to note that Mr. Sprague has just been called to London in response to a cablegram from the new underground railway company in that city who wish to consult him about the electrical equipment of their road. He sailed on the "Normannia," Apr. 29.

Municipal Administration.

The Reform Club of New York City, which has for several years done a large amount of educational work of various kinds in connection with the tariff and sound money, and which was particularly prominent last year in the distribution of literature tending to counteract free silver heresies, has just entered upon a new and important department of its work which will be handled through a Committee on Municipal Administration, of which William B. Hornblower is chairman and William A. McQuaid, secretary. The first result of this committee's efforts has been the publication of the first number of a quarterly publication entitled *Municipal Affairs*, which is, in this first issue, devoted entirely to the publication of a bibliography of works on Municipal Administration. In this bibliography an attempt is made to include the books, pamphlets and periodical literature on this subject of the United States, Great Britain, Germany, France, Italy, Austria and Spain. The bibliography contains some 6000 entries. In the author list 2300 separate titles are arranged under the names of 1400 different authors. 1900 of these titles are in the English language (about one-fourth of them being of British origin), 150 in French, 120 in German, 80 in Italian and 50 in Spanish. There are also references to 1000 anonymous works.

The Three Cent Fare Agitation in Indianapolis.

The city of Indianapolis has been this month the scene of an unhappy contest between the street railway company and the public, growing out of the long pending disputes regarding the company's franchise. A brief review of this controversy may not be without interest at this time.

In the spring of 1893 the city authorities took the ground that the franchises of the Citizens' Street Railway Company expired at the end of that year. A franchise for a new system was drawn up granting the right to the use of the streets for street railway purposes for a period of thirty years, and providing that the franchise should be sold to the highest bidder. The old company made no bid, but a new company composed principally of local capitalists made a bid acceptable to the city and was awarded the franchise. On Jan. 1 following, suit was instituted by the new company to eject the old company from possession of the streets. The latter took the ground that its franchise was perpetual, and what was destined to be a long fight in the courts was instituted by the company's attorney, ex-President Harrison. The Federal Court did not definitely decide the contention raised regarding the perpetual franchise, but held that the franchises certainly did not expire before 1901.

The company's position with respect to certain questions of paving, accommodations, and other matters in dispute with the city and its employes aroused a general bitter feeling against it on the part of the city. Steps were taken to secure legislation declaring that the company's charter expired in 1901, but this legislation was defeated. The next step was to pass a bill in the legislature making it illegal for street railway companies in cities of more than 100,000 population, according to the census of 1890, to charge more than a three cent fare, and requiring them to give transfers when requested to any other of their own lines. This bill was apparently general legislation, but in reality special legislation referring to one city only in the state, Indianapolis, and as such, was claimed by the company to be unconstitutional. The company took steps at once to nullify the law before it should become effective, and entered suit in the United States Circuit Court in the name of the Central Loan & Trust Company, of New York, against the Citizens' Street Railway Company of Indianapolis, the city of Indianapolis, and Charles S. Wiltsie, the prosecuting attorney of the county, asking for an injunction to prevent the defendants from taking action to enforce a three cent fare law on the ground not only that it was unconstitutional, but that it would greatly decrease the revenues of the company and the security of the bondholders and would impair the obligations of the contract. It was expected that the court would act on this case before the law was put into effect by proclamation of the governor, but owing to special effort this law became effective on Apr. 15, earlier, it is said, than ever before in the history of the state. A temporary restraining order was asked for by the company, but without success, and then commenced a struggle between the company and the people. Conductors were instructed not to accept less than five cent fares and to eject passengers who refused to pay it. Many were ejected according to this rule, and finally public excitement became so great that parties of citizens were organized to resist the payment of fares. The situation became so serious that a truce was finally arranged between the company and the city authorities, the company agreeing to eject no one who was willing to pay the three cent fare, but instructing conductors to collect five cent fares from the passengers wherever possible.

Meanwhile suits to recover damages for ejection were instituted in large numbers, the company's officers were indicted and many of its conductors. Test suits are now being carried up to the superior courts on many of the points raised.

On Apr. 23, the decision of Judge Showalter, of the United States Circuit in Chicago, was made and was in favor of the company, the three cent fare law being declared unconstitutional because it was special legislation applying only to the city of Indianapolis. It was also stated in this decision that in the opinion of the court where proceedings in effect destructive of a vested property

right are threatened by a defendent in an official position under cover of a void statute, a preliminary injunction ought to issue. The suggestion by the Attorney General that in any event the United States Court ought not to consider the case until the Supreme Court of Indiana has passed upon the specific enactment in question is one which should not be entertained. The injunction was issued as prayed for. The court also held that if the scheme as proposed in the law be carried into effect, the complainant which is the mortgagee of the railroad company's property to the extent of some $3,000,000 of bonds, will be irremediably injured in its security, that the State of Indiana would violate its engagement to the railroad company as expressed in the general law for the incorporation of street railway companies, and that this is in contravention of the national constitution which declares that no state shall pass any law inpairing the obligation of contracts. On this last named ground, as well as by reason of the non-residence of complainant, the controversy is held to fall within the judicial power of the United States.

This decision is a most important one on account of its bearing on other cities where legislation similar to that found here is now being suggested.

Notes from England.

(*From Our London Correspondent.*)

It may be of interest to note the result for the year 1896 on the basis of the mileage run on the two electric railways in this country which have their own right of way, and therefore work under more favorable conditions than street lines possibly can do. As the result of careful analysis which I have carried on ever since each of these lines was opened, it is plain that both railways are gradually improving their position financially. The City & South London Railway is entirely underground, and an extension is now in progress. Trains, usually of three, but sometimes of two, cars are run. The average expenses, including everything in the first half of 1896, came to 31.92 cents per train mile, and in the last six months of the year 30.96 cents, or an average of 31.44 cents. The receipts were 53 cents in the first period and 54.5 cents in the second, giving an average of 53.7 cents. The percentage of expenses to receipts is thus close on 58.6.

The Liverpool Electric Railway is an elevated one, with the exception of a short, recently completed extension which is underground. The average expenses, computed in the same way, were 30.76 cents per train mile, and the receipts 48.46 cents for the year, giving a ratio of expenses to receipts of 63.5 per cent. Though trains of two cars are usually run, the cars are long and two of them are almost as heavy as the three car trains on the London line. In both cases the weight of a train with a good complement of passengers may be taken as about 38 tons. A third rail is used as conductor on both railways.

The Edinburgh Northern Tramways Company closed its career as a separate body with the end of 1896, the Town Council of Edinburgh having bought up the undertaking by agreement for $575,000 (taking $5 to £1). The system consists of 6 miles of cable track, occupying 3 miles of street. Large eight wheeled, single cars are run. The accounts, taking an average over the two halves of 1896, show that the expenses were 12.46 cents per car mile and the receipts 21.25 cents, giving a ratio of expenses to receipts of 58.6 per cent. The result is very good, bearing in mind that the cable speed allowed is only 6 miles an hour and that the traffic is light. The interval between the cars is seldom less than four minutes. These cable lines will in future be worked along with the other tramways in Edinburgh, all of which, with the exception of one short route, being now in process of conversion to the cable system. When the work is completed Edinburgh will have about 37 miles of cable track.

The schemes for deep tunnel electric railways in London still multiply, and two or three of them are seeking Paliamentary sanction this year. It is however generally a long time after the passing of bills of this kind before the work of construction is actually commenced. What therefore is of more immediate interest is the fact that the Waterloo & City underground railway is now nearing completion, and that the sinking of shafts and driving of tunnels for the big scheme known as the Central London Railway are at length actively going forward at a large number of points along the route. It is now quite evident that the average cost of such undertakings in London, including land, buildings, machinery, tunnels, equipment and preliminary expenses, will not fall short of $2,500,000 per mile. An enormous traffic will be required in order to get reasonable dividends on such capitalization, but then in a place like London an enormous traffic is assured.

The Town Council of Liverpool has entered into an agreement to buy up the undertaking of the Liverpool Tramway Company for £12 : 15 per £10 share, or a total of £560,000, say $2,800,000. The company has been paying a dividend of 5 per cent per annum, and its lease had eighteen years to run. There are 61½ miles of track. It is very probable that the change of ownership will result in the speedy adoption of some kind of mechanical power.

The cable tramway on Highgate Hill, London, after having been closed for four or five years, is about to begin running again. The line is interesting, though it is only three-quarters of a mile long, for it was the first cable road built in Britain. It dates from 1884. The old company had many difficulties to encounter, but good results may now be anticipated, as everthing has been put in first class order, and the new company has a very moderate capitalization.

Six of the cars just ordered for the Leeds Corporation electric tramways are to be fitted with Brill trucks. The cars themselves will be made in England. The work of converting the Leeds lines for electric traction is now well forward.

Foreign Notes.

Bahia, Brazil.—A new electric tram line is now ready for traffic at Bahia.

Berlin, Germany.—The following figures are taken from the "*Zeitung des Vereins*" in relation to the passengers' traffic for 1895 and 1896 on the various lines of tramways and omnibus in Berlin.

	1895.	1896.
Grosse Berliner Pferdebahn	138,900,000	154,200,000
Metropolitan & Belt Line	65,008,158	76,899,568
Berlin-Charlottenburg.	6,998,555	7,476,573
Neue Berliner Pferdebahn.	18,370,000	21,825,000
Steam Tramways Bachstein & Co .	3,527,274	3,358,263
Omnibus Co	37,414,505	43,452,646

The Siemens & Halske electric tramways put in operation Apr. 15, 1896, carried 3,835,894 passengers up to Dec. 31. The total number of passengers carried during 1896 is consequently 311,216,955 as against 270,049,481 in 1895, or an increase of 41,167,474.

At the time of the last census in December 1895, the population of Berlin was 1,677,304 inhabitants.

Birmingham, England.—The City of Birmingham Tramways Company has offered to install a conduit system under the direction of its engineer, Mr. Pearson, if the municipality will remove any water or gas pipes that may be necessary, and will grant a long term franchise.

Brussels, Belgium.—According to *l'Electricien*, the Belgian State Railway will this year experiment with electric traction on a line of railway from Brussels to Tervueren, a distance of about 9 miles. Five large accumulator cars will be run in addition to the present steam service. They are to run at a speed of 18½ miles an hour on the steepest grade (1.6 per cent), and at 31 miles an hour on other parts of the line. Each car will be 52½ ft. long. Three Julien and two Tudor batteries have been ordered, each of 264 cells.

Budapest, Hungary.—The net profits of the Elektrische Stadtbahn, of this city, for 1896, amounted to 760,696 florins, including 82,353 florins carried forward from 1895. A dividend of 12 florins was declared, as against 10 florins in 1895.

Christiania, Norway.—The gross receipts of the Electric Tramways Company (Christiania Elektriske Sporvei) for 1896 were 308,387.36 kroner; the operating expenses amounted to 201,605.51 kroner; net profits, 106,781.85 kroner. The receipts per car kilometer in 1896 were 37.3 öre, as against 37.4 öre in 1895. The expenses per car kilometer in 1896 were 24.85 öre, as against 25.29 öre in 1895. A dividend of 5½ per cent was declared.

Glasgow, Scotland.—The Tramways Committee has endorsed the recommendation of the manager of the Corporation tramways to equip one route with the overhead electric system.

Hamburg, Germany.—A "Tramway Technical Exhibition" is to be held in Hamburg from Aug. 5 to 9, under the auspices of the Verein Deutscher Strassenbahn und Kleinbahnverwaltungen. This society announces a general meeting to be held at the Exhibition on Aug. 6 and 7.

La Rochelle, France.—According to a recent report of the British Consul at La Rochelle, the tramway system has been proceeded with, but the result of the large outlay on it has been of little use to the farmers or anyone else, and not only is it not earning any interest on capital expended, but the working of the lines by the lessees shows a heavy loss.

Liege, Belgium.—Tenders are being invited by the Provincial Government Anthorities at Liège, for the concession of an electric tramway between Chenee and Grivegnee.

London, England.—The Unopposed Bill Committee, of the House of Commons, last month passed a bill reviving and extending the powers for the construction of the underground electric railway from Charing Cross to Hampstead, which was originally authorized by Parliament in 1893.

Netherlands.—Four systems of tramway traction are employed in the Netherlands, viz., steam, mixed (steam and horses), horses only and electricity. According to the return for 1894 the mileages of these were as follows: steam only, 293.9 miles; mixed (steam and horses), 228 miles; horses only, 124.9 miles; electricity, 3.1 miles.

Portsmouth, England.—The Town Council recently decided to acquire the local tramways, the lines to be leased to the present company for twenty-one years, and the corporation to equip same for electric traction within an agreed time. The company agrees to pay as rental an amount equivalent to 5 per cent on the purchase money (£60,000), and on the cost of equipping the lines for electric traction, a d in addition £125 per mile per annum for maintenance of the road.

Turin, Italy.—On the occasion of the coming Italian National Exhibition which will be held in Turin in 1898, to celebrate the fiftieth anniversary of the proclamation of the Italian Constitution, considerable space will be devoted to electrical exhibits.

Alternating Currents for Street Railways.

On Apr. 8, last, A. K. Baylor, of the British Thomson-Houston Company, Limited, read a paper before the London Institute of Electrical Engineers on the subject of "Some Recent Developments in Electric Traction Appliances". Mr. Baylor discussed the subject in a broad way, speaking of the relative merits of large and small, belted and direct connected power station units, and possible use of the alternating current motors for tramway work and cited American experience in these and other departments of tramway operation. Mr. Baylor's paper was highly appreciated as a thoughtful and carefully prepared discussion of what is becoming one of the vital questions in the English municipal and corporation world.

News Notes.

Aurora, Ill.—The Aurora, Yorkville & Morris Railway Company has been incorporated by Vine A. Watkins, H. P. Horde, and Fayette D. Winslow to construct a street railway in Kane, Kendall and Grundy Counties. Capital stock, $10,000.

Bellows Falls, Vt.—E. C. Smith, of St. Albans, Vt., receiver of the Vermont Central Railroad, and H. W. Burgett, of Boston, representing a syndicate of capitalists, will build an electric railway up Mt. Mansfield. Work will be begun about May 1 and it is expected to complete the road within five months. The power house will be located near Shootsville Hill.

Chicago, Ill.—Articles of incorporation have been filed with the Secretary of State of Wisconsin by the Chicago & Wisconsin Inland Lakes Railroad Company, to construct a railroad, 500 miles in length, from Chicago to Rhinelander, Wis., with branches to Milwaukee, Madison, Janesville and other places. The incorporators and directors are E. R. Bryant, of Princeton, Ill.; Bayard Taylor, William J. Marks, Jesse B. Barton and George E. C. Johnson, of Chicago. Capital stock, $5,000,000.

Greensburg, Pa.—The Irwin City Council has gra ted a right of way to the Greensburg, Jeannette & Pittsburgh Street Railway Company. This insures the building of the road through Irwin.

Jersey City, N. J.—The Consolidated Traction Company has decided to make an improvement at its Pennsylvania Ferry office, which will add considerably to the appearance of that part of the city. The old office and the car sheds are to be removed and a handsome fireproof iron and stone building erected in its stead.

Lorain, O.—The Cleveland & Lorain Railway Company has decided not to use the East Lorain Railway Company's line to get into Lorain, but will build over a private right of way about 250 ft. south of the old line.

Niagara Falls South, Ont.—H. C. Symmes, R. Payne and others, of Niagara Falls South, are the promoters of an electric railway from the terminus of the lines of the Niagara Falls, Park & River Railway Company in Queen Victoria Park through Niagara Falls South to the battle field of Lundy's Lane. It is announced that as soon as the right of way and a franchise are secured the road will be built and in running order within thirty days.

Oshkosh, Wis.—The contracts for building the electric lines of the Citizens' Traction Company have been let, that for the general construction work to the Electrical Installation Company, of Chicago. Another special contract for the building of the curves, turnouts, etc., has been let to the Falk Manufacturing Company, of Milwaukee. The contracts call for 12 miles of road, and it is expected that cars will be running by the middle or latter part of June. Work has been begun.

Pueblo, Col.—A company has been incorporated under the name of the Pueblo, Victor, Altman & Cripple Creek Railway Company to connect the above named towns with the Cripple Creek district. The incorporators are H. Paul, B. James, C. B. Carlisle, James L. Bradbury, A. S. Rose and others, of Pueblo, Col. Capital stock, $1,500,000.

Riverhead, L. I., N. Y.—Solomon Brooks has been appointed superintendent of the Riverhead, Quogue & Southampton Railroad Company. He has succeeded in securing all the rights of way for the company's lines in Riverhead,

Springfield, O.—J. M. W. Neff, of Xenia, has been for some weeks making the necessary arrangements for the opening of work on an electric railway between Xenia and Springfield. Contracts have been let and cars are expected to be running by June 1.

Streator, Ill.—John B. Whalen, of Sycamore, Ill., is the promoter of an electric railway from Streator to Lake Geneva.

Wilmington, Del.—The Wilmington & New Castle Electric Railway has applied for permission to extend its lines northerly to Pennsylvania and southerly to Delaware City.

Wytheville, Va.—The Electric Power & Improvement Company will begin construction work on the 2 mile electric railway in Wytheville in a few months.

Reorganization in Long Island City.

The new officers of the New York & Queens County Rapid Transit Company elected last month are the following: president, W. H. Shelmerdine, of Philadelphia; vice-president, E. J. Mathews, of Philadelphia; general manager, J. R. Beetem; secretary and treasurer, Walter A. Pease. Messrs. Shelmerdine and Mathews have also been elected president and vice-president of the Electric Illuminating & Power Company, of Long Island City, and J. R. Beetem is its general manager, secretary and treasurer.

Annual Meeting of the Standard Air-Brake Company.

The annual meeting of the stockholders of the Standard Air-Brake Company was held at the company's office on Apr. 21. The following directors were elected to serve for the ensuing year: Henry Seligman, Edward J. Wessels, Albert Strauss, Leopold Wallach, Theodore Seligman and D. F. Meyer.

The engineering staff of the Standard Air Brake Company has been increased by the addition of Edward H. Dewson, Jr., with whom General Manager Wessels lately closed a contract for a term of years. Mr. Dewson brings to the company a ripe experience. He entered upon his new field on Apr. 26. Mr. Dewson has been long and favorably known in connection with his work while with the General Electric Company in its engineering department and in connection with locomotive practice and the superintendency of one of the Western lines. He has for some time filled the position of master mechanic for the Pratt & Letchworth Company, of Buffalo. Mr. Dewson is thoroughly posted on the mechanical arts and will find full scope for his ability in his new field.

A Reorganization.

One of the best known firms of general contractors in the street railway field—The White-Crosby Company—has just been reorganized under the laws of the state of New York, and has taken the name of "J. G. White & Company, Incorporated" which is a return to the old firm name in which the "Company" was originally nominal. The record of Mr. White, the president and principal stockholder of the new company, is well known to the "old timers" in electric railroading. In 1887 he formed the Western Engineering Company, with headquarters at Lincoln, Neb. This company was a highly successful enterprise, and was sold in the spring of 1890 to the United Edison Manufacturing Company. During the summer of 1890 the Edison General Electric Company, was formed and Mr. White declined a salaried position offered to him with the new company and commenced business as general contractor in New York City under the firm name of J. G. White & Company.

In May 1894, Oscar T. Crosby, who had resigned his managing position with the General Electric Company owing to ill health, joined Mr. White in organizing the White-Crosby Company and expected to devote a large portion of his time to it sbusiness. Unfortunately however, Mr. Crosby's illness ended in an attack of nervous prostration which made it necessary for him to drop active work for a long period of time. On his return from Europe Crosby's plans were changed to such an extent that he decided not to undertake the severe work incident to a general contracting business, but to enter the field of local street railway and lighting companies, and in pursuance of this plan he acquired in connection with Mr. Charles A. Lieb a controlling interest in certain properties in Washington.

For certain legal and other reasons it has been thought best by Mr. White to give up the West Virginia charter of the White-Crosby Company and to reorganize under the laws of the state of New York, to increase its capital stock, and, in view of Mr. Crosby's withdrawal from active participation in the company's business, to change the company's name back to its old form.

Mr. White has been personally concerned in building and equipping many of the most prosperous street railway properties of the country and has been particularly active in Baltimore, in which city during the last five years the contract work done by the firm has aggregated some $3,000,000. Other railways equipped by himself and associates are the Buffalo & Niagara Falls Electric Railway, the power transmission line of the Cataract Construction Company between Niagara Falls and Buffalo, and railways in Spokane, Salt Lake City, Sherman, Tex. and others. At the present time the company has in hand contracts for the complete construction and equipment of the reorganized street railway system of Charleston, S. C., including all buildings, power plant, track and overhead equipment; the changing of the Baltimore City Passenger Railway Company's "Blue Line" from cable to electricity; a large transmission plant to be located near Helena, Mont. the power to be obtained from the Missouri River; the building of extensions for the Norwalk (Conn.) Tramway Company, and others.

Mr. White has long been known to street railway managers and among the manufacturers as an absolutely honest contractor and one who believes thoroughly in good work without reference to the question of greater or less profits. He never hesitates to purchase improved appliances and apparatus at a cost larger than that figured upon when making construction contracts if he feels that the plant is to be benefited thereby. His reputation for fair dealing is such that those who have once had experience of his work do not ordinarily fail to call upon him again when further work is contemplated.

Associated with Mr. White is G. H. Walbridge, the company's secretary. Mr. Walbridge is a graduate of Cornell University and has also had a long experience in electric railway construction.

New General Manager in Milwaukee.

John I. Beggs has been appointed by the board of directors of the Milwaukee Electric Railway & Light Company the general manager to succeed C. D. Wyman, who resigned that position some time ago to go to New Orleans. All heads of departments, except the accounting department, will report to Mr. Beggs by order of the directors. Mr. Beggs is widely known in electrical circles, having been in times past a prominent managing official of the Edison General Electric Company, an ardent champion of the Edison local companies in their contentions with the parent companies at the time of the organization of the General Electric Company, and as the managing official of the Cincinnati Edison Illuminating Company, New York Edison Illuminating Company and other local illuminating properties. Mr. Beggs has long had a considerable financial interest in the Milwaukee Light & Railway properties and is thoroughly familiar with the system over which he is now to exercise control. He has been practically in charge for several months, although the formal announcement of his new position has not until now been made.

Personals.

Mr. T. L. Jackson has been made vice-president of the Brooklyn Heights Railroad Company.

Mr. J. H. Warner has been elected president of the Chattanooga Electric Railway Company.

Mr. F. S. Drake has been appointed superintendent of the Nassau Electric Railroad Company.

Mr. T. J. McMahan has been elected treasurer of the Anderson Electric Street Railway Company.

Mr. S. L. Nelson has been made general manager of the Bay Cities Consolidated Railway Company.

Mr. G. E. Cockings has been made superintendent of the Bristol & Plainville Tramway Company.

Mr. F. B. Smart has been elected superintendent of the Adrian Street Railway to succeed C. T. Geddes.

Mr. Richard Emory has accepted the position of general manager of the Baltimore Traction Company.

Mr. B. B. Corner has been made president of the Birmingham, Powderly & Bessemer Railroad Company.

Mr. J. Bernard Brophy has been appointed general superintendent of the Staten Island Electric Company.

Mr. R. S. Ashe succeeds Mr. Chas. L. Harry as superintendent of the Bay Cities Consolidated Railway Company.

Mr. J. G. Jenkins has been elected vice-president of the Brooklyn, Queens County & Suburban Railroad Company.

Mr. Geo. B. Cornell has been made engineer of the Brooklyn Elevated Railroad Company to succeed Mr. R. L. Cobb.

Mr. W. J. Hamlet, of Alvin, Tex., has been elected secretary of the Galveston & Houston Electric Railway Company.

Mr. John Whitbeck has been elected president of the Chicago General Railway Company to succeed Mr. L. E. McGann.

Mr. F. S. Hunnewell has been appointed to take charge of the Malden Division of the Lynn & Boston Railroad Company.

Mr. F. C. Wilkinson is now superintending the operating of the Lynn Division of the Lynn & Boston Railroad Company.

Mr. I. H. Evans, vice-president of the Austin Rapid Transit Railway Company, has been appointed receiver of the company.

Mr. G. Richard Nicholas has been chosen as the successor of Mr. John McNeill as secretary of the North Shore Traction Company.

Mr. Janon Fisher, of Baltimore, has been elected president of the Norfolk Street Railroad Company to succeed Mr. M. A. Verner.

Mr. J. J. Coleman has been appointed to fill the position of general manager of the Allentown & Lehigh Valley Traction Company.

Mr. Daniel Crook succeeds Mr. James Young as president of the Baltimore, Middle River & Sparrow's Point Electric Railway Company.

Mr. J. Berry has taken the place of Mr. W. H. Whitacre as secretary, treasurer and general manager of the Alliance Street Railway Company.

Mr. W. N. Voorhees is discharging the duties of chief electrician in the power house of the Coney Island & Brooklyn Railroad Company.

Mr. E. Woodruff, vice-president of the Atlanta Consolidated Street Railway Company, has been appointed general manager of that company.

Mr. J. D. Sherwood, formerly treasurer of the College & Grand View Electric Railroad Company, has been elected president of the company.

Mr. Thomas Elliott has accepted the duties of chief engineer and charge of the power house of the Atlanta Consolidated Street Railway Company.

Mr. J. M. Atkinson, of J. M. Atkinson & Co., is making a business trip in the East. He reports an excellent demand for his type of rail bond.

Mr. E. J. Wessels expects to sail for Europe June 2, on the "Majestic." Mr. Wessels will make a somewhat lengthy tour in the interests of his business, which has increased very materially during the past twelve months.

Mr. Isaac Odell, general freight agent of the Providence & Stonington Steamship Company, died last month at the age of eighty-two. He was one of the best known men in the shipping business, having been identified with it since 1848.

Mr. H. J. Quigg, general manager of the Staten Island Electric Railroad, resigned Mar. 26, 1897, the resignation to take effect Apr. 15. Mr. Quigg will engage in steam railroading, having accepted a responsible position with the Erie Railroad Company. His health has been failing for the past year and it is hoped the change will result beneficially.

Mr. J. S. Badger has been appointed manager of the Brisbane Tramways Company, of Brisbane, Queensland, Australia. Mr. Badger is well known in America from his long connection as electrical engineer with the Sprague Electric Railway & Motor Company, and with the General Electric Company. Mr. Badger was one of the early pioneers in electric railroading, having been engaged in the installation of some of the first roads built by the Sprague Company.

Mr. Joseph H. De Grange, president of the Canal & Claiborne Railroad Company, is too well known to street railway interests to need any introduction, having been connected with their management and operation for the past twenty-five years. He is a native of New Orleans, a Confederate veteran of distinction and one of New Orleans' leading citizens. Aside from his railway interests, he is president of the New Orleans Board of Fire Commissioners and the New Orleans Improvement Company, secretary and treasurer of the National Automatic Fire Alarm Company, treasurer of the People's Homestead Association and a prominent member of the Chamber of Commerce and of several other leading institutions. He is also a charter member of a number of New Orleans' best clubs and social organizations, and has long been a leading spirit in its numerous social festivities and Mardi Gras celebrations.

JOSEPH H. DE GRANGE.

However to none of these various interests has Mr. De Grange devoted more of his time and energies than to the development of street railways in New Orleans, especially the Canal & Claiborne Railroad under whose able management and clear judgment the present system has been located and perfected as described elsewhere in this issue. To the presidency of this road Mr. DeGrange has brought that executive judgment which exhibited through his uniformly most courteous personality has won so many friends for the advanced street railway methods which this company has inaugurated.

Obituary.

W. A. HUNGERFORD, New York, manager of the Benedict & Burnham Manufacturing Company, of Waterbury, Conn., died in New York, Apr. 15. Mr. Hungerford was well known in electrical circles and was treasurer and director of the Benedict & Burnham Manufacturing Company. He was also a director of the Waterbury Watch Company and of the Gas Engine & Motor Company, and was a member of various clubs in New York City. He was forty-seven years of age at the time of his death.

AMONG THE MANUFACTURERS.

C. E. Loss & Company, of Chicago, Ill., has been awarded the contract for the construction of the first electric railway in Mexico.

The Kensington Engine Works, of Philadelphia, Pa., has moved its New York office to the St. Paul Building from 74 Cortlandt Street.

The Hine & Robertson Company, of New York, has recently brought out a catalogue which is of interest to all steam users. The company will mail a copy to any one interested.

The Swartz Metal Refining Company, of Chicago, has outgrown its present quarters and in order to secure more space removed May 1 to No. 20 N. Desplaines Street, corner of Eagle.

The Pennsylvania Steel Company, of Steelton, Pa., has recently appointed Richard Peters, Jr., sales agent, and C. L. Mahoney, assistant sales agent for its Philadelphia office with headquarters at the Girard Building.

The Reliance Gauge Company, of Cleveland, is about to put on the market a new feedwater regulator which promises not only most satisfactory results, but to be low in price. It will be sent to responsible parties on trial subject to satisfaction.

The Allis Engine Company, of Milwaukee, Wis., is running full time and reports, among others, two orders for engines: one from the Memphis Street Railway, Memphis, Tenn., and the other from the Staten Island Railway, Staten Island, N. Y. These engines are cross compound condensing, each of 1200 h. p.

The Peckham Motor Truck & Wheel Company, of Kingston, N. Y., reports its works running to their utmost capacity on American and foreign orders. The company has recently received a large order from Japan, and is negotiating for other large orders in South America, Australia, Russia, Germany and England.

Garson Myers, of 1400 and 1402 Fisher Building, Chicago, representing the Christensen Engineering Company for air brakes, Anderson, DuPuy & Company for steel springs, the R. D. Nuttall Company for gears and pinions, and Standard union trolleys and trolley parts, reports increasing activity and sales in the lines he handles.

The New Haven Car Register Company, of New Haven, Conn., writes us that it is finding business improving and that it is enjoying an exceptionally large demand for its new 1897 model of register. The registers of this company have become very popular and the '97 model embodies a number of additional improvements which are valuable.

W. Jens and Bruce Ford, of the Johnson Company, Johnstown, Pa., have combined under the name of Ford & Jens, to place their welded rail bond on the market. T. C. du Pont, general manager of the Johnson Company, is also interested. They are issuing descriptive circulars and samples of their welds, and are looking forward to a busy season.

The Ball Engine Company, of Erie, Pa., has recently installed the engines for an electric light plant in the Wauwatosa County Insane Asylum, Wisconsin. Five direct connected engines of 900 aggregate h. p. have also been recently installed by the same Company in the Chicago Public Library. The Chicago Edison Company, furnished the dynamos.

The Fiberite Company, of Mechanicville, N. Y., reports a large business and much more in sight, especially from abroad. Among the lines which the company has equipped in Europe is the tramway system of Leeds, which is operated by electric power. The overhead appliances of this system have been highly praised in the electrical papers in England.

The Partridge Carbon Company, of Sandusky, O., reports a steady demand for its well known carbon generator and motor brushes, and is running its factory to full capacity. The company is probably the largest concern in the world devoted to this work exclusively, and has of late been giving considerable attention to foreign trade, which seems to promise well.

The Forest City Electric Company, of Cleveland, O., had a fire at its works on the night of Apr. 12. A large quantity of belting, pulleys, etc., was destroyed and the interior of the building was also damaged to a considerable extent. Fortunately the machinery received no injury whatever, and the company recommenced operations, running full time within three days.

The Walker Company, of Cleveland, O., has moved its general sales office from 253 Broadway to the new building on the corner of Wall and Nassau Streets, New York City. The Walker Company has taken a whole floor of this new building, its increased business having necessitated these larger quarters. The company is to be congratulated on its central location and on its prosperity which is thus evidenced.

The Buda Foundry & Manufacturing Company, Harvey, Ill., sole maker of Paulus track drills, reports a large demand for these drills from street railway companies. The Paulus is an automatic feed drill and admits of the operator standing in an erect position while drilling the rail, and it is claimed that one man can as easily do five times the work with these drills as with the ordinary ratchet drill.

The Harrison Safety Boiler Works, of Philadelphia, Pa., have had considerable success in the introduction and sale of Cochrane separators and feedwater heaters. These appliances have been described in the STREET RAILWAY JOURNAL, and are both simple durable. The feedwater heaters are of the open type and give a high economy, while the troubles which have been encountered with former heaters of the open type have been entirely avoided.

The Central Electric Company, of Chicago, is planning out a complete line of all railway motor bearings of a very high grade, but at surprisingly low prices. The company is furnishing trolley wheels in large quantities to railway companies who, it is said, will use no other wheel. The company put special stress upon its desire to have the street railway people as well as the laymen thoroughly investigate the practicability of its new designs of overhead material.

The Consolidated Car Fender Company, of Providence, R. I., has just received orders to equip with its fenders all of the electric motor cars in Syracuse, N. Y., Oswego, N. Y. and Port Huron, Mich. It has also received during the present month orders to equip with its fenders a large number of cars in Stapleton, Staten Island, N. Y.; Hoboken, N. J. (two different roads); Richmond, Va., and New Britain, Conn. The company reports that its factory is running full time.

Harold P. Brown, of New York, manufacturer of the Edison-Brown plastic bond and alloy, reports that his new E. C. A. bond (elastic, copper and amalgam) has been adopted by the Hamilton Street Railway Company, of Hamilton, Ont., for the streets paved with asphalt. This bond was described in the last issue of the STREET RAILWAY JOURNAL and can be applied to rails already in place without disturbing the pavement. It is proving a decided success in Hamilton.

The Standard Underground Cable Company, of Pittsburgh, Pa., has published a very complete pocket handbook of useful information, price lists, etc., relating to underground cable construction. The book is well illustrated and gives diagrams and rules for making the different connections necessary in laying cables, as well as a telegraph code in use by the Standard Underground Cable Company and miscellaneous information. The book was written and compiled by Joseph W. Marsh, and is issued in three styles of binding.

The Price & Evans Manufacturing Company, of Chattanooga, Tenn., is fully equipped with the latest machinery for the manufacture of all kinds of brass work for steam and electric railways. This company makes a specialty of brass castings of all descriptions, including trolley wheels and bearings. It has lately added a repair department, and is now ready to furnish repair parts of any pattern on short notice. The company is doing a flourishing business, and is particularly well located for supplying railroad men in that section of the country.

The National Water Tube Boiler Company, of New Brunswick, N. J., reports a large number of recent orders. Among them are the following: Long Island Electric Railway Company, of Brooklyn, N. Y., 750 h. p.; Midvale Steel Company, 520 h. p.; Baltimore City Water Works, 1100 h. p.; Camden Water Works, 750 h. p.; Kansas City Water Works, 600 h. p. The first two orders were received through Mr. Frick, manager of the New York office of the company, and the last mentioned from F. H. Pond, the manager of the St. Louis office of the company.

The Chenango Engineering Company, of Binghamton, N. Y., is preparing plans and estimates for the Savona Valley & Lake Keuka Electric Railway, a suburban road 20 miles long, connecting at southern terminal with the Erie Railroad or Delaware, Lackawanna & Western Railroad. The roadbed is about finished. A very heavy freight traffic will be carried besides a large passenger traffic to several large summer resorts. A water power midway on the line will be used. The entire issue of bonds for completing the construction of the road has not been placed at this writing.

Alfred G. Hathaway, of Cleveland, O., reports the brake business is booming and he hopes to make a good showing with the Murrey brake this year. Among other recent orders he has equipped all the cars of the Cleveland & Chagrin Falls Electric Railway and will soon have the brakes on the Cleveland & Elyria Railroad. He has also just closed with the Detroit & River St. Clair Electric Railway for fourteen equipments. The Murrey brake works particularly well on double truck cars and it will, it is claimed, bring a car to a stand still as quickly as an air brake.

Russell & Company, builders of automatic engines, Massillon, O., report the following work under way: New Paltz and Walkill Valley Railroad, Ulster County, N. Y., 300 h. p.; Indianapolis, Greenwood & Franklin Railway Company, 700 h. p. in two units; Pittsburgh, Allegheny, & Manchester Railway Company, one 600 h. p.; Cleveland & Chagrin Falls Electric Railway Company, two 250 h. p.; Canton & Akron Railway Company, two 300 h. p.; San Antonio Street Railway Company, San Antonio, Tex., one 350 h. p.; Detroit & River St. Clair Railroad Company, three 500 h. p.

The Consolidated Car Fender Company, of Providence, R. I., has recently issued two very attractive circulars calling attention to its well known fenders. One of these is published in commemoration of Patriots' Day, Apr. 19, and is an illustrated edition of Longfellow's poem on the "Ride of Paul Revere." It bears a silk American flag. The other gives some practical hints on the subject of reaching Prosperity Island, the objective point of all users of the Providence car fenders. By following these directions strictly and by using Providence fenders the prosperity of any railway company is assured.

The Fiberite Company, of Mechanicville, N. Y., has decided to put on the market a full and complete line of its goods in malleable iron, at prices which are in full keeping with the times. This malleable iron will have the regular Medbery insulating compounds and no change whatever will be made except in the metal. Heretofore the Medbery insulation has only been made in aluminum bronze fittings. The Medbery insulation has now been on the market about six years and hundreds of roads are using the same with perfect satisfaction. The orders for these well known goods are now coming in very freely.

The Brooklyn & New York Railway Supply Company, of Elizabeth, N. J., experienced a fire at its works on the evening of Apr. 21. A considerable portion of the works was destroyed together with a number of cars in a completed and half finished condition. The origin of the fire is unknown. The company proposes to commence reconstruction immediately on the portion of

the works destroyed. The register department was not injured, and the fire will not interfere in any way with the manufacture of registers, bronze trimmings, etc. In this branch of its business the company is enjoying a large demand.

The Forest City Electric Company, of Cleveland, O., is running its works to the full day capacity. With any further increase in its business the company will put on a full night force. In addition to a very satisfactory home trade, the company reports a large and increasing foreign demand for its roll drop and drop forged commutator bars and "protected" rail bonds. It issues a catalogue in English, French, German, Spanish and Italian. The company has also recently published a pamphlet entitled "Rail Bonding and the Protected Rail Bond," which describes the Forest City bond and states its advantages. The pamphlet is very attractively printed and bound.

The Standard Air-Brake Company, of New York, has recently closed a contract with the Mason City (Ia.) & Clear Lake Electric Railway for the equipment of two heavy motor cars and seven trail cars, and with the Norfolk (Va.) & Ocean View Railway Company for the equipment of passenger and freight cars. On these two roads the company will supply its motor compressor type of air brake with automatic current controller. The Standard Air-Brake Company has also contracted with the Richmond (Va.) Railway & Electric Company to supply its geared type of compressor air brake for the cars of that line. This type is similar to that employed on the Akron, Bedford & Cleveland Railway and the Washington, Alexandria & Mount Vernon Railway.

The McGuire Manufacturing Company, of Chicago, is among the few which is not complaining about poor business. This company has recently secured the order of the new Benton Harbor Electric Railway & Transit Company, Benton Harbor, Mich., for 200 trucks, and shows also an enviable list of smaller orders taken during April. The "L" trucks furnished by the company to the Brooklyn Bridge are acting admirably and giving perfect satisfaction under this severe service. All this is being carefully noted by railroads and railroad men all over the country who contemplate changes in motive power. The orders for the company's positive lock ratchet handles continue and the company numbers many conservative roads among its customers.

The Standard Air-Brake Company, of New York, during April, closed contracts with the Dighton, Somerset & Swansea Street Railway Company, of Taunton, Mass.; the Commonwealth Avenue Street Railway Company, of Boston, Mass , and through its foreign agents, for air brakes on the Continent. The company is also supplying to the Pennsylvania State College, department of electrical engineering, for use on its experimental line (which has been built to teach the students practically), a complete working outfit, showing the operation of the "Standard" system. The company has received most flattering reports of the working of its brakes recently shipped to Sidney, Australia. The grades on the electric line equipped with these brakes are as high as 7.7 per cent.

The Garvin Machine Company, of New York, has recently published a very complete catalogue and price list descriptive of the many machine tools which it manufactures. These tools are for all classes of work, and the facilities of the Garvin Machine Company for manufacturing both standard and special tools are exceedingly fine. Of course, it would be impossible to illustrate in one catalogue all of the special machines or even a large proportion of them which a large company like the Garvin Machine Company has manufactured, but a very good idea of the facilities which this company has for designing and making machines for any special purpose is shown by the full line of bicycle machinery which is described in the catalogue. The pamphlet is well illustrated.

The Weston Engine Company, of Painted Post, N. Y., reports that it is doing an excellent business, and that there seems to be an increasing call for its well known engines. Among its recent orders the company includes the following since Apr. 1: Soldiers' & Sailors' Home, Xenia, O., one 13 in. × 12 in. and one 10 in. × 10 in. direct connected to Western Electric generators; McCoy's Hotel, Chicago, Ill., 14 in. × 14 in. direct connected to Western Electric generator; Masonic Temple Association, Detroit, two 10 in. × 12 in. and one 6 in. × 8 in. direct connected to Triumph generator; Jacob Reed's Sons, Philadelphia, 14 in. × 14 in. direct connected to General Electric apparatus; Julian Scholl & Company, 14 in. × 14 in., belted. The above are all of the Imperial self-oiling type.

The Oriel Glass Company, of St. Louis, Mo., writes us that among recent orders it includes one from the Terre Haute Electric Railway Company, Terre Haute, Ind., for a lot of bent glass to be used on the curved vestibules which that company is now placing on its cars. The company, which manufacturers bent glass of all character, has just completed new and up-to-date furnaces which are now in operation and turning out excellent work. This doubles its capacity and gives the company a modernly equipped glass bending plant unequaled by any in the world. It might seem strange that the company should double its capacity at this time, but its superior work and the promptness in the execution of all orders received has brought to it business from all parts of the United States and Canada.

Edward Smith & Company, of New York, the well known manufacturers of paints, varnishes, etc., have published in pamphlet form, copy of a paper read some time ago by A. H. Sabin, late Professor of Chemistry in the University of Vermont, before the New England Railroad Club. The demand during the past year for this pamphlet has compelled Edward Smith & Company to bring out a third and enlarged edition of it. Prof. Sabin in this paper went very carefully into the subject of the protection of iron and steel structures from the weather by coatings, and all kinds of anti-rust paints are considered. The author brings out especially the Sabin process or baked coating and also the durable metal coating of Edward Smith & Company, with which firm he is connected. The pamphlet is very finely illustrated by views of different works protected by the Smith compounds.

C. & G. Cooper & Company, of Mount Vernon, O., reports that its works are quite busy with new orders in spite of the hard times reported by manufacturers. The company has orders now on hand for two or three months' work and the prospects are exceedingly bright for the season's business. Among the recent installations made are one of 1200 h. p., cross compound engine at the Warwick Mills, Centerville, R. I., and the company is now erecting a similar engine at the Slater Mills, Webster, R. I. In street railway work the company has also enjoyed a very large share of business and has recently successfully started a 2000 h. p. cross compound engine directly connected to a generator in the power house of the Lowell & Suburban Street Railway Company, Lowell, Mass., and a 750 h. p. simple engine directly connected to a generator in the power house of the Scranton Traction Company. The company has also erected a 750 h. p., cross compound, direct connected engine in the Willoughby station of the Cleveland, Painesville & Eastern Railroad Company.

The H. W. Johns Manufacturing Company, after occupying for twenty-five years the old building, No. 87 Maiden Lane, New York, will move around the corner on May 1 into the ground floor offices in the new Woodbridge Building, No. 100 William Street. Here elegant quarters have been provided for the electrical department of the company's business, which has grown apace during the past few years. Ten years ago, on a small scale, the company began its sale of vulcabeston for electrical purposes. This insulating material with its exceptional heatproof and mechanical properties, is now universally used in almost every kind of electrical apparatus. A recent examination of the company's orders shows that over one million pieces of vulcabeston have been sold for electrical puposes. In addition to this enormous number of pieces the company has sold tons of "steam" vulcabeston, used as packings in steam, gas, water, compressed air and other apparatus. The sale of the moulded mica trolley line insulating materials has also greatly increased. The first overhead lines constructed in the United States were insulated with moulded mica; several hundred roads are now on the list. The sale of the "H. W. J." electric car heaters has also proved most satisfactory. The season just closed has proved a most successful one, and the company anticipates a still greater business in this line next year.

The Chase Construction Company, of Detroit, Mich., has just been incorporated with an authorized capital of $25,000. The company will devote itself to construction and equipment of central station lighting, electric railways, steam and water works plants. It has just secured a constract to build the electric railway running between Cleveland and Lorain, O., for the Lorain & Cleveland Electric Railroad Company, which is to be completed by June 1. The officers of the company are: president and treasurer, George E. Fisher; secretary and chief of engineering department, O. D. Chase, vice-president and superintendent of construction, E. N. Chase. The active men in the company are pioneers in the electrical business; O. D. Chase, whose name the company bears, was electrician and superintendent of the Commercial Electric Engineering Company, while George E. Fisher was its business manager. During the term of the Commercial Company's existence, it installed fifty-six central station lighting plants and 167 isolated plants, in addition to a large volume of other electrical work. The Chase Construction Company has secured the services of E. F. Mann, as superintendent of railway construction, a practical man of large experience in railway work, having superintended the construction of the immense system of the Detroit Electric Railway Company, Niagara Falls, Toronto, and a number of the Cleveland roads covering a period of twelve years. The company has handsome offices in the new Majestic Building in Detroit and anticipates a very active business during the coming season.

The Falk Manufacturing Company, of Milwaukee, Wis., is now doing a large amount of work at Toledo for the Toledo Traction Company on 4½ in. rail, which was way down at the joints. After cast welding this track and surfacing it with a grinding machine, it is impossible to detect a joint. At Cleveland the company has done a great deal of work on 4½ in. rail, and is now about to start on 9 in. new construction. It has also a machine now en route for Brooklyn, N. Y., which will commence work on the Nassau Electric Railroad on 6 in. rail on the 23d or 24th of this month. At Lyons, France, the Falk Company's machine is still hard at work welding the tracks, and the company has now under construction three or four more machines, which will be operated abroad. It has also a machine working on the Pasadena & Pacific Railway, of Los Angeles, and will shortly start on the Piedmont & Mountain View Railway, at Oakland, and on the Market Street Railway, San Francisco, Cal. The company has also just been awarded the contract for the entire special work for a new road, the Citizens' Traction Company, of Oshkosh, Wis. It has also just completed a large amount of special work for the West Chicago Street Railroad Company, the Citizens' Street Railroad Company,

Memphis, Tenn.; the St. Joseph & Benton Harbor Electric Railway & Light Company, St. Joseph, Mich., and the Glen Oak & Prospect Heights Railway Company, Peoria, Ill. The company expects to start work on three more roads shortly. The company has recently published a handsome catalogue bound in cloth, descriptive of the various classes of work which it has recently installed. The illustrations are all blue prints. Some of these pieces are extremely complicated, and show that the company is prepared to take contracts for any kind of work of this character.

The Walker Company, of Cleveland, O., has recently closed the following contracts for generators among others: C. C. Chandler, Chicago, one 100 k. w. belted; J. C. Hubinger & Company, Keokuk, Ia., one 200 k. w belted; Naugle, Holcomb & Company, Chicago (for Suburban Railway, Chicago) one 250 k. w. and one 400 k. w. direct connected; Baltimore & Ohio Railroad Company, one 300 k. w. booster; Foresters Building, Toronto, five 50 k. w. direct connected; Queens Insurance Company Building, New York, one 100 k. w. and one 50 k. w. direct connected; Wendell & MacDuffie, New York City, one 75 k.w. belted; Troy Gas Company, Troy, N. Y. two 150 k. w. belted; Municipal Gas Company, Albany, N. Y. one 200 k. w. belted; New York & Staten Island Railroad Company, one 800 k. w. direct connected; Memphis Street Railway Company, Memphis, one 800 k. w. direct connected; Columbia Electric Light & Railway Company, one 150 k. w. belted; J. E. & A. L. Pennock, New York City, two 75 k. w., one 50 k. w. and one 25 k. w. direct connected; Hon. J. W. Hinkley, Poughkeepsie, N. Y., one 50 k. w. direct connected; Penn Yan, Keuka Park & Branchport Railway Company, two 150 k. w. belted; Agency Walker Company, Paris, France, one 100 k. w., and two 150 k. w. belted; Bagnall & Hilles, Yokohoma, Japan, two 100 k. w. belted. In nearly all of the above cases, the Walker Company supplied the necessary switchboard apparatus. In the line of motor and car equipment the company reports the following recent sales: C. C. Chandler, Chicago, Ill., four No. 4 A double equipments; Naugle, Holcomb & Company, Chicago, fourteen No. 10 double equipments; North Side Street Railway Company, one No. 3 double equipment; D. M. Robbins, Minneapolis, Minn., one No. 5 double equipment; Agency Walker Company, Paris, five No. 3 double, eighteen No. 3 single and twenty-one No. 4 A double equipments; Bagnall & Hilles, Yokohama, Japan, twelve No. 3 single equipments.

The Berlin Iron Bridge Company, of East Berlin, Conn., has the contract for furnishing the steel roof for a large storehouse which is to be erected by the Waterbury Manufacturing Company, of Waterbury, Conn. This building is 54 ft. × 144 ft. The side walls are of brick. The roof will be supported by steel trusses. The covering is to be corrugated iron lined with the Berlin Company's patent anti-condensation fireproof roof lining. The Berlin Company is also engaged upon the steel work of a new boiler shop for the Standard Oil Company, at Bayonne, N. J. This shop will be 300 ft. × 105 ft. The main portion of the shop is divided into three bays. The central bay, about 50 ft. wide, is served with a 15 ton electric crane supported on heavy girders about 40 ft. above the floor. On either side of this main portion is a wing, about 30 ft. wide. The walls of the building are brick and the supporting framework is steel. The roofs are to be covered with corrugated iron. The main columns of the shop are 25 ft apart, and all arranged so that jib cranes of suitable size and capacity can be attached at any point, which, together with the traveling crane in the center, will enable them to cover the entire floor surface of the building. One end of the building, for a distance about 75 ft. in length, is supported by clear span trusses, which gives a clear floor space over this entire area. In this end of the building will be located fires and furnaces and other apparatus for heating and shaping the material for the boilers. The building is well lighted by windows in the sides of the brick walls and in the monitors of the roof, and is amply ventilated by means of large monitors on the ridge. The company has also the contract for furnishing for the Government of Limon, Costa Rica, a market building constructed entirely of steel. The framework of the building will be of light skeleton steel work. The roof covering will be galvanized iron with ornamental cresting and cornices. This building is constructed in the form of a quadrangle 120 ft. square. The interior court is 40 ft. square, in the center of which will be placed a fountain. Each side of this quadrangle will be 40 ft. wide. Completely surrounding the building will be placed an oramental iron fence provided with large entrance gates. The gate posts will be surmounted by elegant wrought iron lamps. The whole design of the market is neat and attractive in every way. The company has also received from the Worcester & Marlboro Street Railroad Company, of Worcester, Mass., a contract for the steel work of a new power station. The engine room is 55 ft. × 63 ft. and the boiler room is 45 ft. × 40 ft. The roof, which is to be gravel on plank, is supported by steel trusses.

The Hunt Air Brake Company, of Pittsburgh, Pa., has secured a number of orders during the past month for air brakes from different railway companies, and the general manager, G. E. Pratt, states that the outlook for new business is extremely encouraging. The company has recently secured the services of I. E. Storey as consulting electrical and mechanical engineer. Mr. Storey is president and general manager of the Storey Motor & Tool Company, of Philadelphia, has been connected for a period of twenty years with hydraulics, pneumatics and power transmission, and has been engaged in the electrical field since 1885. Mr. Storey is well known and highly esteemed throughout the engineering fraternity, and his long experience in this field will bring to the Hunt Air Brake Company assured success in the way of perfect apparatus, mechanically and electrically. In the direction of orders the company has had ample proof that its air brakes are giving satisfaction. One order closed last month was with the Olean & Bradford mountain road, and was received through the Pierce Engineering Company, of Leominster, Mass. This order covers ten equipments for cars now being built at the works of the Wason Manufacturing Company, of Springfield, Mass. These cars are to be 45 ft. in length, and to be models of their class. They are of the open and combination type, seating ninety passengers, and will be mounted on Peckham trucks. From the Johnson Company, of Lorain, O., the company has secured a duplicate order, as the trial brake in use on one of the cars operated by the Johnson Company at Lorain has been very satisfactory. The company is also equipping trial cars in Washington, Boston and several towns in Ohio, and has just finished the equipment of twelve cars for the Mt. Clemens (Mich.) Railway. The recent work of the Hunt Company has been largely directed toward eliminating all noise occasioned in the working of the compressor. This has now been entirely overcome, and the compressor now operates so quietly that when standing beside it a person would hardly know that it was in operation. As an evidence of the satisfaction given by the compressor in service, the company has many letters and telegrams from users commendatory of its apparatus. One of these, from the superintendent of the Norfolk & Ocean View Railway, of Ocean View, Va., is given herewith: "We are pleased to express ourselves as regards the apparatus turned out by the Hunt Air Brake Company. The four axle geared pumps are in daily service and give perfect satisfaction. We work them at 50 lbs. pressure. Your automatic electric compressor is perfection itself; at 70 lbs. pressure we control a five car train absolutely, and have never known it to fail; oiling and inspection is all that is required for this apparatus. We have had numerous parties here to inspect this outfit, and their comments are always favorable. Our 200 h. p. freight hauler is equipped with your 'automatic,' and we find that it works perfectly with the standard Westinghouse brake cylinders on refrigerator cars and passenger coaches of other lines which we are handling daily." The company has also just received the accompanying letter from the general manager of the Cleveland, Berea & Elyria Railway Company, of Cleveland, O.: "We have have been using your air brake upon our Elyria road for nearly eighteen months. They have given good satisfaction, and we have had no difficulty with flat wheels during the time that the brakes have been on. I am much pleased with the action of the brake."

New Publications.

Marine Engineering, for April, 1897. Vol. I, No. 1. Marine Publishing Company: World Building. New York.

This new paper is designed to cover the broad field of vessel construction and propulsion and their allied interests. The first number indicates that the journal will be progressive and one worthy of the extensive field which it aims to cover. It has a number of interesting articles, is well illustrated, and contains a good showing of advertisements for the first number of a new paper. The periodical has an exceedingly strong editorial and business backing, the sponsors having had a long and very successful experience in trade journalism, and it is easy to predict under their management a most successful career for our new contemporary.

Trade Catalogues.

Illustrated Catalogue and Price List. Published by the Garvin Machine Company, New York. 160 pages. Illustrated.

Special Work. Published by the Falk Manufacturing Company. Milwaukee, Wis. Seventy-two pages. Cloth. Illustrated with blue print productions.

Additional Evidence of the Merits and Value of the Cochrane Separators. Published by the Harrison Safety Boiler Works, Philadelphia, Pa. Fifty-two pages. Illustrated.

The Application of Paints, Varnishes, etc., for the Protection of Iron and Steel Structures and Hydraulic Work. Edward Smith & Company, New York. Third Edition. Sixty-nine pages. Illustrated.

List of Street Railway Patents.

U. S. Patents Issued Mar. 30, to Apr. 20, 1897, Inclusive.

Mar. 30.

Street Railway Switch.—Chas. E. Groves, Attica, O. No. 579,575.

In a switch, the combination with track mechanism including a laterally movable pin operatively connected with the switch rail, of car mechanism including an upwardly yielding cam-plate having a vertical axis, and an actuating spring to normally and yieldingly hold the cam-plate in its depressed position and in a plane parallel with the direction of movement of the car, whereby the plate may be deflected in either direction from said normal position to engage the pin of the track mechanism and move the same in either direction.

TROLLEY WHEEL FRAME FOR TROLLEY CARS.—Wm. Grunow, Jr., Bridgeport, Conn. No. 590,788.

A tangential trolley wheel frame, which is connected with the trucks of a car, one end being pivotally connected therewith, and adapted to swing, and the other end being also pivotally connected therewith, and provided with means whereby as light sliding motion may be secured, said frame being also provided with trolley arms or levers pivotally connected with the bottom thereof, each of which is provided with a trolley wheel, and with a vertical rod which passes through said frame, on each of which are mounted spring regulating nuts, each rod being provided with a strong spiral spring, which bears upon said nuts, and with a vertically movable sleeve, which rests upon said springs and means for operating said devices.

CAR FENDER.—C. P. Mains, Cleveland, O. No. 579,650.

TROLLEY SYSTEM.—Wm. H. Walker, Pittsburgh, Pa. No. 579,728.

In a trolley system, the combination of a trolley head consisting of a bracket, wheels mounted therein and adapted to contact with opposite sides of an overhead conductor, one of said wheels being mounted on a fixed axle and another being mounted on an axle movable in a slot in said bracket, a lever connected with said fixed and movable wheel axles and adapted to press the movably mounted wheel away from the conductor, and means connecting the axles of the wheels for forcing the wheels into contact with the conductor.

ELECTRIC RAILWAY.—Frank Mansfield, New York, N. Y. Nos. 579,759 and 579,760.

The combination of a car having double trucks, a contact device suspended therefrom and consisting of a short conducting bar supported horizontally beneath and between the axles of each truck, and an intermediate conducting bar hinged between said short bars.

APR. 6.

SWITCHING APPARATUS FOR STREET CARS.—Edw. G. Jay, Philadelphia, Pa. No. 579,984.

The combination of the wheels and axle, the truck frame having side beams extending over the axle, the car body resting on springs mounted on the side beams, the switching trolley, the vertical frame in which it is mounted and the axis of which is in line with the flange on one of the front wheels, so that a trolley may traverse the groove of a grooved rail, a bracket secured to one of the side beams close to the edge of one of the front wheels and in which the trolley supporting frame has its bearing and is free to move about a vertical axis, a handle for operating the trolley frame, rods connecting the handle with the frame, and a stationary switch point in the track with which the trolley engages to shift the car bodily.

CAR FENDER.—Theo. Lampus, Cleveland, O. No. 579,990.

COMBINED SAFETY GUARD AND GATE FOR OPEN STREET CARS.—John H. Williams, Boston, Mass. No. 580,026.

Consists of two pairs of jointed bars pivoted at points substantially midway the length of the car and extending in opposite ways toward the ends of the car, each jointed bar consisting of a short bar and a long bar jointed together and adapted to occupy a horizontal position when in use and a right angular position when out of use, and hooks which support the outer ends of said jointed bars in their different positions.

ELECTRIC RAILWAY SYSTEM.—Wm. Robinson, Boston, Mass. No. 580,057.

The combination of a plurality of electromagnets included in a continuously closed circuit formed in part of two parallel lines of sectional contact conductors, said magnets being operated or controlled without opening the circuit of the same, an electric generator furnishing current to said magnets through said parallel sections of contact conductors, and means for demagnetizing each of said magnets in succession, independently of the others, by making short circuiting contact between said respective parallel sections of contact conductors.

CAR FENDER.—Meyer W. Schloss, New York, N. Y. No. 580,059.

CAR FENDER.— A. C. Woodworth, Providence, R. I. No. 580,119.

In a car fender the combination, with the pilot member adapted to be pivoted to the end of a car, of a guard member pivoted to said pilot member and having its upper end free.

STREET-CAR FENDER.—Henry Wilson, Philadelphia, Pa. No. 580,243.

CONDUIT SYSTEM FOR ELECTRIC RAILWAYS.—A. O. Babendreier, Washington, D. C. No. 580,246.

In an electric railway conduit system, an insulator support comprising a casing provided with outwardly projecting lugs at each end thereof, brackets fixedly secured to said lugs, and means for supporting said brackets within the conduit.

APR. 13.

SUPPORTING MEANS FOR ELECTRIC RAILWAY SUPPLY CONDUCTORS.—H. P. Davis, Pittsburgh, Pa. Nos. 580,380 and 580,381.

A support for crossover and branch conductors for electric railways comprising a plate provided with a plurality of radial grooves, a cap plate and means for clamping the conductors between the said plates.

CAR FENDER.—Geo. Hipwood, H. C. Barrett and Stephen Porter, Boston, Mass. No. 580,549.

CAR HAND-STRAP.—Geo. W. Clark, Bayonne, N. J. No. 580,571.

Consists of a U-shaped band for the car rod, a depending flexible support pivotally carried by said band, an independent grasping piece supported by the sopport, and an intermediate vertical binding securing together the two parallel portions of the flexible support.

CAR FENDER.—Theo. Lamfus, Cleveland, O. No. 580,618.

STREET CAR.—T. H. Lovejoy, Chicago, Ill. No. 580,620.

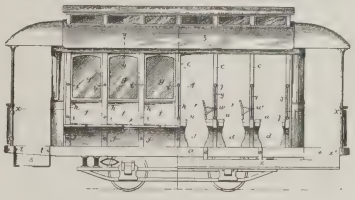
In a street car, the combination with the truck frame and life guard of a collapsible support interposed in the supporting connection between the life guard and truck frame and serving when in its extended position to sustain the weight of the life guard itself operating to collapse said support the moment it is flexed or moved out of its extended position.

CAR FENDER.—G. W. Granger, Allegheny, Pa. No. 580,684.

TROLLEY CATCHER.—Robt. Orme, Racine, Wis. No. 580,708.

The combination on a car with a spring actuated trolley pole provided with a trolley cord, of a pole retrieving device mounted on the car, comprising a gravity actuated weight to which the cord is attached, a catch or catches releasably supporting the weight, and means by which the catches are actuated by the raising of the weight to automatically release it.

CAR FENDER.—O. L. Badger, Pittsburgh, Pa. No. 580,751.



NO. 580,822.

CONVERTIBLE STREET CAR.—Robt. Steel, Philadelphia, Pa. No. 580,822.

A car whereof the body comprises a bottom, a roof, laterally disposed posts rising from said bottom and sustaining the roof, said posts having side pieces or braces at their lower ends, panels removably fitted between the said posts and between the roof and the floor, vertical strips detachably secured to said posts to overlap adjacent panels, longitudinally disposed strips or beads secured to the panels at their lower portions, and seats adapted to be removably supported on the side pieces or braces and having notches which engage the said posts.

APR. 20.

CAR FENDER.—A. Di Trani, New York, N. Y. No. 580,932.

CAR TRUCK.—Wm. A. McGuire and M. G. Hubbard, Jr., Chicago, Ill. No. 580,951.

The combination with a car truck frame and journal boxes, of two laterally swinging links suspended from said journal boxes and two springs carried by said links and arranged parallel with the axle for supporting the truck frame, and seats and caps for said springs.

NO. 580,951.

SAND BOX FOR RAILWAY CARS.—F. S. Bilss, Mansfield, Mass. No. 581,016.

An improved sand box having one side of the sand receiving space thereof constituted by a sliding valve, and having within the same an agitator or stirrer, and also provided with means to actuate said valve and agitator in unison, whereby whenever the valve is moved to start or arrest the flow of sand the agitator is caused to stir the sand.

CAR FENDER.—E. M. Carhart and Edw. K. Aldrich, Providence, R. I. No. 581,059.

We will send copies of specifications and drawings complete of any of the above patents to any address upon receipt of fifteen cents. Give date and number of patent desired. THE STREET RAILWAY PUBLISHING COMPANY, HAVEMEYER BUILDING, NEW YORK.

Annual Report of the General Electric Company,

SCHENECTADY, N. Y., Apr. 27, 1897.

To the Stockholders of the General Electric Company:

The business of your company has suffered during the past year, in common with that of all manufacturing enterprises, from the disturbed financial and political conditions which have prevailed during a considerable portion of the time. These conditions have curtailed the amount of capital ordinarily available for the establishment and extension of power and lighting plants, and have enforced the practice of great economy on the part of its customers. As a result, the shrinkage in orders received by your company was very marked, especially during the latter half of the year. This shrinkage is not shown by a material falling off in shipments, as given in the profit and loss statement accompanying, but the amount of work in progress and unfilled orders on hand is considerably less than a year ago.

With a return to normal commercial conditions, a corresponding revival in the business of your company may be expected. The volume of business secured by it for the first three months of the current year is slightly in excess of that for the same period in either of the previous three years.

On Jan. 31, 1895, the sum of $2,000,000 was set aside, as shown in the annual report of that year, to provide for shrinkage in assets, exact values of which it was then extremely difficult to fix. During the past year your directors have been able to value these items with substantial accuracy, and the $2,000,000 fund has been found sufficient and has been used to provide for the proper adjustment of all accounts and other assets for which it was created.

BUSINESS OF THE YEAR.

Gross earnings	$12,820,395.87	
Less expenses	11,207,388.65	
		$1,613,007.22
Deduct.		
Interest on debentures*	431,250.00	
Less interest and discount, and interest and dividends rec'd on securities owned	370,479.70	
		60,770.30
Deduct amounts written off.		1,552,236.92
Sundry losses and allowances for possible losses	318,531.13	
Patents	349,919.20	
Inventories and consignments	61,084.36	
Less.	729,534.69	
Profit on securities sold and debentures canceled	136,955.85	
		592,578.84
Reduction of the deficit of previous years		$959,658.08

*On $8,750,000 for ten months and on $8,000,000 for two months.

Additional purchases of your company's debenture bonds have been made during the year to the amount of $750,000, leaving now outstanding $8,000,000. All debentures purchased have been canceled.

The decrease in the amount of interest and dividends received as compared with the previous year, is due largely to the cessation of dividends by the Canadian Company, which it is hoped will soon resume dividends on its reduced capital. As a partial offset, there has been an increase in the income derived by your company from dividends on stocks held by it in various local companies.

PATENT LICENSES AND PATENT LITIGATION.

In the last annual report attention was called to an arrangement which had been concluded with the Westinghouse Electric & Manufacturing Company for an exchange of licenses under patents owned and controlled by the two companies. Your directors are pleased to report that the result of this arrangement has been highly satisfactory.

The result of the work of your company in protecting its patents and enjoining infringers thereof has been especially encouraging, and a considerable number of patents of value has been acquired by it during the year.

The courts have invariably recogized the validity and controlling importance of the Van Depoele patents on the electric railway, trolley and switch system, and at the present time substantially all manufacturers of infringing trolleys and switches are under injunction The company has met with no reverses in its patent litigation during the past year.

Many new suits have been brought, involving important patents, and are now being actively pushed.

SALES, FINANCIAL AND MANUFACTURING DEPARTMENTS.

Attention is called to the report of the second vice-president, containing much valuable information with respect to his department. Owing to the absence in Europe of the first and third vice-presidents, their annual statements will be delayed.

The great improvements made by your company during the past year in the design and construction of its apparatus have been very satisfactory. The development in long distance transmission of electricity and the progress made in electric railway service have been especially noteworthy. Many new enterprises, involving the application of electricity to railways now operated by steam, are under consideration, and the ensuing year promises to be marked by a very rapid growth in that field of work.

Your company has added one large factory of brick and steel construction to its plant in Schenectady during the year, besides completing and occupying another, which was commenced in 1895. Other important improvements at these works are in preparation, designed to add to the facility and economy of handling their output.

By order of the Board of Directors,

C. A. COFFIN,
President.

Report of Second Vice-President.

The balance sheet and statement of profit and loss, herewith transmitted, include the assets and liabilities and profit and loss accounts of the Edison General Electric, Edison Electric Light, and Thomson-Houston Electric Companies (which, for convenience of book-keeping, are consolidated with those of the General Electric Company) at Jan. 31, 1897; and when "the company" is spoken of, all the above mentioned corporations are included.

I submit explanations of what each item on the balance sheet represents.

PATENTS AND FRANCHISES.

During the year there was expended for acquiring new patents and patent litigation, $349,919.20, all of which has been written off to profit and loss; leaving the patents, franchises, good will, etc., of the company standing unchanged at $8,000,000.

FACTORY PLANTS.

This account represents the real estate (lands and buildings) machinery, tools, appliances, etc., patterns, drawings, etc., and sundries (fittings and other small property accounts) of the factories at Schenectady, Lynn and Harrison. The lands amount to 72 acres and the total factory floor space of all buildings is approximately 1,416,000 sq. ft. All are free from mortgage or other lien. These plants being a permanent investment, all expenditures for their maintenance and repair, plus an allowance to provide against depreciation are charged to operating expenses.

Their book value at the date of last annual report was $3,468,002. The amount written off during the fiscal year for depreciation, over and above the total cost of all maintenance, repairs and additions, was $68,000—leaving the book value of factory plants at Jan. 31, 1897, $3,400,002.

REAL ESTATE.

This account represents the investment in the Edison Building and a large building at Avenue B, both in New York; and sundry parcels of land in various places, mostly improved and rented, which have been acquired at various times, chiefly in payment of debts. All will be sold when opportunity offers.

STOCKS AND BONDS.

Schedule A. annexed hereto contains a list of nearly all the company's stocks and bonds which are carried at more than merely nominal values. Those having a market value are carried at slightly under the price of recent sales. The book value of those not readily salable has been fixed after careful examination of their present worth. I believe their actual present value is equal to the aggregate at which they stand in the Balance Sheet, viz., $8,545,660.68. In addition, the company owns various miscellaneous securities of many manufacturing, selling and patent owning corporations, and also of street railway and lighting companies. As the present value of these is doubtful and their future value speculative, they are carried at $1 for each lot, making in all $135. The total book value of all stocks and bonds is $8,545,795.68. The book value

of stocks and bonds in the last annual report was $5,479,332.23 and the increase is therefore $3,066,463.45.

Although some securities have been purchased for cash, most of those acquired during the year have been accepted in payment of *old* indebtedness. The principal items of the above increase at their par values are as follows:

Edison Electric Co., of New Orleans received in exchange for the claim against the receivers of the Fort Wayne Electric Co., and for cash advanced to the Edison Electric Co. to purchase the Louisiana Electric Light Co. and build a large new Central light and power station:	
First mortgage bonds	$ 891,000
Preferred stock	1,980,000
Common "	1,000,000
Baltimore & Ohio Railroad Co.'s receivers' certificates, received in payment of balance due for electric plant and electric locomotives for its tunnel under the city of Baltimore	323,000
Bonds of the city of Jacksonville, Fla., received in part payment of a lighting plant	58,000
Sacramento Electric Power & Light Co., received in part payment of a contract	44,000
Bonds of the Brush Electric Co. (the entire issue outstanding) received in payment of notes and purchased for cash	369,000
Bonds of the Columbus (Ga.) R. R. Co., received in payment of claim against Brush Electric Light & Power Co., of Columbus	50,000
Preferred stock of the United Electric Securities Co., bought for cash	74,200
Bonds of the Citizens' General Electric Co., of Louisville, Ky., purchased	94,000
Bonds of the Tacoma Ry. & Motor Co., purchased under old contracts with the United Electric Securities Co	231,000
Bonds of the Augusta Ry. & Electric Co., received in exchange for claims against Thomson-Houston Electric Co., of Augusta, Ga	41,000
Stocks and bonds received from licensees in payment of royalties	119,750
Total	$5,274,950

SALES OF STOCKS AND BONDS.

The past has not been favorable to the established policy of selling securities which there is no special reason for holding permanently, and but few have been sold since the last annual report.

Securities whose par was $326,115, were sold for	$285,829.56
They were carried on the books at	206,012.80
Profit	$ 79,816.76

The cash thus received was used toward the purchase of securities mentioned on the preceding page.

CASH.

The policy of the previous two years has been adhered to and sales maintained on a basis of cash or short credit to desirable customers. It has not been necessary to borrow money, nor has the company's credit been used during the year either by issuing notes, endorsing customers' paper for discount or lending its name in any way. During the year all purchases have been paid for in cash. None of the money realized from the sale of assets was required for the current business of the company during the year.

NOTES AND ACCOUNTS RECEIVABLE.

These accounts represent the total amount now due to the company by customers.

They appear in the balance sheet at an estimated realizable value (*i. e.* their face, less allowance for possible losses) which I believe to be a fair one.

They may be classified approximately as follows:

	Face Values.	Face Values.
Current notes	$1,196,715.81	
" accounts	2,901,773.96	
		$4,098,489.77
Slow notes	766,974.05	
" accounts	207,188.16	
		974,162.21
		$5,072,651.98
Due from local lighting and street railway properties owned by the company		217,700.92
Due from the Brush Electric Company		194,516.85
Total face value*		$5,484,869.75

Collection of the old indebtedness remaining from previous years has been as satisfactory as was possible under the financial conditions of the year.

WORK IN PROGRESS.

This account does not include anything in process of manufacture; but represents expenditures for labor, material, etc., on 194 installations of manufactured apparatus delivered at various places $900,807.52

Less partial payments thereon, received under the terms of the contracts as work progressed 372,941.22

Balance $517,866.30

None of the estimated profit to be derived from these installations is included in the earnings of the year, and no allowance is made thereon for possible loss.

INVENTORIES.

These accounts represent raw materials and goods manufactured and in process of manufacture at the factories; manufactured goods in storerooms of local offices and on consignment; office furniture, fixtures, instruments, etc., in the general office and in local offices; tools and materials in local repair shops; and also shipments in transit to local storerooms. All have been counted and valued item by item.

Raw materials have been valued at the market prices prevailing on Jan. 31, 1897; active selling finished and partly finished apparatus and supplies at factory cost; inactive or slow selling apparatus and supplies at about 50 per cent of factory cost; obsolete apparatus and supplies at scrap value; and tools, instruments, furniture, etc., at present value.

The inventories of the factories showed an excess over book value of $141,184.98, which is not taken as a part of the year's profit, but is retained as a reserve. All other inventories showed a shrinkage from book value of $50,354.85, which has been written off as a loss for the year. As goods are taken in and out of local office inventories at factory cost, at the time being, the bulk of the above shrinkage is due to facfory costs at Jan. 31, 1897, being lower than at Jan. 31, 1896; and the remainder to writing down the book value of slow selling apparatus and other personal property.

CONSIGNMENTS.

Finished apparatus for novel uses has been delivered to various concerns, subject to purchase if its operation is successful. The greater part of this account represents such contingent sales, and the remainder represents apparatus on exhibition, or loaned to regular customers for temporary use by them.

All the above apparatus is charged, at factory cost, to this account at a total of	$73,729.80
Less allowance for depreciation	35,977.15
Net book value of consignments	$37,752.65

LIABILITIES.

The company has no notes payable, nor is any paper bearing the company's endorsement or guaranty under discount.

DEBENTURES.

During the year the company has purchased and canceled $750,000 of its own debentures at an average cost of 92.38 per cent.

ACCRUED INTEREST ON DEBENTURES.

This account, as its name implies, is the full amount of interest accrued to Jan. 31, 1897, on the company's $8,000,000 outstanding 5 per cent gold coupon debentures.

ACCOUNTS PAYABLE.

This account includes all unpaid audited indebtedness.

At the close of business on Jan. 31, 1897, the unpaid vouchers on hand amounted to only $40,155.32, and none of these was due under the terms of purchase. The difference between that amount and the amount of accounts shown in the balance sheet, $402,264.81 represents expenditures belonging to the year, vouchered between Jan. 31 and Feb. 23, the date of closing the general books. The amount of vouchers which have to be carried over in this way monthly, owing to keeping the books—other than the cash book—open a sufficient time to include expenditures of a particular month in that month, is usually about $500,000.

MORTGAGE ON EDISON BUILDING.

A mortgage, created when the company's building at 44 Broad Street, New York, was erected, was paid off in full Feb. 26, 1897.

Respectfully submitted,

J. P. ORD,
Second Vice-President.

CONSOLIDATED BALANCE SHEET.

Dated Jan. 31,	1894.	1895.	1896.	1897.
ASSETS.				
Patents and franchises. Factory plants.	$12,100,392	$12,059,263	$8,000,000 3,468,002	$8,000,000 3,400,002
Real estate (other than factory plants)	323,685	423,787	453,585	643,016
Stocks and bonds	5,490,963	5,329,011	5,479,332	8,545,796
Notes and accounts receivable	8,934,159	5,508,499	6,584,123	4,578,601
Work in progress	1,198,343	846,291	961,386	517,866
Inventories	4,834,792	3,913,787	4,219,884	4,034,753
Cash	591,144	404,236	879,686	703,484
Miscellaneous, including Ft. Wayne claims.		1,176,666		
Profit and loss	12,454,967	14,294,717	13,917,071	12,957,413
Total	$45,928,449	$43,956,257	$43,963,069	$43,380,931

*In addition, there are old notes and accounts receivable of 435 debtors aggregating $2,644,547.59 which have all been written off to Profit and Loss except the nominal book value of $1 for each debtor. They are being liquidated as rapidly as possible.

LIABILITIES.

Capital stock, com. .	$30,459,700	$30,460,000	$30,460,000	$30,460,000
" " pref'd	4,251,900	4,252,000	4,252,000	4,252,000
5 p. c. gold coupon debentures . . .	10,000,000	8,750,000	8,750,000	8,000,000
Accrued interest on debentures . . .	83,333	72,917	72,916	66,666
Accounts payable .	1,067.426	421,341	428,153	402,265
Mortgages.	26,200			200,000
Sundry credits. . .	34,889			
Total.	$45,928,449	$43,956,257	$43,963,069	$43,380,931

CONSOLIDATED PROFIT AND LOSS ACCOUNT.

EARNINGS.

Years ending Jan. 31,	1895.	1896.	1897.
Sales	$12,540,395	$12,730,058	$12,540,994
Royalties and sundry profits .	420,818	585,609	279,402
Interest and discount	114,451	100,784	88,336
Dividends and interest on securities owned	187,947	320,257	282,144
Profit on sales of stocks, bonds			79,817
Discount on debentures purchased and canceled. . . .			57,139
Balance forward.	14,794,717	13,917,071	12,957,413
Total	$28,058,328	$27,653,779	$26,285,245

EXPENSES.

Balance from previous year. .	$15,209,360	$14,794,717	$13,917,071
Cost of goods sold	9,557,328	9,860,216	9,691,501
General expenses and taxes } Patents and patent expenses }	1,894,536	1,899,641	{ 1,515,888 / 349,919
Interest on debentures . . .	464,583	437,500	431,250
Sundry losses and allowance for losses	130,834	27,178	318,531
Depreciation of inventories. .	177,417	{ 101,191	50,355
" " consignments		22,013	10,730
Written off	624,271	511,322	
Total	$28,058,328	$27,653,779	$26,285,245

Annual Report of Twin City Rapid Transit Company of Minneapolis.

The annual report of President Thomas Lowry to the stockholders of the Twin City Rapid Transit Company is always looked forward to with much interest, as an indication not only of the success of this important street railway system, but also of the general business conditions in the great Northwest as reflected in its receipts and expenses. An abstract of this report follows:

Earnings.—The gross earnings were $2,059,217.57, an increase of 3.54 per cent.

Many of the principal business streets in the centers of the two cities, on which the lines are located, have been repaved during the past year, causing a practical abandonment of these streets for periods varying from forty to ninety days, during which the gross receipts suffered a great loss.

Interurban Line.—The gross passenger receipts of the interurban line, connecting business centers of the two cities, were $384,720.90 for the year 1896, being a gain of 6.09 per cent over 1895, and 8.98 per cent over 1894.

This line, 9 miles in length, operates twenty cars daily, and earned from passenger traffic during 1896, an average of $1050 per day.

Net Earnings.—In addition to its total operating expenses the Twin City Rapid Transit Company has earned all its fixed charges due and accrued, also earned and paid its fixed dividends of 7 per cent, amounting to $79,534 on all its outstanding preferred stock, and in addition thereto has passed to the credit of its surplus account $299,997.92, as the result of the operations for the fiscal year ending Dec. 31, 1896.

Consolidated income account Minneapolis Street Ry. Co. and St. Paul City Ry. Co. for years ending Dec. 31,

	1892.	1893.	1894.	1895.	1896.
Rects. from pass.	$2,136,658	$2,164,925	$1,981,706	$1,964,773	$2,037,935
" other s'rces	50,922	24,232	21,973	24,031	21,283
" total.	2,187,580	2,189,157	2,003,679	1,988,804	2,059,218
Operating exp. .	1,309,274	1,264,408	890,031	846,892	875,787
Other " .	109,315	145,824	154,517	132,593	119,372
Total " .	1,418,589	1,410,232	1,044,548	979,485	995,159
E'r'ngs from op'n.	768,991	778,925	959,131	1,009,319	1,064,059
Deduc. fr'm earn.					
Int. charges	474,360	611,491	686,022	701,768	705,891
Taxes.	54,064	51,144	52,939	49,071	58,170
Net income.	240,567	116,290	220,170	258,479	299,998
Total surp. acct. . .	117,037	710,204	827,572	1,086,051	1,386,049
Per cent. total exp. to total receipts.	64.8	64.4	52.1	49.3	48.3

INTERURBAN LINE.

Operating report of the interurban line connecting St. Paul and Minneapolis (included in the complete operating report given above).

Year ending Dec. 31,	1894.	1895	1896.
Gross receipts.	$353,015	$362,637	$384,721
Operating expenses	128,225	120,209	
Earnings from operation.	224,790	242,428	
Per cent. op. exp. to gross receipts. .	36.32	33.15	

OPERATING EXPENSES.

Year ending Dec. 31,	1892.	1893.	1894.	1895.	1896.
General expenses.	$106,697	$ 94,281	$ 61,162	$ 56,934	$54,053
Maint. of equip. . .	200,502	180,831	103,350	81,816	97,724
" " way and structures	108,061	98,931	66,607	58,069	62,738
Wages cond't'rs & motormen	482,697	452,687	369,598	378,256	386,464
Wages insp'ct'rs & transfer agents. .	30,919	27,252	14,300	8,859	9,019
Station expense. . .	142,649	144,518	90,639	87,131	84,902
Power station exp.	226,987	229,358	161,375	154,104	156,764
Machine shop exp.	10,762	36,550	23,000	21,722	24,122
Total.	$1,309,274	$1,264,408	$890,031	$846,891	$875,787

OTHER EXPENSES.

Year ending Dec. 31,	1892.	1893.	1894.	1895.	1896.
Insurance	$ 20,514	$ 18,966	$ 16,685	$ 13,638	$ 11,520
Inj. and damages. .	51,504	97,436	106,814	80,891	65,587
Legal expenses.	13,786	18,614	17,038	14,925	19,276
Contingent expenses	23,511	10,808	13,980	23,139	22,989
Total	$109,315	$145,824	$154,517	$132,593	$119,372

Financial.—The company paid on Jan. 1, 1897, $205,000 of the outstanding 6 per cent certificates issued by the underlying companies, and canceled $45,000 of those held in the treasury of the Twin City Rapid Transit Company. This leaves a balance still outstanding of $1,250,000; of this amount, $225,000 is owned by the company and held in its treasury. Add to the amount of outstanding certificates the excess in the current liabilities over the current assets of $354,101.91, and we have a total debt of $1,379,101.91, in addition to the bonded indebtedness. To provide for the payment of this, the company has in its treasury $1,862,800 of 7 per cent cumulative preferred stock.

Improvements.—The City Councils of Minneapolis and St. Paul ordered the repaving of the principal business streets in both cities to be completed during the past season.

In addition to that portion of the expense of paving on the streets where the tracks are located, required to be paid for by the company, we decided that it would be best to substitute a heavier type of track construction, which was done at a large cost. The company put in 80 lb. T rail, 60 ft. long, "cast welded," making it a continuous construction and all imbedded in concrete, dispensing with the use of wooden ties, the gage of the track being maintained by the use of steel rods connecting the rails, thus giving a track practically indestructible. This "cast-welded" joint has been adopted by the principal electric roads of the country, the Chicago City Railway Company, of Chicago, alone having welded over 80 miles of its track. The process of "cast-welding," though very simple, is effective, and consists of removing the fishplates, and encasing the adjacent ends of two rails in 150 lbs. of molten iron which, when cooled, holds the rails in an immovable clasp.

The item of $7471.98, charged to real estate, is not a new purchase, but a transfer from our former bills receivable account, occasioned by default of the maker of a note and mortgage held by the company, and who gave the company a quit-claim deed to the entire property.

Motive Power.—A very important and considerable factor in the cost of operation is the motive power.

The Pillsbury-Washburn Milling Company will have completed and ready for operation by July 1, of the present year, a magnificent stone dam across the Mississippi River, below the present Falls of St. Anthony, creating an additional water power of 10,000 h. p.

The Twin City Rapid Transit Company has leased this power for a term of forty years on a basis that will add largely to its net revenue.

The company will have a large surplus of power to lease, and although the dam is not yet completed, there is an active demand for the surplus power.

The company is relieved from any expense whatever in connection with the installation of the machinery or electrical apparatus necessary to a complete utilization of all the power generated.

The Pillsbury-Washburn Milling Company has contracted with the General Electric Company for all electrical machinery, including its most modern direct connected electrical apparatus, by means of which the power will be transmitted, both underground and overhead, to the lines in both Minneapolis and St. Paul.

The one feature that will give this water power its supremacy over that of Niagara, or any other similar power, will be its geographical location. Here is a great water power situated in the center of a population of nearly half a million people, and increase of the population will not disturb this centralization of power. This is an important factor, when the cost of electrical transmission is taken into consideration.

Respectfully submitted,

THOMAS LOWRY, President.

ELECTRICAL ENGINEERING DEPARTMENT
University of Illinois.

DIGEST OF CONTENTS.—MAY, 1897.

Abkürzung des Inhalts—Mai 1897.

"Das System der Canal & Claiborne Strassenbahn Gesellschaft" [Seite 265.]

Beschreibung einer elektrischen Strassenbahn welche neulich in New Orleans eröffnet wurde, und ein höheres Muster der modernen Strassenbahnbaukunst darselbst. Die eigenartige Beschaffenheit der Stadt, besonders derer sumpfige Grund, machte verschiedene Neukonstruktionen erforderlich. Für den Oberbau wurden 19 m. lange, 152 mm hohe Rillenschienen von 37 kg. Gewicht für das Meter verwendet. Die Querschwellen sind auf eine 100 mm. tiefe Bettung von Ballast verlegt, unter welcher eine 2½ cm. starke Cypressendiele liegt. Auf einem Theile des Systems, welcher mit den Gleisen anderer Bahnen parallel läuft, wird eine oberirdische Stromzuleitung mit 10 Leitungsdrähte benutzt. Diese Einrichtung erfordert die Anwendung von zahlreichen speziellen Luftkreuzungen. Die Wagen messen 9 m. Länge, sind auf einfachen Untergestelle getragen, und mit einem mittleren Durchgang und niedrigen Fensterrahmen versehen, so dass sie für den Sommer- sowohl wie für den Winterverkehr geeignet sind. Der Bau der Kraftstationsgründung war mit bedeutenden Schwierigkeitet verbunden und ist ausführlich beschrieben. Verwendet werden zwei-cylindrige, mit 300 kilowatt starke Generatoren direkt gekuppelte Corliss-Maschinen. Die Röhre sind doppelt eingerichtet, und unterscheiden sich in mehreren Punkten von der gewöhnlichen Anordnung.

Betrieb.

"Die finanziellen Erfolge des elektrischen und Kabelbahnbetriebs in den Vereinigten Staaten. II. Vorort- und Kleinbahnbetrieb in Massachusetts" . . . . . [Seite 281.]

In diesem Artikel wird durch sehr interessanten Zahlen die bedeutende Steigerung in Brutto- und Netto-Einnahmen gezeigt, welche seit den vergangenen zehn Jahren in einem der bevölkertsten Staaten Amerikas stattfand, während den letzten fünf Jahren derselben der Pferdebetrieb durch elektrischen Betrieb fast ausschliesslich ersetzt wurde. Der Erfolg des gesammten Betriebes spricht sich in dem Eifer aus, mit welchem die ganze Bevölkerung die Strassenbahnen *per capita* benutzt. Der Einfluss des neuen Verkehrsmittels zwischen Städte und Vororten auf die Verbreitung der Bevölkerung in diesen Oertlichkeiten ist klärlich dargestellt, und wird der Artikel besonders jene Direktionen interessiren, welche die Umgestaltung des Pferdebetriebes auf elektrischen Betrieb auf ihren Linien beabsichtigen.

"Streitfrage über Kraftstationen in Chicago" . [Seite 285.]

In diesem Artikel erscheint eine Kritik welche durch eine hervorragende Firma von Ingenieuren über zwei grosse und bedeutende Kraftstationen in Chicago geführt wird, sowie eine Erwiderung seitens der Ingenieuren welche die Stationen erzeugten. Die Streitfrage bringt die hervorstehenden Punkte des amerikanischen Kraft-Stationen-Bauwesens heraus, und ist von grossem Interesse für Ingenieure.

"Entwerthung" . . . . . [Seite 288.]

Erörterung der Beträge welche für Entwerthung abgeschrieben werden sollten.

"Versammlung des Internationalen Tramway-Instituts" [Seite 288]

"Strassenbahnen-Parke" III. . . . . . [Seite 289.]

Fortsetzung eines Artikels über Parkanlagen welche durch Strassenbahn-Gesellschaften betrieben werden; zwei Abtheilungen desselben wurden schon früher gegeben. Die Betriebskosten der verschiedenen Grundstücke, das von der Verpachtung gewisser Vorrechte zu erwartende Einkommen, und das durch die Strassenbahnen entwickelte Verkehrswesen werden erörtert.

"Sandstreuung der Bahnen in Albany" . . [Seite 292.]

Briefe und Mittheilungen von Sachverständigen.

"Schutzvorrichtung für Stromabnehmer," von W. Sonneberg, von der Union Traction Company, Philadelphia . . [Seite 293].

Beschreibung einer neuen Vorrichtung um Störungen bei dem Verlassen des Stromabnehmers von der Arbeitsleitung vorzubeugen.

"Strassenbahn-Angestellten-Klub in San Francisco" [Seite 293.]

"Betriebskosten der elektrischen Triebkraft auf einer kleinen Strassenbahn" . . . . . [Seite 294.]

"Verwendung der Schutzdrähte für Telephonleitung" [Seite 294.]

In diesem Artikel wird ein Verfahren beschrieben, welches durch die bedeutendste Trambahnlinie in Brooklyn gebraucht wird, indem die Schutzdrähte über die Arbeitsleitung des "Trolleys" für die Leitung des Telephonstroms benutzt wird.

"Praktischer Wagenaufzug" . . . . . [Seite 294.]

Beschreibung eines Wagenschuppen-Aufzugs, welcher in Cleveland sehr zweckmässig verwendet wurde.

"Rechnungsmethode für Reparatur-Werkstätten" . [Seite 295.]

Beschreibung einer in Paterson, N. J., angewandten Methode, um die durch das Personal der Werkstätte zur Reparatur jedes Wagens verbrauchte Zeit schnell zu rechnen.

"Verzeichniss der Strassenbahn-Unfälle in New Orleans" [Seite 295.]

Beschreibung einer durch die "New Orleans Traction Co." angewandten Art und Weise, um die Handlung des Wagenpersonals zu kontrolliren, mit der Abbildung eine Zettels, der von den Wagenführer benutzt wird, um Unfälle zu berichten.

"Rechtswesen." . . . . . [Seite 296.]

Leitartikeln.

"Betrieb der unterirdischen Bahn in New York" . [Seite 298.]

"Das System der Canal & Claiborne Strassenbahn-Gesellschaft" [Seite 298.]

"Strassenbahnen contra Stadtobrigkeiten" . . [Seite 299.]

Dies ist eine Erwiderung der in gewissen Städten der Vereinigten Staaten ausgesprochener Behauptung dass die Fahrpreise auf Strassenbahnen erniedrigt oder die Betheiligung der Stadt in den Fahrgeld-Einnahmen erhöht werden sollten.

Oberbau.

"Der Bahnprüfungswagen der Chicago City Railway Company" [Seite 301.]

Beschreibung eines Wagens, welcher niedrige Schienenstösse, Schienenausdehnungen und dergleichen auf einer Bahn vorkommenden Defecten automatisch anzeigt.

"Neuer Oberbau in Pittsburgh" . . . . . [Seite 302.]

Beschreibung des durch die "Consolidated Traction Company" in Pittsburgh verwendeten Strassenbahn-Oberbaus, mit ausführlichem Verzeichniss für Schienen, Lagerplatten, Querstangen, u. s. w.

"Stromzuführungs-Kanalbau" . . . . . [Seite 303.]

Auszug aus dem Bericht des Ingenieurs der Elektrischen Kommission in Baltimore über die verschiedenen Methoden für den Bau der unterirdischen Stromzuführung, die verschiedenen Gattungen von gegenwärtigen Kanäle, und der besten Einrichtungen für Kanallüftung.

"Schienenstösse" . . . . . [Seite 303.]

Erörterung von Alfred Birk, in Wien, der besten Verfahren für die Befestigung von Schienenstössen.

"Strassenbahnen des Staats Illinois" . . . Seite 306.]

Ausführlicher Aufsatz mit Auszüge aus verschiedenen kürzlich durch Strassenbahn Gesellschaften in Chicago veröffentlichten Flugschriften, welche die Vortheile der elektrischen Strassenbahnen für die Entwickelung von Ortschaften beschreiben, und die für Chicago beabsichtigten Aenderungen in den Konzessionen erörtern. In demselben Artikel werden auch Konzessionen in zwei oder drei anderen amerikanischen Städten besprochen, welche öfters durch

die Vertheidiger von niedrigen Fahrpreisen oder höheren Steuern als Beispiel angeführt werden.

"Vergleich der amerikanischen und europäischen Betriebsverhältnisse" . . . . . [Seite 309.]

Uebersicht, durch einen hervorragenden Strassenbahn-Direktor, der Konzessions-Verhältnisse unter welchen der Betrieb europäischer und amerikanischer Strassenbahn-Gesellschaften stattfindet, und der Wirkung eines einförmigen Fahrpreises auf die Entwickelung einer Stadt, in Vergleich mit den in Europa üblichen Stufenpreisen.

"Elektrische Eisenbahnen in der Argentinischen Republik" [Seite 311.]

Wissenschaft. — Baukunst. — Erfindungen.

"Leitungsregister für Motorwagen" . . . . [Seite 312.]

Beschreibung einer neuen und billigen Methode um ein Verzeichniss des maximal Stromverbrauchs für jeden einzelnen Wagen eines Systems zu erzielen.

"Verfahren für das feste Aufhängen von Arbeitsleitungen." [Seite 312.]

Beschreibung eines neuen geschützten Arbeitsleitungs-Aufhängers, welcher unter niedrigen Brücken, Hochbahnen oder sonstigen Stellen verwendet wird, wo die Befestigung des Drahtes besonders stark sein muss.

"Selbstthätige Schmierung für Dampfmaschinen" [Seite 313.]

Beschreibung eines Verfahrens für die Schmierung von Dampfmaschinen.

"Neuer selbstthätiger Schaltapparat" - . . [Seite 313.]

Beschreibung eines Schaltapparetes welcher für Stromleitung von 100 bis 500 Ampèren verwendet wird.

"Rasche Umgestaltung eines Strassenbahnwagens" [Seite 314.]

Beschreibung eines Wagens, welcher in kurzer Zeit von den Winterbetrieb zum Sommerbetrieb umgestaltet werden kann.

"Automatischer Bremsenhebel" . . . . . [Seite 314.]

Beschreibung eines neuen Bremsensperrhebels.

"Variety Holzmaschine" . . . . . [Seite 314].

Beschreibung einer Maschine zur Verfertigung von Trambahnwagen, durch welcher das Holz in den verschiedensten Arten bearbeitet werden kann.

"Neuer elektrischer Motor" . . . . . [Seite 315.]

Beschreibung einer neuen Gattung von Stahlmotoren, welche eine Anzahl von Neuerungen einbegreifen.

"Neues geschmeidiges gusseisernes Zahnrad" . [Seite 315.]

"Magnetischer Blitzableiter" . - . . [Seite 316.]

"Luftdruckmotor für Hochbahnen" . . . [Seite 316.]

Beschreibung eines auf der New Yorker Hochbahn einzuführenden Motores.

"Kupplung für Vorort-Bahnen" - - - - [Seite 316.]

Beschreibung einer selbstthätigen Kupplungs-Einrichtung, welche für schweren elektrischen Strassenbahn-Betrieb in bedeutender Verwendung getreten ist, und sich durch mehrere speziellen Einzelheiten kennzeichnet.

Mittheilungen über Strassenbahnen.

"Luftdruck Motoren in Washington" . . . [Seite 317.]

"Schwerer elektrischer Eisenbahnbetrieb" . . [Seite 318]

Kurze Besprechung der Pläne für die elektrische Ausrüstung zweier bedeutenden Dampfeisenbahnen.

"Mittheilungen von England" . . . . . [Seite 319.]

Finanz.

"Finanzieller Bericht der General Electric Company" [Seite 326.]

"Finanzieller Bericht der 'Twin Cities' elektrischen Strassenbahn-Gesellschaft" . . . . . [Seite 328.]

Table des Matières—Mai 1897.

Le système de la compagnie du chemin de fer Canal & Claiborne. [Page. 265.]

Description d'un système électrique récemment mis en service dans les rues de la Nouvelle-Orléans, et représentant un type supérieur de construction moderne de tramway électrique. Les conditions spéciales qui règnent dans cette ville, particulièrement son terrain marécageux, donnèrent lieu à un certain nombre d'innovations. Pour la construction de la voie, il est fait usage de rails à gorge en sections de 19 mètres de long, pesant 37 kilogrammes par mètre courant. Les traverses sont posées sur 10 centimètres de ballast, reposant sur une fondation de planches de cyprès de 2½ centimètres. Sur une partie du système, passant par des rues desservies par d'autres compagnies, il est fait usage d'une construction aérienne composée de 10 fils de contact. Cette disposition nécessita l'emploi d'un certain nombre de croisements aériens spéciaux. Les voitures ont une longueur totale de 9 mètres; elles sont montées sur des trucks simples, et construites d'après un système à passage central et fenêtres basses qui les rend propres au service d'hiver et d'été indifféremment. Il est donné une description minutieuse de la station centrale, dont la fondation donna lieu à un problème important. Des machines compound tandem Corliss à condenseurs, directement accouplées à des génératrices de 300 kilowatts sont employées. La tubulure est faite en double, et se distingue par plusieurs points de la méthode habituelle.

Service.

Les résultats financiers de la traction électrique et à câble aux Etats-Unis. 2ème. partie. Service de banlieue et interurbain dans l'Etat de Massachusetts . . . . [Page 281.]

Ce deuxième article de la série d'études commencée dans le numéro d'Avril présente des données très intéressantes indiquant l'augmentation considérable dans les recettes brutes et nettes des tramways de l'un des états les plus peuplés de l'Union, pendant les dix dernières années, dont les cinq dernières ont vu la transformation de la traction animale en traction électrique sur la grande généralité des lignes. Il est aussi démontré à l'aide de statistiques, que l'habitude de se servir des tramways s'est très fortement répandue en proportion de la population, L'influence des nouvelles lignes reliant les localités entre elles sur la répartition de la population dans ces centres est clairement démontrée dans cet article, qui ne saurait manquer d'intéresser toutes les directions se proposant de substituer l'électricité à la traction animale sur leurs lignes.

Controverse au sujet de certaines stations centrales à Chicago. [Page 285.]

Cet article est consacré à une critique faite par les chefs d'une notable maison de construction au sujet de deux stations centrales importantes à Chicago, ainsi qu'à une réplique des ingéneurs qui les avaient construites. Ce débat met en relief les côtés les plus prononcés du système américain de construction de stations centrales, et présente le plus grand intérêt pour les ingénieurs de tramways.

Séance de l'Institut International des Tramways . [Page 288.]

Dépréciation . . . . . [Page 288.]

Cet article discute le montant de l'amortissement à appliquer pour la dépréciation du matériel roulant.

Parcs exploités par des compagnies de tramways, III. [Page 289.]

Ceci est la troisième partie d'un article sur les parcs exploités par des compagnies de tramways. L'auteur y passe en revue les dépenses d'exploitation des différentes propriétés, les revenues devant résulter de la cession de certains priviléges, et l'essor donné au mouvement des affaires par les parcs.

Sablage de voie à Albany . . . . . [Page 292.]

Lettres et Communications Diverses.

Appareil de sûreté pour trôlet, par W. Sonneberg, de la "Union Traction Company," Philadelphia . . [Page 293.]

Description d'un nouveau procédé pour éviter des avaries lors de l'interrupcion du contact entre la perche et le trôlet.

Club des employés de tramways à San Francisco . [Page 293.]

Coût de la force motrice électrique sur une petite ligne de tramway. [Page 294.]

Fils de fer de garde employés dans le service téléphonique. [Page 294.]

Cet article décrit la méthode employée par la principal compagnie de tramways à Brooklyn, en se servant de fils de fer de garde placés au-dessus du trolley pour transmettre le courant téléphonique.

Comptabilité des ateliers de réparation. . . . . [Page 295.]

Description d'une méthode employée à Paterson, N. J., afin de déterminer rapidement la main-d'œuvre employée par le personnel d'un atelier de réparation pour chaque voiture et sur tous les appareils employés par la compagnie.

Contrôle des accidents et des voitures à la Nouvelle Orléans. [Page 295.]

Cet article décrit la manière de tenir un contrôle des mouvements des employés de tramways, en usage sur la ligne de la New Orleans Traction Co., et donne le modèle d'un bulletin employé par les conducteurs en rendant compte des accidents.

Jurisprudence. . . . . . (Page 296.)

Articles de Fond.

Le système de la compagnie de tramways "Canal & Claiborne." [Page 298.]

Exploitation du système à caniveaux à New York . [Page 298.]

Les tramways contre les municipalités . . . [Page 299.]

Cet article répond aux réclamations soulevées dans certaines villes des Etats-Unis, demandant une réduction du prix des places dans les tramways ou une augmentation des impôts à percevoir par la municipalité.

Construction.

Chariot de voie du Chicago City Railway. . . [Page 301.]

Description d'un chariot qui enregistre automatiquement toutes les jointures de rails défectueuses, élargissements de voie, et autres imperfections qui peuvent se produire dans la construction d'une voie.

Nouvelle méthode de construction de voie à Pittsburgh. [Page 302.]

Description d'une nouvelle construction de voie adoptée récemment par la "Consolidated Traction Company" de Pittsburgh, et accompagnée de détails du cahier des charges en ce qui concerne les rails, éclisses, traverses, etc.

Méthode de construction de caniveaux. . . . . [Page 303.]

Extrait d'un rapport présenté par l'ingénieur de la Commission d'Electricité de Baltimore, relatif aux meilleurs systèmes de construction des caniveaux, aux différentes manières de placer les "feeders," et aux meilleurs moyens d'obtenir une bonne ventilation des caniveaux.

Joints de rails . . . . . [Pag. 303.]

Revue des meilleures méthodes de jointure de rails, par Alfred Birk, à Vienne.

Tramways de l'Illinois. . . . . . [Page 306.]

Cet article reproduit des extraits de brochures publiées dernièrement par les companies de tramways à Chicago, dans lesquelles sont décrits les avantages matériels produits par l'etablissement de tramways électriques sur le développement des municipalités. Il est aussi question dans le même article des nouvelles concessions à accorder à d'autres lignes de tramways dans Chicago. Le même article entre dans des détails sur les concessions accordées dans trois ou quatre autre villes aux Etats Unis, fréquemment citées par les partisans de prix réduits et de taxes élevées comme exemple à suivre.

Conditions d'exploitation en Europe et en Amérique. [Page 309.]

Aperçu, par le directeur d'une ligne importante de tramways, des conditions imposées en Europe et en Amérique pour l'exploitation des tramways, et de l'effet d'un tarif uniforme sur le développement d'une ville en comparaison avec le systéme d'échelonnement employé en Europe.

Chemins de fer électriques dans la République Argentine. [Page 311.]

Science — Génie — Inventions.

Indicateur de courant pour voitures automotrices. . [Page 312.]

Description d'une méthode nouvelle et économique pour tenir compte de la dépense maximum de courant par chaque voiture du réseau.

Attachement de fils de trôlet pour la rigidité du soutien. [Page 312.]

Description d'un nouveau genre d'attachement de fil de trôlet à protection, employé sous des ponts à voûte basse, sous les chemins de fer aériens, et en d'autres endroits oú il est nécessaire que le fil soit soutenu rigidement.

Graissage automatique des machines à vapeur . [Page 313.]

Description d'un système de graissage de machines à vapeur.

Nouveau coupe-circuit automatique . . . . [Page 313.]

Description d'un nouvel appareil employé pour des prises de courant de 100 à 500 ampères.

Voiture à transformation rapide . . . . [Page 314.]

Description d'une voiture de tramway qui peut être transformée rapidement du service d'hiver au service d'été et vice-versà.

Levier de frein automatique. . . . . . [Page 314.]

Description d'un nouveau genre de levier de frein à serrage.

Machine "Variety" pour la construction des voitures. [Page 314.]

Description d'une machine employée pour la construction des voitures de tramways, à l'aide de laquelle on peut façonner le bois de diverses manières.

Nouveau moteur électrique. . . . . . [Page 315.]

Description d'un nouveau type de moteur en acier, se distinguant par un certain nombre de perfectionnements.

Roue dentée en fer malléable . . . . . [Page 315.]

Parafoudre magnétique . . . . . [Page 316.]

Moteur à air comprimé pour chemins de fer aériens . [Page 316.]

Description d'un nouveau moteur qui doit être installé à New York.

Accouplement pour tramways de banlieue. . . [Page 316.]

Description d'un accouplement automatique dont l'emploi s'est fortement répandu sur les lignes de tramways électriques à service exceptionnel, et qui se distingue par plusieurs particularités spéciales.

Faits Divers.

Moteur à air comprimé à Washington . . . [Page 317.]

Chemins de fer électriques à grand service . . [Page 318]

Court aperçu des plans pour l'équipement électrique de deux grandes lignes de chemin de fer à vapeur.

Notes d'Angleterre. . . . . . [Page 319.]

Finance.

Rapport financier de la "General Electric Company." [Page 326.]

Rapport financier de la "Twin Cities Rapid Transit Company." [Page 328.]

Lista de Materias—Mayo 1897.

El sistema de la "Canal & Claiborne Railroad Company." [Pág. 265.]

Descripción de un sistema eléctrico recientemente abierto á la explotación á Nueva Orleans, el cual representa un tipo superior de construcción moderna de tranvías eléctricos. Las condiciones especiales de la ciudad, particularmente su terreno pantanoso, exigiren varias nuevas disposiciones de construcción. La vía está compuesta de carriles de 152 mm., de 37 kilógramas de peso, y 19 metros de longitud. Las traviesas van asentadas sobre 100 mm. de lastre, con una fundación de planchas de cipres de 0.025 mm. de espesor. En una parte del sistema que está paralel con las vías de otras compañías de ferrocarriles, se hace uso de una construcción aérea, con 10 alambres de *trolley*. Esta disposición necesita el empleo de numerosos cruzamientos aéreos. Los carruajes miden 9 metros de longitud, son montados sobre carretones simples, y construidos con pasajes centrales y ventanas bajas, para ambos servicios de estío é invierno. Se empléan máquinas compound Corliss á condensación juntadas directamente con generadores de 300 kilowatts. La tubería está hecha en doble, y se diferencia en varios puntos del sistema ordinario.

Operacion.

Resultados financieros de la tracción eléctrica y de cable en los Estados Unidos. II, Servicio suburbano é interurbano. [Pág. 281,]

En este articulo son presentados algunas cifras muy interesantes, ilustrando el aumento considerable de las recetas en bruto y netas de las lineas de tranvias en uno de los Estados más poblados de la Unión, durante los dies últimos años, y particularmente desde los cinco años pasados, cuando la tracción animal fué reemplazada por la tracción eléctrica sobre casi todas las lineas del sistema. Está ilustrado también el aumento extraordinario de pasajeros sobre los

tranvias por tablas estadisticas. La influencia de los tranvias interurbanos sobre la distribución de las poblaciones está claramente demostrada, y el articulo está muy interesante para los directores de compañias que inclinan al cambio de la tracción animal en sistema eléctrico.

Controversia sobre el sujeto de estaciones de fuerza motriz á Chicago. [Pág. 285.]

En este articulo parece una critica por una firma notable de ingenieros sobre dos estaciones importantes de fuerza motriz á Chicago, asi como una contestación á esta critica por los ingenieros que habian construido las estaciones. El argumento está ilustrativo de los puntos salientes en el método américano de construcción de estaciones de fuerza motriz, y más precioso para ingenieros.

Desestimación . . . . . [Pág. 288.]

Discusion de los importes que hay necesidad de aplicar para desestimación.

Convención del Instituto Internacional de Tranvias. [Pág. 288.]

Parques administrados por compañías de tranvías, III. [Pág. 289.]

Continuación de un artículo sobre parques manejados por compañías de tranvías, dos partes de cuyo han todavía sido publicadas. Los gastos de operación de las varias propiedades, el resultado que se espera del arrento de ciertos privilegios, y el aumento causado al tráfico por los parques son discurridos.

Enarenación de vias en Albany. . . . . [Pág. 292.]

Varias Comunicaciones.

Aparato de protección para trolley, por W. Sonneberg, de la "Union Traction Company," de Philadelphia . . . [Pág. 293.]

Descripción de un aparato para evitar disturbios cuando el contacto entre la pértiga y el "trolley" está suprimido.

Club de empleados de tranvias á San Francisco . [Pág. 293.]

Costo de la fuerza motriz eléctrica sobre una pequeña linea de tranvias . . . . . [Pá. 294.]

Ascensor de carruajes conveniente. . . . [Pág. 294.]

Descripción de un ascensor de cochera de carruajes, que funcióna á Cleveland con resultados excelentes.

Alambres de guardia para servicio telefónico . . [Pág. 294.]

Descripción de un método empleado por la principal compañía de tranvias en Brooklyn, sirviéndose de alambres de guardia sobre los "trolleys" para la transmisión de la corriente telefónica.

Cuentas de talleres de reparación . . . . [Pág. 295.]

Método empleado por una maquinista en Paterson, N. J., para determinar facilmente el labor consumido en los obradores para cada carruaje y por cada máquina.

Cuentas de Casualidades sobre los Tranvias en New Orleans. [Pág. 295.]

Descripción de un método para tener cuenta de la conducta del personal de tranvías, empleado por la "New Orleans Traction Co.," con reproducción de un buletin empleado por los conductores para referir casualidades.

Jurisprudencia. . . . . . (Pág. 296.)

Articulos de la Redaccion.

El sistema de la compañia de tranvias "Canal & Claiborne." [Pág. 298.]

Operación del tranvia subterráneo á Nueva York . [Pág. 298.]

Tranvias contra municipalidades . . . . Pág. 299.]

Eso es una contestación á los argumentos hechos en ciertas cindades de los Estados Unidos en favor de una reducción de precio de pasaje ó de un aumento del impuesto.

Construcción.

Carruaje indicador de vía del "Chicago City Railway." [Pág. 301.]

Descripción de un carruaje para registrar automáticamente los empalmes imperfectos, la estención de los carriles, y otros defectos que pueden occurrir en una construcción de vía.

Nueva construcción de vía á Pittsburgh. . . . [Pág. 302.]

Descripción de la construcción de vía adoptada por la "Consolidated Traction Company" de Pittsburgh, con presupuestos para los carriles, eclisas, travesaños, etc.

Construcción de Cañerías . . . . . [Pág. 303.]

Compendio de una relación presentada por el ingeniero de la Comisión Eléctrica de Baltimore sobre los varios métodos para colocar "feeders" subterráneos, los varios tipos ya en el mercado, y los mejores métodos para establecer una ventilación adecuada de las cañerías.

Juntos de carriles . . . . . [Pág. 303.]

Revista de los mejores métodos de juntadura de carriles, por Alfred Birk, Viena.

Tranvías en Illinois. . . . . . [Pág. 306.]

En este artículo son dados compendios de folletos recientemente publicados por compañías de tranvías á Chicago, describiendo las ventajas de tranvías eléctricos para el progreso de municipalidades, y refiriendo á los cambios de privilegios propuestos á Chicago. Son detallados también unos privilegios en dos ó tres ciudades en los Estados Unidos, frecuentemente citados por abogados de precios más bajos ó de impuestos más elevados como ejemplos á seguir.

Condiciones de la explotación de tranvías en Europa y en América. [Pág. 309.]

Revista, por el director de una prominente compañia de tranvias, de las condiciones expresadas para la concesión de tranvias en Europa y en América, y del efecto sobre el progreso de una ciudad de un precio uniforme, en comparación con precios graduados.

Ferrocarriles eléctricos de la República Argentina . [Pág. 311.]

Ciencia. — Ingenieria. — Invenciones.

Método nuevo para medir la corriente de motores. . [Pág. 312.]

Descripción de un método nuevo y barato para medir la cantidad máxima de corriente empleada por cada carruaje de una línea.

Apoyos de alambres de "Trolley" para soporto firme. [Pág. 312.]

Descripción de un nuevo tipo de apoyo de "trolley" protegido, para uso soto puentes bajos, ferro-carriles aéreos ú otros lugares, donde es necesario que el soporte sea firme.

Grasaje automatico de máquinas de vapor . . [Pág. 313.]

Nuevo corta-circuito automatico . . . . [Pág. 313.]

Empleado con corrientes de entre 100 y 500 amperes.

Carruaje para doble servicio . . . . . [Pág. 314.]

Descripción de un carruaje de tranvia que puede ser transformado en breve tiempo del servicio de invierno en servicio de estio.

Asa de freno automatico . . . . . [Pág. 314.]

Descripción de un nuevo tipo de asa de freno.

Máquina "Variety" para obrar Madera . . [Pág. 314.]

Descripción de una máquina para fabricar carruajes, que puede obrar madera en varios modos.

Nueva rueda dentada de hierro maleable . . [Pág. 315.]

Nuevo motor eléctrico . . . . . [Pág. 315.]

Descripción de un nuevo tipo de motor de acero, con numerosos mejoramientos.

Pararayo magnetico . . . . . [Pág. 316.]

Motor de aire comprimido para ferocarriles aéreos . [Pág. 316.]

Descripción de un nuevo tipo de motor á instalar sobre los ferrocarriles aéreos en Nueva York.

Enlace para tranvias interurbanos. . . . . [Pág. 316.]

Descripción de un enlace automático que está muy empleado para el servicio pesado de tranvías eléctricos, y posee varias disposiciones especiales.

Novedades.

Motores á aire comprimido en Washington . . [Pág. 317.]

Servicio pesado de ferrocarril eléctrico . . . [Pág. 318.]

Breve descripción de los planos para la instalación eléctrica de dos lineas importantes de ferrocarriles de vapor.

Notas de Inglaterra. . . . . . [Pág. 319.]

Financia.

Relación financiera de la "General Electric Company." [Pág. 326.]

Relación financiera de la "Twin Cities Electric Railway Company." [Pág. 328.]

Financial Notes.

Baltimore, Md.—The call for proxies from stockholders of the City & Suburban Railway and the Traction Company, is being largely responded to. It was reported in financial circles on Apr. 20 that the basis of consolidation would provide that the capital stock of the consolidated lines should be $9,000,000.

NEGOTIATIONS are in progress for the consolidation of the Baltimore Traction Company and the City & Suburban Railway Company. It is rumored that the terms of consolidation, agreeable to both parties, are that $4,000,000 of City & Suburban stock shall be rated at $4,750,000, so as to equalize it with the $5,750,000 of Baltimore Traction stock. President Perin, of the City & Suburban, is to be the president of the consolidated company and President House of the Baltimore Traction is to be genral manager.

Birmingham, Ala.—Phil Campbell has been appointed receiver of the Highland Avenue & Belt Railroad Company.

UPON motion of the Columbian Equipment Company, of New York, Judge Bruce, in the Federal Court, has decided to appoint a receiver for the Highland Avenue & Belt Railroad Company.

Birmingham, Mich.—The Birmingham Railway & Electric Company since its organization in May 1, 1890, as a consolidation of the Birmingham Union Railway, which was composed of the city horse lines and the East Lake dummy line, the Ensley Railway, a dummy line from Birmingham to Ensley, and the Bessemer & Birmingham Railroad has proved to be a very enterprising and staunch company. At the time of its incorporation there were about 42 miles of track operated by horses and steam. Extensions have been made from time to time, and at present the mileage is about 55, including double track and sidings. In October, 1892, the horse lines were electrically equipped, and this important event was hailed as the beginning of a new era for Birmingham and it so proved to be, for a substantial growth has ever since been enjoyed by the city. The Ensley and Bessemer lines are still operated by steam, but it is expected to have electricity on the Ensley line by the coming fall. The company owns fifteen locomotives, thirty-eight steam passenger coaches, and six freight cars, and forty-five electric motor cars. Its annual business shows a haulage of 5,000,000 passengers and 200,000 tons of freight. The officers of the company are: president, A. M. Shook, of Nashville; first vice-president, Robert Jemison; second vice-president, William A. Walker; secretary and treasurer, J. A. Stratton, and general manager, J. B. McClary.

Brockton, Mass.—The Brockton, Bridgewater & Taunton Street Railway Company has applied to the State Railroad Commissioners for permission to issue $100,000 new capital stock. The company will also issue bonds to the same amount.

Buffalo, N. Y.—The stockholders of the Buffalo Traction Company have assented to a lien for $5,000,000 to the Central Trust Company, at $50,000 per mile of track constructed. Forty year 5 per cents. will be issued.

Burlington, Ia.—The property of the Burlington Electric Railway Company, has been sold at public auction to a Boston company for $50,000. The lines will be improved by the expenditure of $100,000 this season.

Canandaigua, N. Y.—A company of Buffalo men is negotiating for the purchase of the system of the Canandaigua Electric Light & Railroad Company. If successful the road will be extended by the new owners in Canandaigua and to Manchester.

Charleston, S. C.—At a recent meeting of the stockholders of the Charleston Street Railway Company, it was voted to issue coupon bonds to the amount of $850,000, and to increase the capital stock of the company to that amount. Application will be made to the Secretary of State for an amendment of the company's charter, authorizing the increase of the capital stock.

Chicago, Ill.—The directors of the North Chicago Street Railroad Company have declared the usual dividend of 3 per cent on the stock.

NEGOTIATIONS are in progress for the consolidation of the North Chicago and West Chicago Street Railroad Companies and their allied roads by a legislative provision now pending.

RECEIVER MCKEAN of the defunct National Bank of Illinois is now in control of the Calumet Electric Street Railway. The indebtedness of the road, indorsed by Farson, Leach & Company to the bank, and secured by nearly all the stocks and bonds of

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the road, has been adjudicated to the receiver by a decree of Judge Showalter in the Federal Court. The receiver is to furnish all the money needed to keep the road in operation and to develop and keep the roadway in repairs, and to charge 6 per cent interest thereon.

Cleveland, O.—The Cleveland City Railway Company has declared a dividend of ¾ of 1 per cent.

Columbus, O.—The directors of the Columbus Street Railway Company have declared a dividend of 1 per cent payable May 1.

Corning, N. Y.—The Savona Valley & Lake Keuka Electric Railroad Company has been organized and the following officers elected: president, Charles A. Cockroft, of Binghamton; vice-president, C. C. Covert, of Binghamton; secretary and treasurer, C. A. Brown, of Binghamton; general manager, James D. Nares, of Corning. Incorporation articles have been applied for. The company projects a line from Savona to Bradford, Wayne and Keuka Landing where it will cross the lake via a ferry system to Gibson and Pultney. The road will be completed by Sept. 1, in time for the grape traffic and will cost about $200,000 to construct and equip. The specifications have all been made, and all contracts will be closed by May 1. The ties for the road will come from Michigan. The power house will be located at Bradford and will cost about $30,000. Water power will be used nine months of the year and steam the balance. The road will be 18 miles in length excluding the 2 miles of ferrying system. The civil engineers have completed the surveys and the whole of the right of way has been secured. The road will be used as much for the transportation of grapes and other fruit as for passengers.

Duluth, Minn.—The Minnesota Point Street Railway, which is a horse line operated during the summer, has made an assignment to Paul Sharvy. The assignment states that the company is unable to pay a note held by Charles A. Pettingell, amounting to $6,700. The assignee will probably operate the road this summer.

Fairhaven, Wash.—The Fairhaven & New Whatcom Railway Company's property has been sold at auction for $75,000 to S. Z. Mitchell, of Portland, acting as agent for the General Electric Company. The debt for which the property was sold were mortgage bonds amounting to $380,485.

Glens Falls, N. Y.—At the regular quarterly meeting of the Glen Falls, Sandy Hill & Fort Edward Street Railroad Company held recently, the usual quarterly dividend of 1¼ per cent was declared.

Hamburg, N. Y.—The Hamburg Railway Company, which is constructing an electric railway from Buffalo to Hamburg, Woodlawn Beach and Blasdell, a distance of 8 miles, has been granted permission to increase its capital stock from $10,000 to $50,000. The company's offices are in 601 Ellicott Square, Buffalo.

Hamilton, Ont.—W. McKenzie, president of the Toronto Railway Company, and B. B. Osler, president of the Hamilton & Dundas Railway Company, will apply to the Ontario Legislature for the incorporation of a company which shall have the authority to lease or purchase any property in the city of Hamilton operated under a franchise granted by the City Council. These men have acquired an option on the Hamilton Street Railway, the Hamilton & Dundas Railway and will offer to purchase the Hamilton Radial Electric Railway. The company will be known as the Hamilton Franchise Company.

Hudson, N. Y.—The Hudson Electric Railway Company has been incorporated with a capital of $50,000, to operate the road of the Hudson Electric Railway Company which was sold under foreclosure on Mar. 6 last. The directors are William H. Lamb, R. Rainey, Peoni S. Johnson, Robert W. Evans, William A. Harder, Jr., Smith Thompson, William M. Brownell and Charles S. Rogers, of Hudson, and John E. Gillette, of Catskill Station.

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See page 73.

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Jackson, Mich.—The Jackson Street Railway is about to be sold to a company of Eastern capitalists, represented by William A. Boland, of Boston, and Daniel F. Lewis, of New York. The new owners will probably extend the line to Vandercook's Lake in time for the summer traffic.

Kansas City, Mo.—The West Side Street Railway Company has filed a statement of increase of capital stock from $20,000 to $100,000.

La Crosse, Wis.—The La Crosse, Black River Falls & Neillsville Electric Railway Company is contemplating an issue of bonds for the completion of its lines.

Leominster, Mass.—Fuller, Harding & Company, brokers, of 60 Devonshire Street, Boston, offer for sale the new $150,000 loan of the Leominster & Clinton Street Railway Company, which is secured by first mortgage with interest at 5 per cent.

Massillon, O.—The opening up of new coal mines west of Massillon, and somewhat improved business conditions generally, have led to the preliminary organization of a street railway company, whose line is projected from Massillon to Dalton. The right of way has been obtained from property owners. The successful management on a co-operative basis of the Farmers' Telephone Company is what has given rise to the formation of this company. Every farmer along the road has agreed to take stock, and the grading and timber will all be furnished by the stockholders, so the only cash outlay will be for iron and rolling stock. A gasoline motor will probably be used, although it is possible that a contract may be made with the Light, Heat & Power Company for electricity.

McKeesport, Pa.—George Sheppard and other bondholders of the McKeesport, Duquesne & Wilmerding Railway Company have applied for the appointment of a receiver for the company. The company is bonded for $350,000, and it is alleged that the earnings have been misapplied in order to avoid paying interest.

Mobile, Ala.—The Mobile Light & Railway Company and the Spring Hill Railway Company have just been consolidated under the name of the Mobile Light & Railroad Company. The new company has secured a charter from the legislature extending its powers and it has already commenced the building of 4 miles of new track along Mobile Bay in order to connect the two lines. The power house is being equipped with two new surface condensers, an Edmiston's oil separator and a new heater. A new car barn has just been built at Monroe Park for motor cars. The dimensions are 70 ft. × 170 ft., with brick wall and steel truss roof. A shed for trailers, 60 ft. × 140 ft., is in process of construction.

Montreal, Can.—It has been decided to issue only $500,000 of new stock instead of $1,000,000, as authorized by the stockholders of the Montreal Street Railway Company.

THE Montreal & Southern Counties Railway Company is being organized to build electric railways to connect Montreal and the south shore with the counties of Chambly, Vercheres, Ronville, St.

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Durability; Brilliancy; Economy.
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ELECTRIC RAILWAY
Construction and Equipment.
PROJECTED RAILWAYS FINANCED.

Hyacinthe, Laprairie, Brown, Shefford, Stanstead, and Sherbrooke. From Montreal to Sherbrooke the main line and branches will form a system of 150 miles of track to be constructed on the most approved methods. Cars run as fast as 40 miles an hour. A. F. Corriveau, who is associated with a New York and Montreal company, is interested. The capital of the company is $2,000,000.

Nanticoke, Pa.—The People's Street Railway Company has issued $100,000 in bonds.

New Haven, Conn.—The New England Street Railway Company has declared a dividend of 1 per cent.

New York, N. Y.—The Thirty-fourth Street Crosstown Railway Company, leased to the Metropolitan Street Railway Company, has filed a mortgage for $1,000,000 to the Central Trust Company, of New York.

Another bid for the Sixth and Eighth Avenue street railway lines, now operated by the Metropolitan Street Railway Company, was made recently by Henry J. Braker, an importer, of 95 William Street. He offers to pay the city for the cost of the two roads and the 10 per cent additional which the city would have to pay the owners to get possession of them, and also the sum of $1,000,000 for the franchise of each road and 3 per cent of the gross receipts for five years and 5 per cent thereafter.

Norfolk, Va.—The Port Norfolk Electric Railway Company has been re-organized with its capital increased to $150,000.

Oshkosh, Wis.—The Citizens' Traction Company has filed a mortgage for $200,000 on all its property to the New York Security & Trust Company, to secure an issue of a like amount of bonds.

Paris, Tex.—John A. Porter has been appointed receiver of the Paris Railway Company on the application of the St. Louis Trust Company and the Farmers' & Merchants' Bank.

Peoria, Ill.—The Glen Oak & Prospect Heights Railway Company has filed a mortgage for $100,000 to the Royal Trust Company, of Chicago, to secure an issue of $100,000 six per cent bonds due 1901.

Pittsburgh, Pa.—The Pittsburgh Traction Company has declared a dividend of $1.50 per share on its preferred stock.

St. Louis, Mo.—The Southern Electric Railway Company has been reorganized with the following officers: president, Charles F. Orthwein; vice-president, C. H. Spencer; secretary, Joseph S. Minary; directors, Charles F. Orthwein, C. H. Spencer, Henry Nicolaus and H. I. Drummond.

By the sale of 6000 or more shares of preferred stock and 2000 shares of common stock, the control of the Southern Electric Railway Company has passed from the hands of Louisville (Ky.) men to Charles F. Orthwein, William J. Lemp and other St. Louis men. New officers will be elected.

Edwards Whitaker and Charles D. McClure representing the Lindell Railway Company have purchased a controlling interest in the Missouri Railroad Company. The change of ownership involved about $4,000,000 cash, and a part of this has been already deposited with the State Bank. Missouri Railroad stockholders received $165 a share for their securities.

Charles Green, receiver of the People's Railroad Company and the Fourth Street & Arsenal Railway Company, will petition the Court for an order to sell both roads. This is the outcome of the negotiations with Thomas C. Barr, E. J. Moore and F. W. Roebling. Unless present plans fail, they will buy in both roads, consolidate and extend them and operate them with electricity under the name of the People's Traction Company.

Torrington, Conn.—The stock of the Torrington & Winchester Street Railway Company has all been subscribed for, W. B. Fergerson, of Malden, Mass.; C. A. Richardson, of Worcester, Mass., and M. S. Myrick, of Boston, each taking 500 shares each thus completing the required amount.

TRADE MARK ALCATRAZ AA ASPHALT REG. U.S. PAT. OFF.

ALCATRAZ ASPHALT PAINTS
ALCATRAZ ASPHALT PIPE DIP
MANUFACTURED BY
THE CALIFORNIA ASPHALT CO. OF NEW YORK,
Are absolutely superior to anything now in the market for
STRUCTURAL IRON WORK, ELEVATORS,
POWER AND CAR-HOUSES,
DEPOTS, FREIGHT SHEDS,
ROOFING AND INSULATING PURPOSES.
Our productions are made from the celebrated brand of Alcatraz Asphalt, thoroughly ground in pure linseed oil, combining great strength and elasticity, and insure a perfect preservative against the action of the elements, acids, alkalis, etc. Our ALCATRAZ ASPHALT PIPE DIP is
AN IDEAL INSULATING COMPOUND,
preventing corrosion and decay of metal and wood.
Samples and full information cheerfully furnished upon application.
THE CALIFORNIA ASPHALT CO.,
No. 57 East 59th Street, New York.

Vacation Days.

In the Lake Regions of Wisconsin, Northern Michigan, Minnesota, Iowa and South Dakota, along the lines of the Chicago, Milwaukee & St. Paul Railway, are hundreds of charming localities pre-eminently fitted for summer homes, nearly all of which are located on or near lakes which have not been fished out. These resorts range in variety from the "full dress for dinner" to the flannel shirt costume for every meal. Among the list are names familiar to many of our readers as the perfection of Northern summer resorts. Nearly all of the Wisconsin points of interest are within a short distance from Chicago or Milwaukee, and none of them are so far away from the "busy marts of civilization" that they cannot be reached in a few hours of travel, by frequent trains, over the finest road in the Northwest—the Chicago, Milwaukee & St. Paul Railway. Send a two cent stamp for a copy of "Vacation Days" giving a description of the principal resorts, and a list of summer hotels and boarding houses, and rates for board, to Geo. H. Heafford, G. P. A., Chicago, Ill. ***

The Tonnage Plan.

The B. & O. Will Adopt It for Freight Service on May 1.

The Baltimore & Ohio Railroad Company has decided to inaugurate on May 1st the tonnage system for handling its freight trains. For the past eight or nine months General Manager Greene has been experimenting along this line, and has arrived at the conclusion that the cost of operation may be decreased, to some extent, by using this plan. It is not expected that a very great gain will be made, as the B. & O. for the past year has been loading very close to the limit. The unit system will be the basis for operation on the tonnage system, the unit of weight being 6½ tons. When cars are loaded or received from other lines, the number of units of weight it contains will be plainly marked on the side of the car so that the trainmen will have no difficulty in arriving at the proper number of units to place in the train. The use of the unit system renders it very easy for trainmen to figure on just how many tons they are handling, and does away with the use of five and six figures in addition.

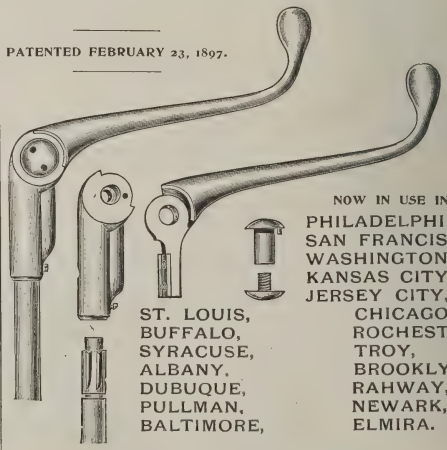
When the great improvements to the track between Martinsburg and Cumberland are completed, more cars to the train can be handled over the Second Division. It is expected that the gain over the entire system will be large enough to justify the adoption of the tonnage plan. ***

A Brand New Brake Handle.

A Ratchet and Trip Both Operative Without Springs.

No excuse for motorman removing his hand from the brake at any time.

PATENTED FEBRUARY 23, 1897.



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ST. LOUIS, BUFFALO, SYRACUSE, ALBANY, DUBUQUE, PULLMAN, BALTIMORE,

Our circular explains the operation.

Waldran Automatic Brake Handle Co.,
Chemical Building, St. Louis, Mo.

Street Railway Journal.

Vol. XIII. *NEW YORK AND CHICAGO, JUNE, 1897.* *No. 6.*

ELECTRIC RAILROADING ON THE NEW YORK, NEW HAVEN & HARTFORD SYSTEM.

BY N. H. HEFT.

So many inquiries have been addressed to me by steam and street railroad managers and engineers concerning the work of the Electrical Department of the New York, New Haven & Hartford Railroad Company, that I have decided to give in this form an outline of what we have been doing in the last three years. It is generally admitted, I believe, that President Clark and the board of directors of the New Haven system have been pioneers in this larger work of electric railroading, and so long ago as 1891, Mr. Clark was far-sighted enough to speak in no uncertain terms, in his annual report to the directors, about the probability that electricity would conquer larger fields than were then seriously considered, even by electrical enthusiasts. In the experiments made and the work done upon the New Haven system, we have tried to solve our own problems only, not those of all railroad systems, and while our experience will be valuable to other companies, it does not necessarily follow, of course, that they will come to our conclusions either broadly or as regards details.

POWER STATION AND TRAIN YARD AT BERLIN, CONN.

The New Haven system differs from every other important railroad property in the country, (*a*) in the immense volume of its passenger traffic, (*b*) in the large percentage of passenger to total revenue, (*c*) in the large percentage of local to total passenger revenue, (*d*) in the density of residential population in the territory served by its lines, and (*e*) in the smallness of that territory as compared with the mileage of the system. The company is carrying nearly 50,000,000 passengers per annum and is earning over $16,000,000 from its passenger department, while its passenger receipts amount to over 50 per cent of the receipts from all sources. The system provides regular transportation facilities for about 6,000,000 people, and the density of population in Massachusetts, Rhode Island and Connecticut, in which nearly all its mileage is located, is 250 inhabitants per square mile, a figure greater than that of any other state or section in the Union. The complicated network of the company's lines is shown by the map on page 331, and by the statement that in spite of the fact that it controls nearly 3000 miles of track, a passenger can travel from New York to Boston—practically the extreme distance limits of the system—in five hours time.

Within its territory are found two great cities with rich suburban residential areas tributary to their business centers, five other important cities with suburbs, and no less than sixty-three independent cities and towns of greater or less importance for manufacturing or residential reasons. A coast line, many hundred miles in length and rapidly filling up with beautiful summer homes and pleasure resorts, is dependent entirely upon the service given by the company.

It is evident from these statements that the passenger traffic conditions which the New Haven system has to meet are closely analagous, in many respects, to those which have been successfully dealt with by the multitude of suburban and interurban electric railways which have so thoroughly pre-empted the public highways of the Eastern and Middle States during the last three or four years. The principal differences lie in the ownership of the right of way, in the number of stopping points, in the possibilities of speed, in the weight of the moving units and in the time intervals between these units.

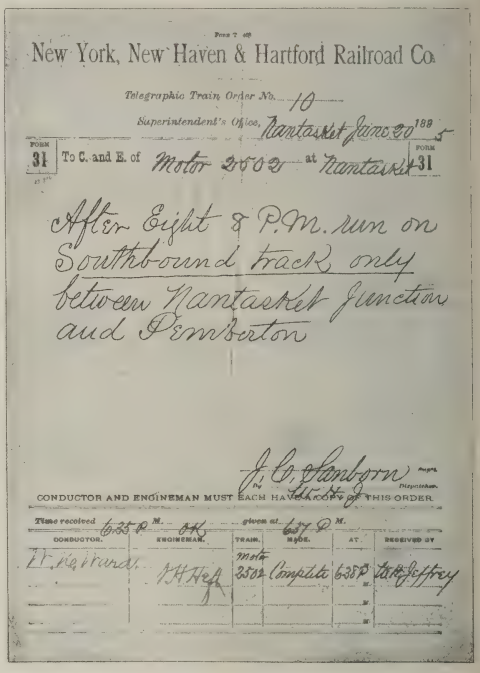
The building of these electric railway parallel lines in Massachusetts and Connecticut has imposed serious responsibilities upon the New Haven management—responsibilities to the public, and responsibilities to stockholders. If it is certain that the public can be better served by electricity than by steam, it is obviously the duty of the railroad company to change its motive power to meet the new conditions, and should the preferences of the public be made clearly evident by diversion of traffic, this public duty becomes a private necessity, if the interests of stockholders are to be protected. I do not propose to here discuss the question as to whether municipalities are, or are not justified in practically subsidizing electric railway systems by granting them the use of a roadbed constructed at state or city expense. Much can be said on both sides of this question, but irrespective of theoretical considerations, the practical fact that this is being done must certainly be recognized and steps taken accordingly.

Within a short time after the intimation given in President Clark's annual report of 1891 regarding possibilities of the future, the situation was met by him and by his directors with characteristic promptness. It was determined to establish an Electrical Department and to equip for operation by electricity, a 7 mile section of road running from Nantasket Junction to Pemberton along Nantasket Beach in the State of Massachusetts. This section was equipped with overhead conductors and put in operation in July 1895, and an additional 3½ miles of track was equipped with the third rail system and put in operation just one year later.

This Nantasket Beach line has been made the company's experimental ground and upon it has been developed a system of electric railroading which is in many respects, I believe, unique, and while far from being perfect, is yet sufficiently so to warrant the management in pressing ahead with its electrical equipment on a large scale and with a more than theoretical understanding of the limitations of different motive powers.

EXPERIMENTS AT NANTASKET BEACH.

From a large amount of engineering data and experimental results obtained in the operation of the Nantasket Beach line, I have selected certain curves, illustrated herewith (see inset between pages 336 and 337), showing


New York, New Haven & Hartford Railroad Co.

Telegraphic Train Order No. 10

Superintendent's Office, Nantasket June 30 1895

FORM 31 To C. and E. of Motor 2502 at Nantasket FORM 31

After Eight P.M. run on Southbound track only between Nantasket Junction and Pemberton

J. C. Hanborn Supt.

CONDUCTOR AND ENGINEMAN MUST EACH HAVE A COPY OF THIS ORDER.

Time received 6.35 P. M. ... given at 6.37 P. M.

CONDUCTOR.	ENGINEMAN.	TRAIN.	MDE.	AT.	RECEIVED BY
L.T. Railroad.	H.H. Hall	Motor 2502	Complete	6.38 P.M.	J.H. Jeffrey

FAC-SIMILE OF THE FIRST ELECTRIC TRAIN ORDER EVER ISSUED.

mental runs *A*, *B*, *C* and *D*. From them it will be seen that the greatest curvature on the line is 10 degs., and the steepest gradient 1.07 per cent, the road being very nearly level. The method of plotting the curves will be easily understood. The current, voltage and wattmeter readings were taken at five second intervals, and the speed was directly obtained from a continuous speed recorder.

These curves tell their own story, and I shall therefore refer briefly to two or three points only which are clearly brought out. The most interesting of all to the railroad engineer is the rapid rate of acceleration seen to be possible with electric motors—a rate exceeding anything found in steam locomotive practice, certainly with motors of the same power. The constant torque of electric motors is

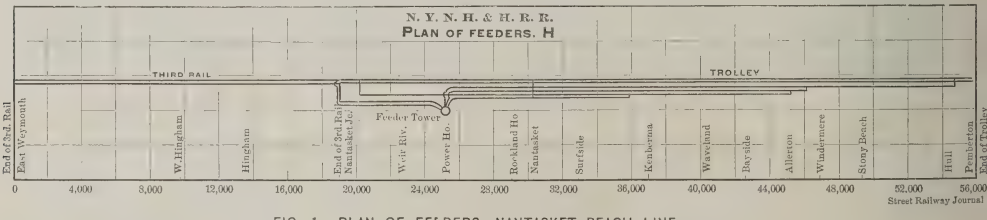
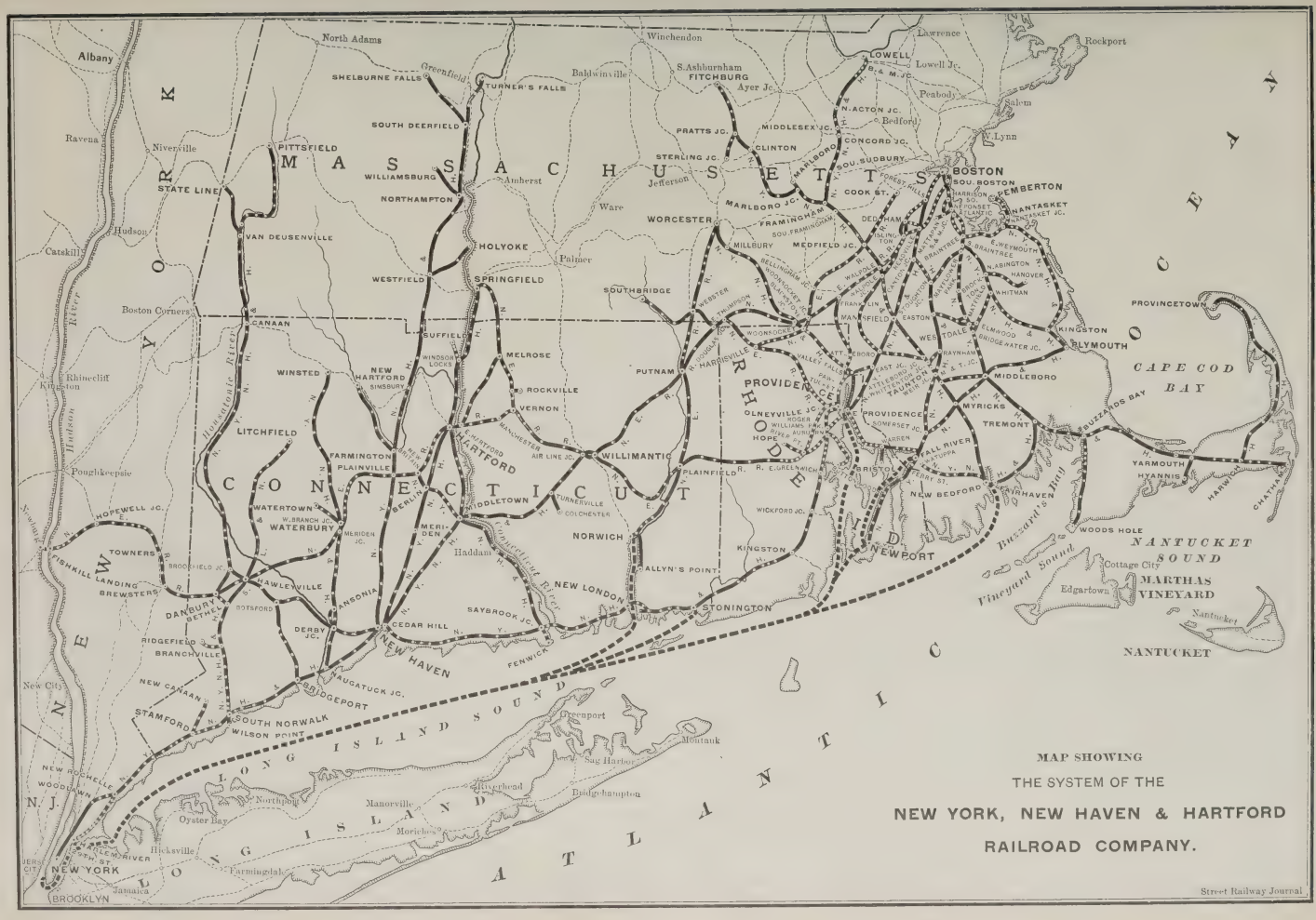


FIG. 1.—PLAN OF FEEDERS—NANTASKET BEACH LINE.

the speed and power consumption of trains on the Nantasket Beach line, and these will be, I think, of considerable interest to railroad managers and engineers who may not be thoroughly familiar with the possibilities of electricity in handling this larger work.

The tests of which these curves are a record were made in August and September, 1896. The plan and profile of the road are shown in each of the four experi-

undoubtedly responsible for this rapid acceleration rate, as well as for the ability of electric cars to mount steeper grades, or moderate grades at a higher speed, than can be done with locomotives. The latter are handicapped in a test of this kind by the varying power exertion of the reciprocating motion employed. The practical effect of this rapid acceleration in electric motor work is seen in curves *E* and *F*, which are the records of regular service runs on


MAP SHOWING
THE SYSTEM OF THE
NEW YORK, NEW HAVEN & HARTFORD
RAILROAD COMPANY.
Street Railway Journal.
NEW YORK
MASSACHUSETTS
CONNECTICUT
RHODE ISLAND
LONG ISLAND
LONG ISLAND SOUND
ATLANTIC OCEAN
CAPE COD BAY
NANTUCKET SOUND
Albany
North Adams
Winchendon
Lawrence
Rockport
Greenfield
Baldwinville
S. Ashburnham
FITCHBURG
Ayer Jc.
LOWELL
Lowell Jc.
B. & M. JC.
Peabody
Salem
Lynn
Bedford
N. ACTON JC.
CONCORD JC.
MIDDLESEX JC.
PRATTS JC.
STERLING JC.
CLINTON
MARLBORO JC.
SOU. SUDBURY
BOSTON
SOU. BOSTON
HARRISON SQ.
NEPONSET
ATLANTIC
PEMBERTON
NANTASKET
NANTASKET JC.
COOK ST. JC.
DEDHAM
FORREST HILLS
SHELBURNE FALLS
TURNER'S FALLS
SOUTH DEERFIELD
PITTSFIELD
WILLIAMSBURG
Amherst
Jefferson
Ware
NORTHAMPTON
WORCESTER
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SOU. FRAMINGHAM
MILLBURY
MEDFIELD JC.
Ravena
Niverville
STATE LINE
Hudson
Catskill
VAN DEUSENVILLE
HOLYOKE
Palmer
WESTFIELD
SPRINGFIELD
SOUTHBRIDGE
Boston Corners
CANAAN
SUFFIELD
WINDSOR LOCKS
MELROSE
NEW HARTFORD
SIMSBURY
WINSTED
ROCKVILLE
VERNON
PUTNAM
Rhinecliff
Kingston
LITCHFIELD
FARMINGTON
PLAINVILLE
HARTFORD
MANCHESTER
AIR LINE JC.
WILLIMANTIC
PLAINFIELD
Poughkeepsie
HOPEWELL JC.
TOWNERS
WATERTOWN
W. BRANCH JC.
WATERBURY
MERIDEN JC.
MERIDEN
MIDDLETOWN
TURNERVILLE
COLCHESTER
NORWICH
Haddam
KILLINGWORTH
Connecticut River
NEW LONDON
ALLYN'S POINT
STONINGTON
KINGSTON
WICKFORD JC.
NEWPORT
FISHKILL LANDING
BREWSTERS
DANBURY
BETHEL
ROTSFORD
HAWLEYVILLE
CARSONIA
DERBY JC.
CEDAR HILL
SAYBROOK JC.
FENWICH
NEW HAVEN
RIDGEFIELD
BRANCHVILLE
NEW CITY
NEW CANAAN
STAMFORD
NAUGATUCK JC.
BRIDGEPORT
SOUTH NORWALK
WILSON POINT
Greenport
Sag Harbor
Montauk
NEW ROCHELLE
WOODCHUCK
N. J.
Oyster Bay
Northport
Manorville
Riverhead
Bridgehampton
Hicksville
Moriches
NEW YORK
(BROOKLYN)
Jamaica
Farmingdale
WOONSOCKET
PAWTUCKET
PAWTUCKET JC.
VALLEY FALLS
CENTRAL FALLS
ATTLEBORO
ATTLEBORO JC.
TAUNTON
EAST JC.
NORTH DIGHTON
DIGHTON
BRISTOL
FALL RIVER
PRESTON
PROVIDENCE
OLNEYVILLE JC.
ROGER WILLIAMS PK.
REECE AVE.
HOPE
BARREN
SOMERSET JC.
MYRICKS
TREMONT
MIDDLEBORO
WEST TAUNTON
RAYNHAM
BRIDGEWATER JC.
ELMWOOD
WEST DUXBURY
KINGSTON
PLYMOUTH
PROVINCETOWN
HANOVER
WHITMAN
EASTON
MANSFIELD
FRANKLIN
WALPOLE
NORWOOD
NEPONSET
BRAINTREE
E. WEYMOUTH
N. ABINGTON
BELLINGHAM
WOONSOCKET JC.
HOPEDALE
MILFORD
WHITINSVILLE
DOUGLAS
WEBSTER
NEW BEDFORD
NEW BEDFORD HAVEN
ACUSHNET
WOODS HOLE
Buzzard's Bay
Vineyard Sound
Cottage City
MARTHAS VINEYARD
Edgartown
Nantucket
NANTUCKET
BUZZARDS BAY
YARMOUTH
HYANNIS
HARWICH
CHATHAM

the Nantasket Beach line. That a 64 ton train running over a road 10½ miles in length and making thirteen stops in that distance, should be able to reach a maximum speed of 37 miles per hour between stations, and an average speed for the run of 17 miles per hour is a fact, the significance of which will be at once apparent to railroad engineers.

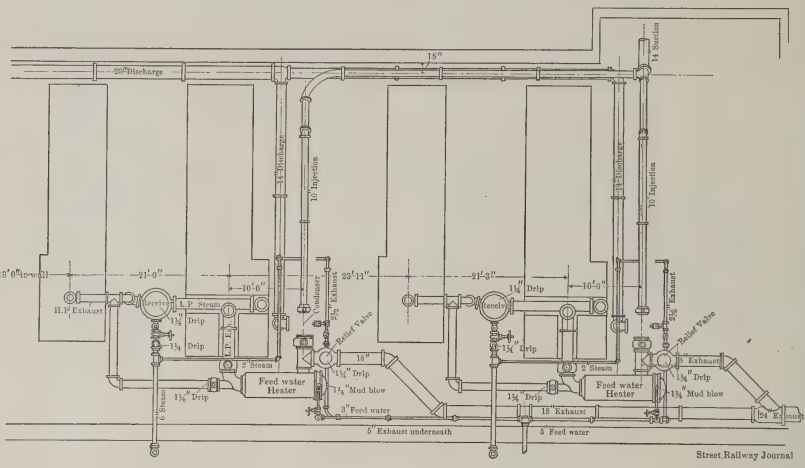


FIG. 2.—PLAN OF BASEMENT PIPING—BERLIN POWER STATION.

In order to bring out more clearly this feature of rapid acceleration there are shown in curves *G* the speed, the distance covered and the power consumption of a 60 ton train during the first 50 seconds run from a dead rest, the curves being plotted from 1 second readings. It will be seen that in the first 10 seconds the train reached a speed of 7.3 miles per hour, covered a distance of 50 ft. and consumed about 300 watt hours. At the end of 30 seconds the train attained a speed of 18.4 miles per hour, covered a distance of 460 ft. and consumed 1200 watt hours. In 50 seconds the train was running 22.5 miles per hour, it had covered a distance of 1125 ft. and had consumed 1900 watt hours. At this point the speed and power curves began to approach a horizontal, showing that the principal part of the acceleration took place in the first minute of the run.

Another interesting point shown by the curves is that bearing on the relative economy of different methods of handling the controller. Curves *A* and *B*, are both records of a single motor car running without stop over the entire line, for experimental purposes only. The run shown by curve *A*, was made in three minutes thirty seconds less time than that of curve *B*, and the maximum speed was 57½ miles per hour, as against 36 miles per hour in the longer run. Nevertheless but 26,000 watt hours were consumed in the high speed run as against 32,900 in the low speed run. These two tests illustrate what we have found to be generally true, namely, that when the current is turned on quickly and used generously in moving the car, the economy in power consumption is greater than when the rate of acceleration is less rapid. It is of course true, however, that power consumption alone is not a right test of commercial efficiency since repairs of apparatus due to overloads of current may wipe out any moderate savings in fuel. As a matter of practice, a medium course in the use of current has been found best by us and motormen are instructed to wait until the power has responded to each service notch of the controller before passing to the next.

That the Nantasket Beach line is not a purely experimental one may be seen from the fact that in the 3½ summer months of 1896, over 6000 revenue earning train miles were made over the line and about 700,000 passengers were carried.

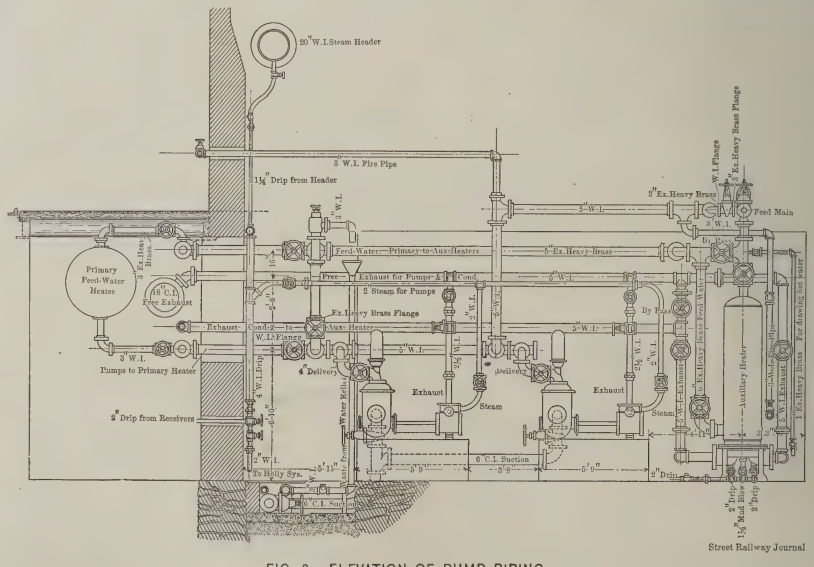
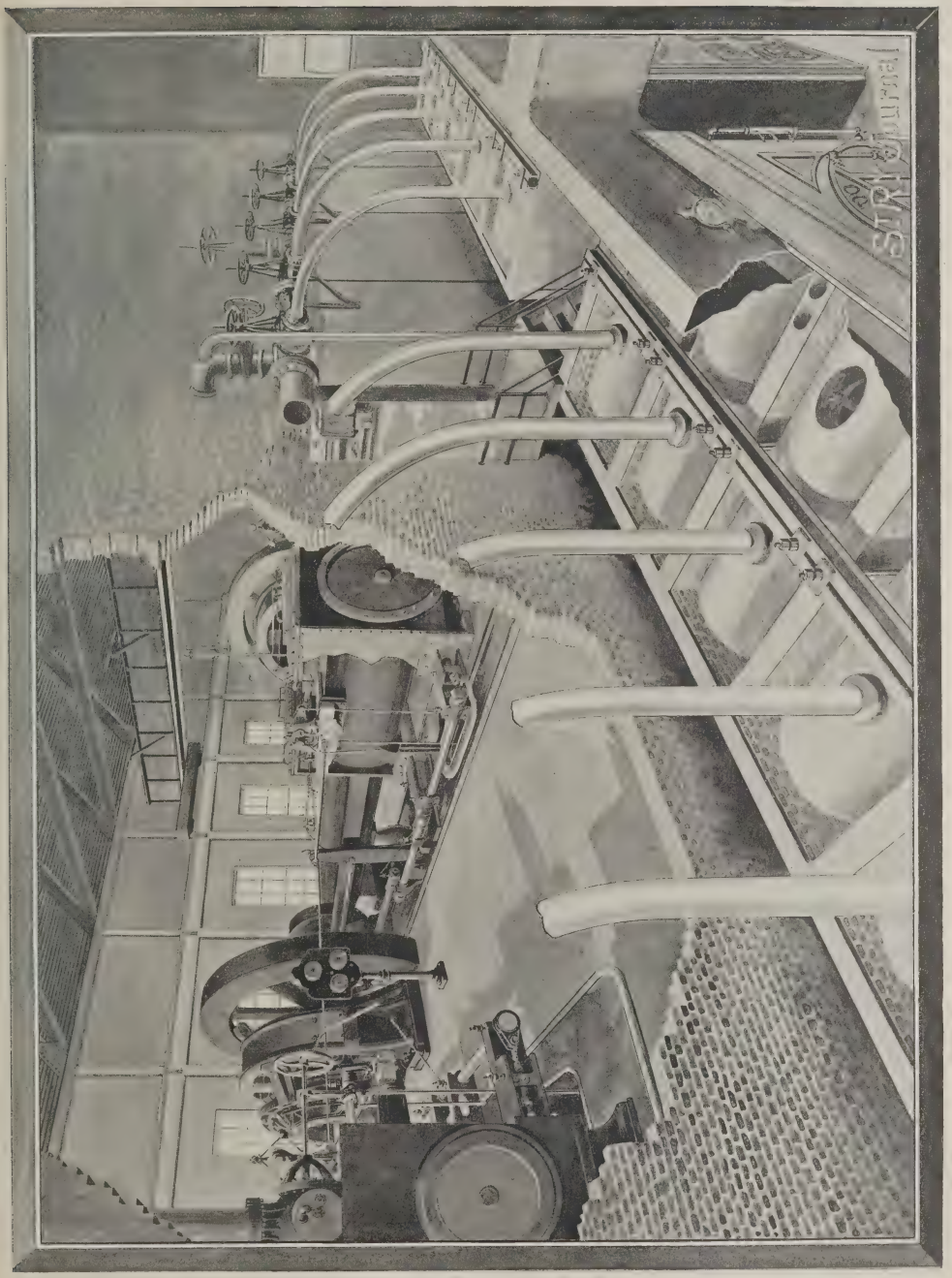


FIG. 3.—ELEVATION OF PUMP PIPING.

Our experience with the overhead electric and the third rail constructions at Nantasket Beach has led us to believe very firmly in the advantages of the latter form of



THE BERLIN POWER STATION.

conveying current from the station to the cars. There have been no mechanical troubles of importance with the overhead construction, and the pole lines and wires are today in practically as good condition as when first installed, but the difficulties of passing the heavy currents, frequently called for by the cars, through the trolley wheels to the motor circuits are most serious, and burnouts of trolley wheels are not infrequent, while there is doubtless a considerable waste of power in arcing at the wheels. The method of obtaining current from the third rail by means of shoes has been found almost entirely satisfactory, and the principal objection raised to the third rail—that of danger to the public—has been a theoretical rather than a practical one, partly because the currents employed are not such as are dangerous to life or limb (as has been proven a hundred times), partly because it is not easy to obtain a serious shock without special effort, and partly because the employes and the public have been carefully warned about the third rail, and have learned to respect our right of way. As a matter of fact not a single accident, for which damages have been claimed, has occurred on the Nantasket Beach third rail section.

The engineering advantages of the third rail construction are obvious. The rail can be easily and quickly laid, and so insulated from the ground that the leakage is little or nothing. This we have absolutely proven. We have even run one line with all three rails on a section of track completely submerged in water. The third rail provides a conducting capacity for the current equivalent to a very large copper cable, so that on many light traffic lines copper feeder capacity will not be required. There is little sparking between the shoe and the rail, and no appreciable wear from friction. Altogether, the advantages of the third rail construction are such that we have no doubt that, in one form or another, it will become the standard method of conveying heavy currents in railroad service.

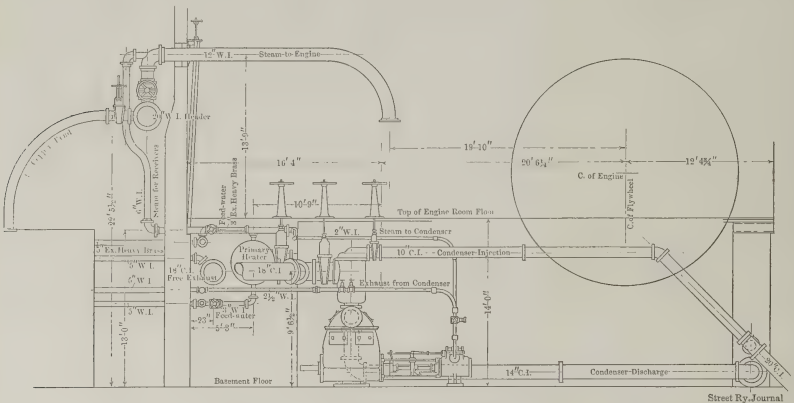


FIG. 4.—CROSS SECTION OF BERLIN POWER STATION, SHOWING PIPING.

THE HARTFORD-NEW BRITAIN-BERLIN INSTALLATION.

The results of these and a multitude of other experiments made at Nantasket Beach and upon the company's street railway properties at Stamford and Meriden, have been embodied in the equipment, just completed, of two lines, one running from Hartford to New Britain and the other from New Britain to Berlin, both of which lines are now in regular operation. The distance from Hartford to Berlin via New Britain is 12.3 miles and the two lines are operated by a single power station at the Berlin end. In the following somewhat detailed description of this plant I shall be able to explain reasons for the decisions which have been made.

POWER STATION.

The power station building at Berlin is a simple rectangular brick structure 106 ft. × 117 ft. with a chance for indefinite expansion along the line of its greatest length. It has three general divisions, an engine generator room, 53 ft. × 117 ft., designed to receive the two 1200 h. p. direct connected units now installed; a basement of the same dimensions directly below the engine room, containing the accessory steam apparatus; and a boiler room, 53 ft. × 117 ft., at the rear of both engine room and basement. This general arrangement provides for easily bringing coal to the furnace doors and for an excellent disposition of piping, steam appliances, etc. The accompanying illustrations so thoroughly explain the details of the power station equipment that little more than a few general statements about the apparatus are necessary.

We have decided upon horizontal tubular boilers for the Berlin station, because of their simplicity, their high economy and their general reliability. This is without prejudice, however, against water tube boilers, which have many points of excellence. The boilers, of which ten are now in position, are set in a somewhat novel way, so as to provide for free expansion in all directions, but particularly in the direction at right angles to their axis. The method of suspending the boiler from I beams supported on the tops of the brick settings is clearly seen from the engravings. The fronts of these boilers are made according to special plans furnished by us, so that they can be removed at any time, without interfering with the brickwork.

The grates, which are forty-eight inches below the

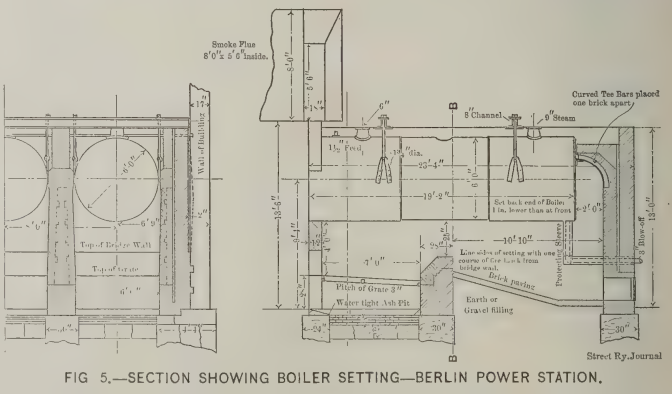
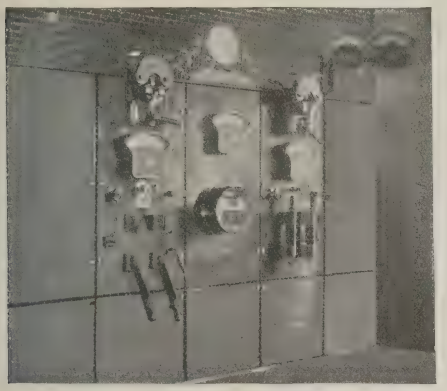

Smoke Flue
Curved Tee Bars placed one brick apart
8" Channel
6" Steam
Set back end of Boiler 1 in. lower than at front
Line sides of setting with one course of fire brick from bridge wall.
Brick paving
Pitch of Grate 3"
Water tight Ash Pit
Earth or Gravel filling
Top of Bridge Wall
Street Ry. Journal

FIG 5.—SECTION SHOWING BOILER SETTING—BERLIN POWER STATION.

bottom of the boiler shell, are designed for the burning of "sparks," i. e., the half burned coal dumped from the fire boxes of the locomotives running on the New Haven system. Several hundred tons per month of these cinders



SWITCHBOARD—BERLIN POWER STATION.

are regularly made, and can be transported in the company's cars to any point of consumption and delivered at a total cost, including freight, which, it is needless to say, is much less than that of any other available fuel. The grates are so arranged that the clinkers can be dumped at the rear. In burning sparks it is necessary to supply the oxygen which has been taken from the coal in the locomotive furnace, and this is done by passing under the grates through intake flues, placed in the partition walls of the boilers, a mixture of air and steam. The result of using this otherwise waste coal has been most satisfactory in our Stamford power station.

The engines selected are of 1200 h. p. rated capacity each, and are of the cross compound type, with high pressure cylinders, 28 ins. × 48 ins., and low pressure cylinders, 48 ins. × 48 ins. The speed is 100 r. p. m. The flywheel is 18 ft. in diameter, and weighs about 52 tons. The engine dynamo shaft is of hollow forged steel.

The generators, two in number for the present installation, are ten pole, 850 k. w. machines, overcompounded to give 600 volts at no load and 650 volts at full load. From the efficiency curve of these machines shown in Fig. 6, it is seen that the maximum efficiency is about 94 per cent and that the efficiency is above 90 per cent for all loads down to 30 per cent of the full rated capacity. Dynamo electric machines as now generally made are perhaps the most efficient converters of energy known.

The piping system in the Berlin station is very simple. I do not believe in spending enormous sums of money in duplicate systems with all their accessory valves and special appliances, but rather on making an installation of piping as simple, strong and perfect as possible, and then looking out carefully for the beginnings of trouble. A single wrought iron header runs the length of the boiler room. To it each boiler is connected by a heavy copper pipe 9 ins. in diameter, bent to a radius of 8½ ft., and to it also are similarly connected the two engines. The accessory steam apparatus is piped in such a way that the plant can be run at pleasure condensing or non-condensing, either side of the engine can be run without the other, and the feedwater can be heated or not as desired, so that, in general, ordinary accidents to sections of the plant will not interfere with its continuous operation. The details of pipe connections are seen in the engravings.

The station switchboard is simple in design and does not differ in any particulr way from that common in street railway work when currents of similar volume are employed, except that special care is taken to provide against short circuits on the line, by using uncommonly large circuit breakers. Seven panels are at present installed, three of which are now in use, the remaining four being left blank for a possible increase in the capacity of the station. Of the three panels in use, two are generator panels and the third is a totalizing panel. The latter carries a 5000 amp. recording wattmeter and an 8000 amp. station ammeter, measuring the total output of the station, also two illuminated dial voltmeters mounted on a bracket at one corner of the switchboard.

OUTGOING AND RETURN CIRCUITS.

In every electric railway installation, but particularly in one of this kind where heavy currents are used for each moving unit, the question of providing the most perfect outgoing and return circuits is one of paramount importance. As before stated, we have adopted the third rail form of outgoing circuit for the Hartford-Berlin installation, doing away entirely with any form of overhead wire construction. In Figs. 7 to 13 will be seen details of this third rail construction, which is practically identical with that successfully used on the Nantasket Beach line last year. The rail is rolled in 30 ft. lengths and weighs 93 lbs. to the yard. The section chosen is one which it is believed will be to a large extent self protecting as against rain, snow and ice, as the tendency is to shed water to each side, leaving a fairly dry place immediately below the rail. This rail is mounted upon wooden block insulators impregnated with a preservative and insulating compound.

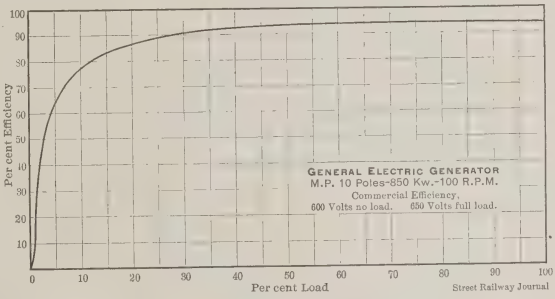
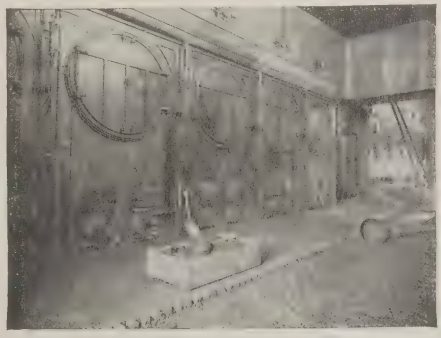


FIG. 6.—EFFICIENCY CURVE OF 850 K. W. GENERATORS—BERLIN POWER STATION.

These blocks are fastened to the ties by 2 in. × 2½ in. dowels, and three blocks to each 30 ft. rail are ordinarily

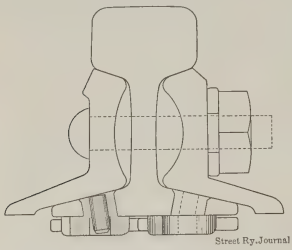


BOILER ROOM—BERLIN POWER STATION.

employed. The blocks are of such a length that the top of the third rail is held 1 in. above the top of the service rails, and the lowest points of the third rail are 1⅝ ins. above the ties. It is necessary to have the shoe on the car carried high enough to clear the special work of the

track, and the third rail low enough to avoid reaching any of the metal parts of the truck on the electric and other trains passing over the line. Careful inspection of all cars must be provided to prevent accidental short circuits due to contact of truck mechanism with the third rail.

The third rails are mechanically and electrically connected together at their ends by heavy wrought iron fish-



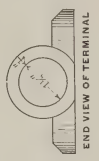


FIG. 7.—SECTION OF SERVICE RAIL SHOWING METHOD OF BONDING.

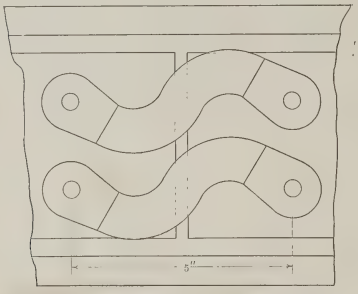


FIG. 8.—CABLE BOND FOR SERVICE RAILS.

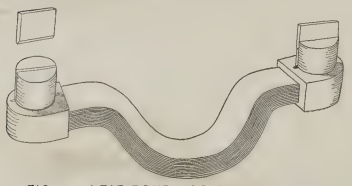


FIG. 9.—LEAF BOND FOR SERVICE RAILS.

DETAILS OF TRACK BONDING AND CONNECTIONS.

is broken by the shoes, and a train can, of course, be always managed so as to run over any gap of this kind by its own momentum. Beveled wooden blocks are provided at the ends of the third rail, so that the shoe will mount the rail on an angle.

Where the third rail is broken at switches and crossings it is, of course, necessary to maintain the circuit in some way, and this is done by means of a bare copper cable of 850,000 circular mils, drawn into creosoted

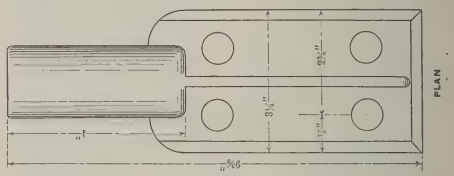


FIG. 10.—FEEDER TERMINAL.

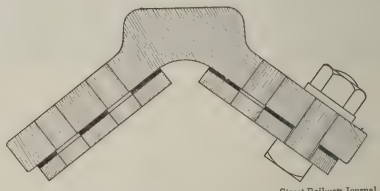


FIG. 11.—SECTION OF THIRD RAIL, SHOWING BONDS AT JOINTS.

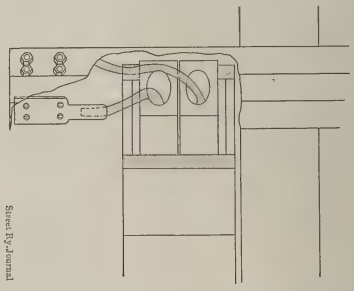


FIG. 12.—PLAN OF FEEDER CONNECTIONS AT THIRD RAIL.

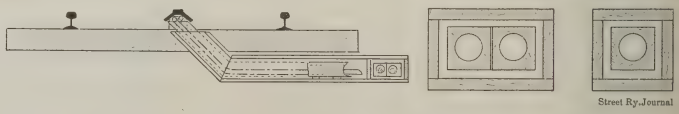


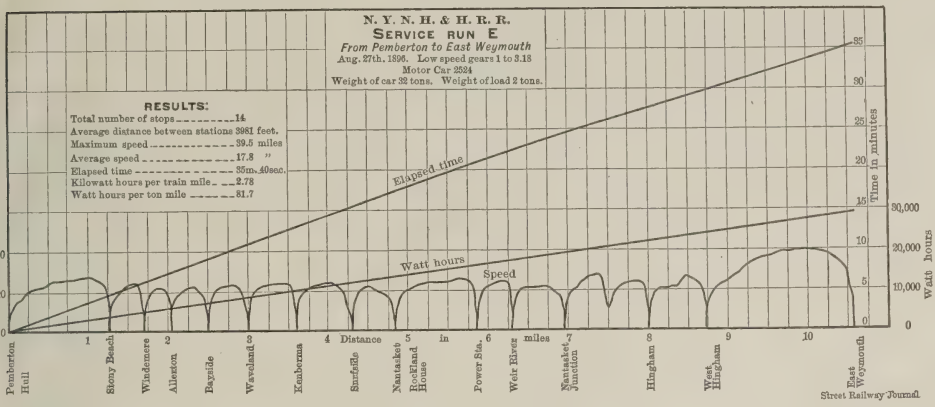
FIG. 13.—SECTION OF BOX CONDUITS.

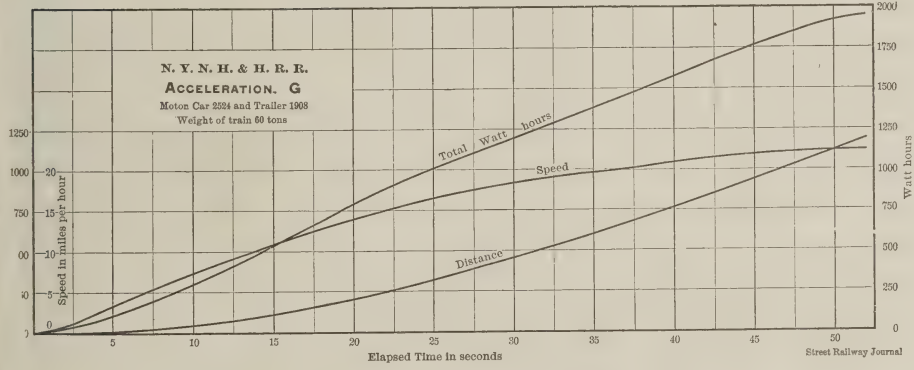
plates, 12 ins. × 4½ ins. × ¾ in., between which and the rails are placed ⅜ in. sheet copper bond plates of the same area. These four plates, two of copper and two of iron, are firmly bolted to the rail by sixteen ⅝ in. bolts with lock nuts, and the entire double bond has a current carrying capacity equivalent to 1,800,000 c. m., which is in excess of the capacity of the rail itself, as I believe should always be the case. As a matter of fact, many careful measurements have shown us that the actual resistance of the joints is considerably less than that of the rail itself.

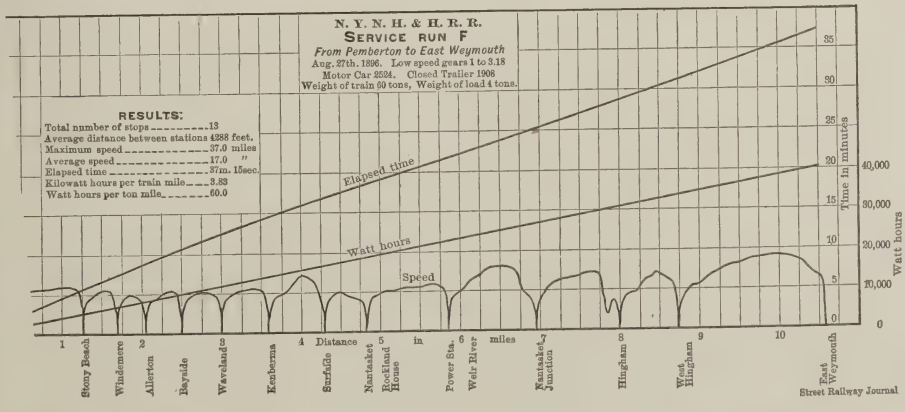
At switches and crossings there is a gap between sections of the third rail, but this gap is usually less than the length of a two-car train, so that the shoe of the rear car will maintain connection with the circuit until the shoe of the motor car re-establishes connection at the end of the gap. Where the gap is slightly longer than a train, the motorman is instructed to turn off his current before the circuit

wood conduits filled with an insulating material made of residuum and asphalt. These conduits are then laid in creosoted wooden troughs buried in the earth, and these are filled with the same compound. The connection between the cables and the third rail at each end are made by a heavy copper connector which is thoroughly sweated and bolted to the rails. (See Figs. 10-12-13.)

Far too little attention is ordinarily paid by electric railway managers to the return circuit. The practice of going to great pains and expense to provide against losses on the outgoing circuit while assuming that "anything will do" for the return circuit, is one which is utterly wrong from an economic point of view, since in addition to the ordinary losses of power due to poor connections or insufficient current carrying capacity at the joints, any imperfections in bonding involve further troubles through corrosion of bonds and of other metallic conductors in the

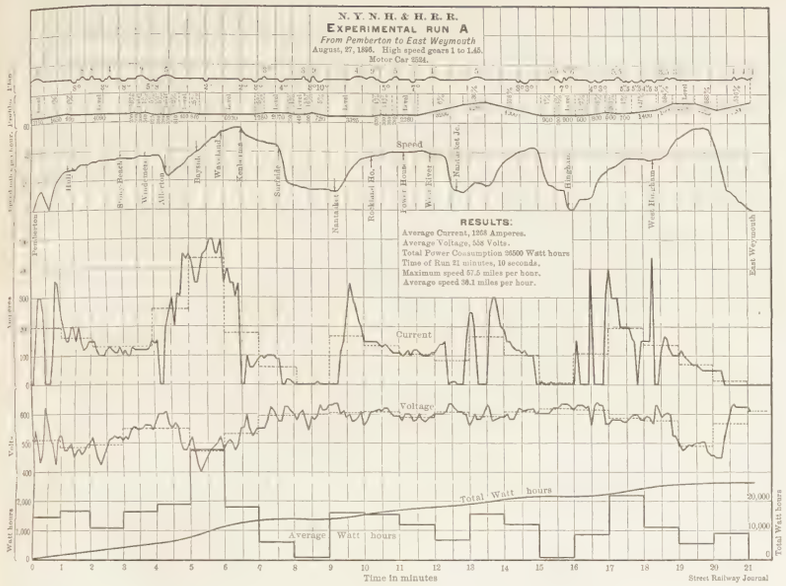

N. Y. N. H. & H. R. R.
SERVICE RUN E
From Pemberton to East Weymouth
Aug. 27th. 1896. Low speed gears 1 to 3.18
Motor Car 2524
Weight of car 32 tons. Weight of load 2 tons.
RESULTS:
Total number of stops 14
Average distance between stations 3981 feet.
Maximum speed 39.5 miles
Average speed 17.3 "
Elapsed time 35m. 40sec.
Kilowatt hours per train mile 2.78
Watt hours per ton mile 81.7
Elapsed time
Watt hours
Speed
Time in minutes
Watt hours
Distance in miles
Pemberton Hull
Stony Beach
Windemere
Allerton
Bayside
Wavelands
Kenberma
Smfelds
Nantasket Rockland House
Power Sta.
Weir River
Nantasket Junction
Hingham
West Hingham
East Weymouth
Street Railway Journal

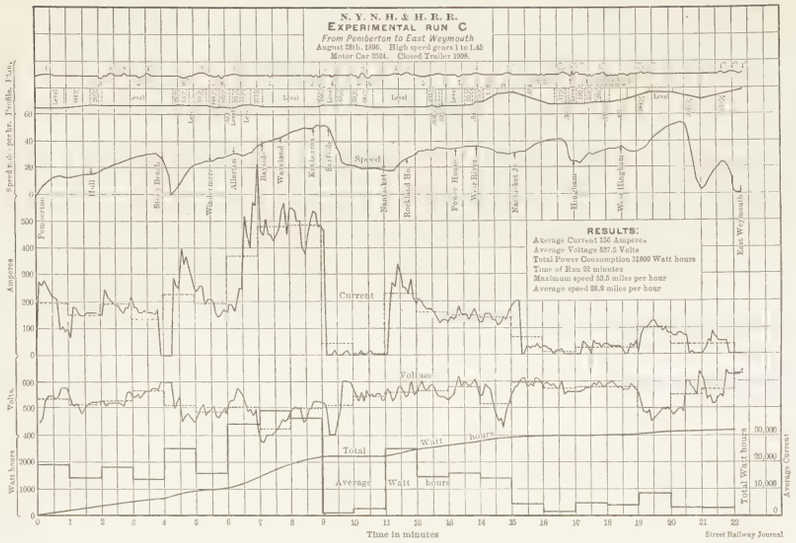

N. Y. N. H. & H. R. R.
ACCELERATION. G
Moton Car 2524 and Trailer 1908
Weight of train 60 tons
Total Watt hours
Speed
Distance
Speed in miles per hour
Watt hours
Elapsed Time in seconds
Street Railway Journal

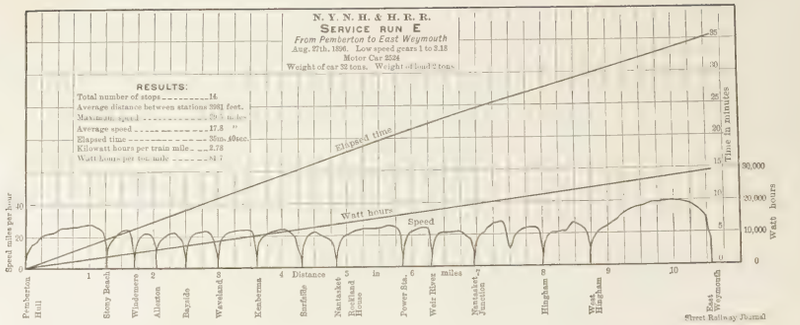

N. Y. N. H. & H. R. R.
SERVICE RUN F
From Pemberton to East Weymouth
Aug. 27th. 1896. Low speed gears 1 to 3.18
Motor Car 2524. Closed Trailer 1908
Weight of train 60 tons, Weight of load 4 tons.
RESULTS:
Total number of stops 13
Average distance between stations 4288 feet.
Maximum speed 37.0 miles
Average speed 17.0 "
Elapsed time 37m. 15sec.
Kilowatt hours per train mile 3.83
Watt hours per ton mile 60.0
Elapsed time
Watt hours
Speed
Time in minutes
Watt hours
Distance in miles
Stony Beach
Windemere
Allerton
Bayside
Wavelands
Kenberma
Smfelds
Nantasket Rockland House
Power Sta.
Weir River
Nantasket Junction
Hingham
West Hingham
East Weymouth
Street Railway Journal

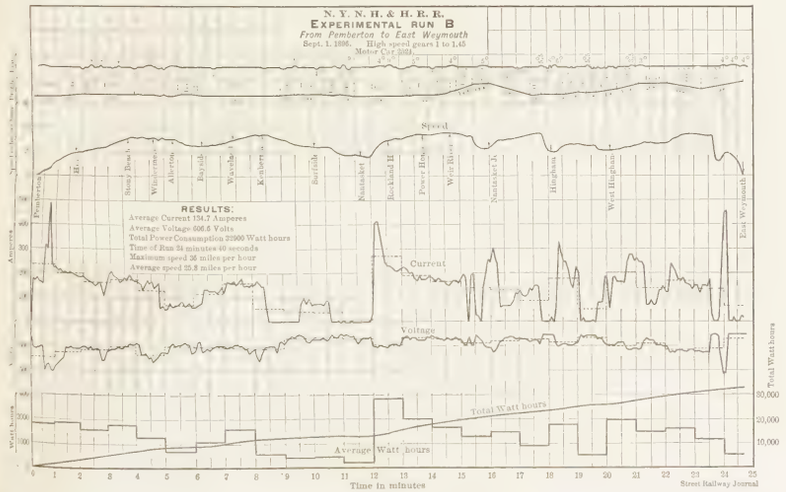
NEW YORK, NEW HAVEN & HARTFORD RAILROAD COMPANY—NANTASKET BEACH LINE.

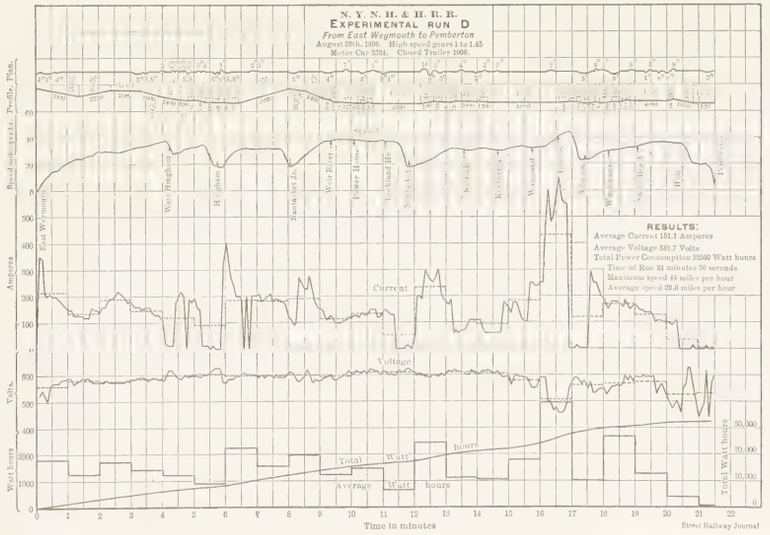
CURVES OF SPEED, CURRENT, VOLTAGE AND POWER CONSUMPTION.

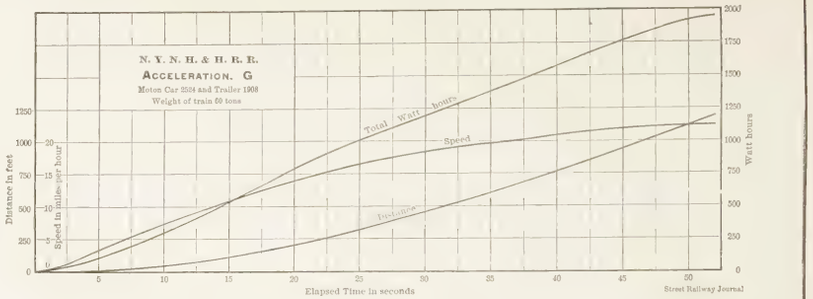

N. Y. N. H. & H. R. R.
EXPERIMENTAL RUN A
From Pemberton to East Weymouth
August, 27, 1896. High speed gears 1 to 1.45.
Motor Car 2524.
RESULTS:
Average Current, 126.8 Amperes.
Average Voltage, 558 Volts.
Total Power Consumption 26500 Watt hours
Time of Run 21 minutes, 10 seconds.
Maximum speed 57.5 miles per hour.
Average speed 36.1 miles per hour.
Speed
Current
Voltage
Total Watt hours
Average Watt hours
Time in minutes
Street Railway Journal

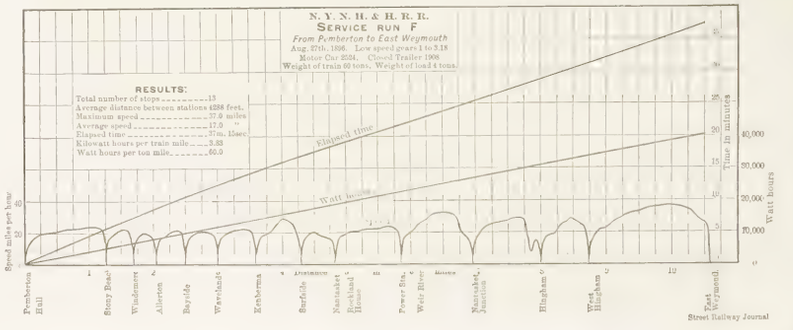

N. Y. N. H. & H. R. R.
EXPERIMENTAL RUN C
From Pemberton to East Weymouth
August 28th, 1896. High speed gears 1 to 1.45
Motor Car 2524. Closed Trailer 1908.
RESULTS:
Average Current 150 Amperes
Average Voltage 537.5 Volts
Total Power Consumption 32800 Watt hours
Time of Run 22 minutes
Maximum speed 52.5 miles per hour
Average speed 28.9 miles per hour
Speed
Current
Voltage
Total Watt hours
Average Watt hours
Time in minutes
Street Railway Journal


N. Y. N. H. & H. R. R.
SERVICE RUN E
From Pemberton to East Weymouth
Aug. 27th, 1896. Low speed gears 1 to 2.13
Motor Car 2524
Weight of car 32 tons. Weight of load 2 tons.
RESULTS:
Total number of stops 16.
Average distance between stations 3561 feet.
Maximum speed 39.5 miles
Average speed 17.8 "
Elapsed time 35m. 40sec.
Kilowatt hours per train mile 2.76
Watt hours per ton mile 84.7
Elapsed time
Watt hours
Speed
Distance in miles
Street Railway Journal




N. Y. N. H. & H. R. R.
EXPERIMENTAL RUN D
From East Weymouth to Pemberton
August 29th, 1896. High speed gears 1 to 1.45
Motor Car 2524. Closed Trailer 1908.
RESULTS:
Average Current 151.1 Amperes
Average Voltage 581.7 Volts
Total Power Consumption 28500 Watt hours
Time of Run 21 minutes 30 seconds
Maximum speed 44 miles per hour
Average speed 29.6 miles per hour
Speed
Current
Voltage
Total Watt hours
Average Watt hours
Time in minutes
Street Railway Journal




N. Y. N. H. & H. R. R.
SERVICE RUN F
From Pemberton to East Weymouth
Aug. 27th, 1896. Low speed gears 1 to 2.13
Motor Car 2524. Closed Trailer 1908
Weight of train 60 tons. Weight of load 4 tons.
RESULTS:
Total number of stops 13
Average distance between stations 4236 feet.
Maximum speed 37.0 miles
Average speed 17.5 "
Elapsed time 37m. 15sec.
Kilowatt hours per train mile 3.33
Watt hours per ton mile 60.9
Elapsed time
Watt hours
Speed
Street Railway Journal

neighborhood of the return circuit, such as water and gas pipes, etc. Believing firmly that the return current should be confined as closely as possible to the rails, and that ample carrying capacity should be provided in the bonds, we have made a great many experiments at Nantasket Beach, and elsewhere, for the purpose of determining the relative advantages of different types of bonds for both third and service rails, and have obtained some highly interesting results. We have used with some success the bond shown in Fig. 8, which is made by drop forging two ends of a heavy copper cable of 300,000 c. m. equivalent area in such a way as to form rivet ends, and these bonds can by attached to the rails by expansion pins or wedges in the usual way. We have found, however, that a cable of this kind is almost as stiff as a solid rod and is likely to become brittle and break from crystallization due to the jar of passing trains, and in place of this we are now using a leaf bond (Fig. 9) having an equivalent area of 550,000 c. m. from which we expect to obtain the best results yet found in joint bonding work. In my judgment, all rail bonds should be attached to the bottom flanges of the rails, not on the web, for the alternate depression and return to position of a rail bond tends to loosen in its socket even the most tightly riveted bond, as well as to put a shearing strain on the rivet which will eventually cut it off. We have also found by experiment that wedge driven bonds, such as are shown in Fig. 9, are much more firmly held in position than are pin driven bonds.

MOTOR CAR PLATFORM, SHOWING MOTOR COMPRESSOR, CONTROLLER AND SWITCH.

It has been determined by delicate and accurate tests made upon our Nantasket Beach and Berlin-Hartford lines, that the electrical resistance of both third and service rails when carefully and thoroughly bonded, is so small that current sufficient for several trains can be delivered along a ten or fifteen mile line without seriously reducing the voltage of the motors.

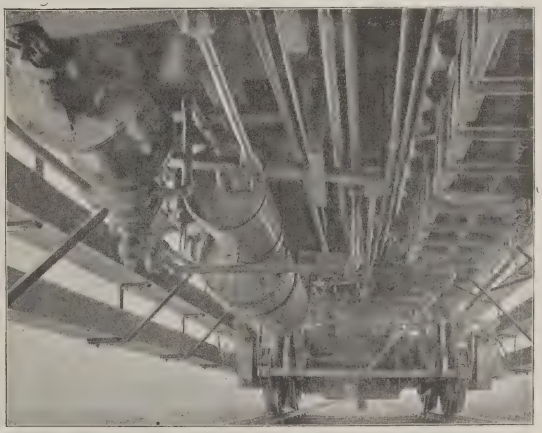
CAR EQUIPMENT.

The type of cars used in the Hartford-Berlin installation is practically identical with that used on the Nantasket Beach line. The cars are 51 ft. in length over all and have sixteen cross benches, each seating six passengers. The total seating capacity of the car is therefore ninety-six passengers, but at Nantasket Beach as many as 350 passengers have been carried on a two-car train. The Hartford-Berlin trains are at present made up with two cars of which the forward car only is provided with motors. Both cars are, however, equipped with shoes for taking current from the third rail, in order, as before explained, to bridge over any gaps in the third rail which may be made necessary by frogs and switches, as well as to provide against loss of shoes or temporary trouble of any nature. The cars are electrically connected by a heavy double plug connector illustrated in Figs. 17-18.

The shoe is a 12 in. × 5 in. cast iron plate and is suspended from a wooden insulated support, fastened to the truck by links jointed in such a way as to give the shoe considerable flexibility.

The motors at present in use have a rated capacity of about 125 h. p. each. Their curves of efficiency, tractive effort and speed are shown in Fig. 14, and their practical results in drawing trains of different weights are shown in the Nantasket Beach curves previously described. Both motors are mounted on one truck of the motor car. Experiments have been made with four-motor equipments for heavy train service, with results which were very satisfactory. The trucks are solidly and heavily built, and are equipped with 36 in. wheels.

The brake equipment is a most important auxiliary apparatus in a system of this kind, where speeds of from 40 miles to 60 miles per hour are to be made in regular service. The special problems of braking electric cars with air brakes have been well solved by the apparatus illustrated herewith. A 10 h. p. motor is carried on one of the platforms of the motor car, and is put in connection with the engineer's valve of the regular Westinghouse air brake equipment used on the New Haven cars, and in this equipment no material change has been made. The motor compressor is put in operation and cut out automatically according to the requirements of the air reservoir. When the pressure falls below a certain point the motor is automatically cut in, the pump commences to work, and when the required pressure is again reached, the pump is cut out and the compressor stops. The automatic regulator necessary for the operation of a system of this kind is an ingenious device which has so far proved satisfactory. It may be adjusted to operate at from 45 lbs. to 100 lbs. gauge, and on a difference in pressure of from 5 lbs. to 7 lbs. per square inch. The capacity of the compressor is 52½ cu. ft. of free air per minute, working against 90 lbs. per square inch gauge pressure. At this pressure the speed is 250 r. p. m., and the power consumption is 16 amps. at 600 volts, equivalent to about 13 h. p.



UNDER SIDE OF MOTOR CAR.

The average power consumption required in service is, of course, much less than the maximum power.

The system of car wiring is similar in most respects to that used with street cars. The path of the current is as follows; from the third rail it passes into (*a*) the shoes, and (*b*) through a copper cable to (*c*) the circuit breakers, (*d*) the lightning arrester, through (*e*) the "kicking coil," to a point where it divides into two paths, each going to (*f*) a controller at opposite ends of the car; in the controller it passes first through (*g*) the magnetic blowout coil, thence through (*h*) a cable to (*i*) the resistances in the center of the car, thence back through the resistance contacts to (*j*) the controller cylinder, where it reaches (*k*) the motors and passes (*l*) to ground. The details of connections are seen in the accompanying diagram (Fig. 15).

Considerable trouble having been found at the exposed point where the wires enter the motors, we have devised a special connector box which thoroughly protects these wires, and has completely done away with the trouble. This is illustrated in Fig. 17. All the switches, automatic circuit breakers, lightning arresters, etc., used with these trains are of a size commensurate with the currents employed, and have given little trouble in practice.

throughout the day from about six in the morning till twelve at night. The distance will be covered in twenty minutes, or less, and the fare charged will be ten cents each way. The country through which the line passes is

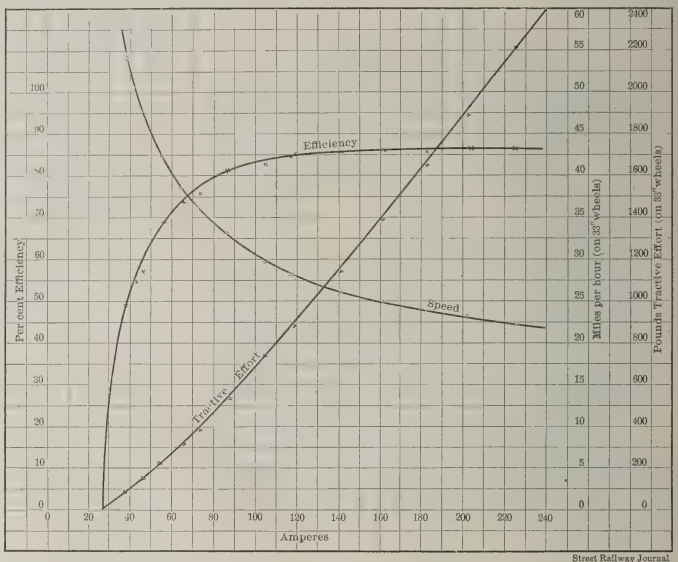


FIG. 14.—CURVES OF THE G. E. 2000 MOTOR.

TRAFFIC CHANGES.

The distance from Hartford to New Britain is, as before stated, 9.3 miles, and the distance from New Britain to Berlin is 3 miles. Until the beginning of electric operation, eight trains per day were run each way between Hartford and New Britain, and fourteen trains per day were run each way between New Britain and Berlin. By the new electric schedule between Hartford and New Britain, two-car trains will be run every thirty minutes a pleasant one, and considerable pleasure traffic, in addition to the regular traffic morning and night (which is unusually large), is expected. Between New Britain and Berlin, sixteen trains per day will be run in each direction, and a five cent fare will be charged.

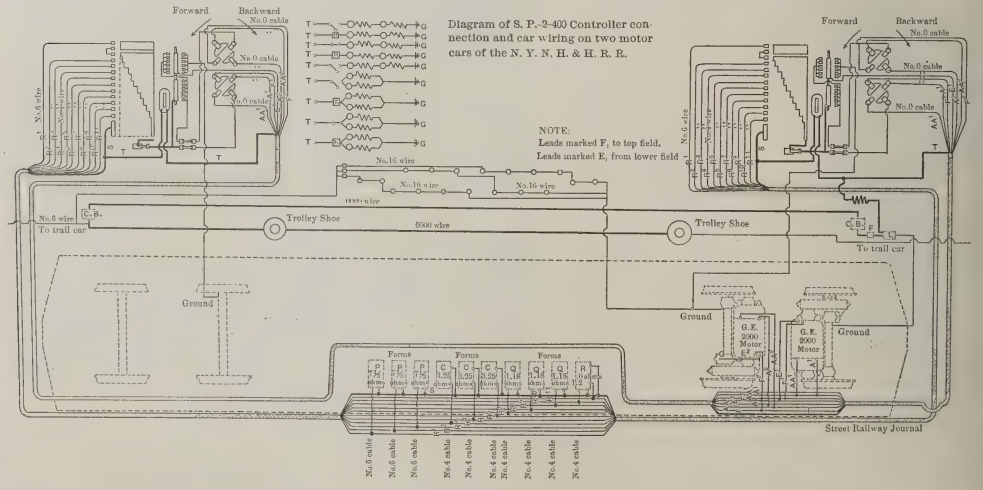
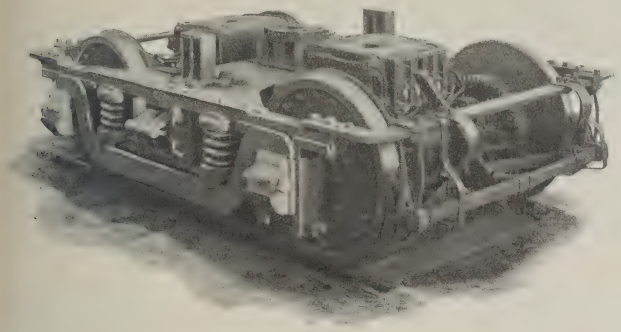


Diagram of S. P.-2-400 Controller connection and car wiring on two motor cars of the N. Y. N. H. & H. R. R.
NOTE:
Leads marked F, to top field.
Leads marked E, from lower field
Forward
Backward
Trolley Shoe
To trail car
Ground
G.E. 2000 Motor
Street Railway Journal

FIG. 15.—DIAGRAM OF CAR WIRING FOR MOTOR CAR.

I have thus hastily reviewed the main features of the work done on the New Haven system in Massachusetts and Connecticut since the establishment of its Electrical Department. These are only small beginnings in a field

whose magnitude we can hardly even yet appreciate. Electricity as a form of energy has many things to commend it to railway engineers. Among these are ease of control and ability to instantaneously transfer and deliver to many moving units along the line power developed under favorable economic conditions at a central point, together with compactness of motors, large reserve power in the combined generator—motor system for occasional use in emergencies, and—quite as important an advantage as any—freedom from disagreeable operating features annoying to passengers. Electricity, doubtless has its limitations, however, and how far we shall be able to go in applying it to the New Haven system has yet to be determined. But a railroad system of this kind, so largely dependent upon the short distance transportation of many million people residing in its territory, must not fail to make every effort to give to its patrons the best possible service, and will surely strive to obtain all the traffic which its dearly purchased right of way, its expensive plant and its peculiar facilities give it the right to expect. In the light of what has already been accomplished and what we expect to demonstrate to our own satisfaction in the Hartford-Berlin installation, there is certainly ground for hope that some, at least, of the traffic problems of the New Haven system will be solved by the extending use of electric traction.



250 H. P. MOTOR.

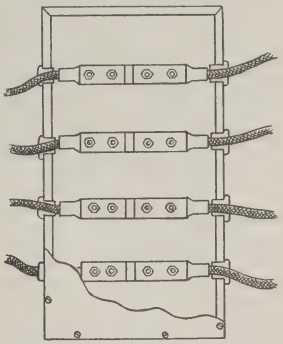


FIG. 16.—CONNECTION BOX FOR MOTOR TERMINALS.

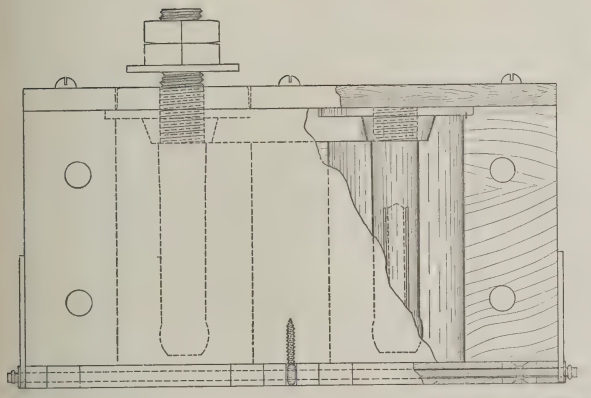
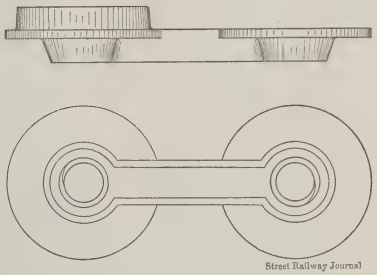
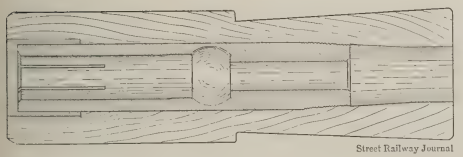


FIG. 17.—ELECTRICAL CAR COUPLER.



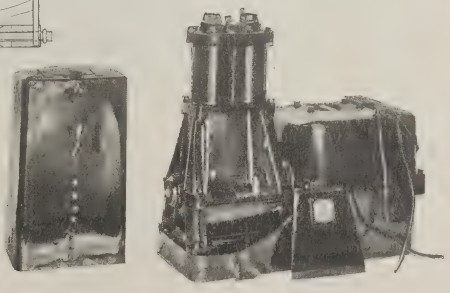
Street Railway Journal

FIG. 18.



Street Railway Journal

FIG. 19.—PLUG FOR CAR COUPLER.



COMPRESSOR FOR AIR BRAKES.

Proposed Consolidation in Baltimore.

The proposed consolidation of the Baltimore Traction Company and the City & Suburban Railway Company, of Baltimore is expected to become a practical fact soon. The name of the new organization will be the Baltimore, Consolidated Street Railway Company, and, as now arranged, Nelson Perin, of the City & Suburban, will become president, and Wiliam A. House, president of the Baltimore Traction, will be vice-president and general manager.

The Kioto Water Power and Electric Railway Plant.

Barely thirty years ago, Japan was a country little known to Europeans, and one upon which the civilization of the West had made no impression. To-day she is rapidly forging ahead in all matters relating to commercial and industrial development, and it is not improbable, that coming into competition with her Western neighbors, Japan may prove an influence which will leave a deep impress upon the commercial history of the world. Among other important engineering works recently completed in that country is the construction of an electric railway at Kioto, operated by water power from Lake Biwa. The development of this water power, which has excited the interest of engineers the world over, may briefly again be referred to.

Lake Biwa, with a superficial area of 500 sq. miles lies some 6 miles from Kioto beyond two ranges of hills. Through Kioto runs a water way known as the Kamogawa by which boats can pass through the city to tide water at Osaka Bay. Lake Biwa lies 150 ft. above Kamogawa, and the junction of the two seemed so naturally destined that so far back as the twelfth century, projects for bringing the upper waters to the lower, were presented; but not until the conservatism of old Japan, with its duplicate emperors and its feudal system was abolished, could the project receive that consideration which the necessity of assimilating European ideas, compelled. In 1885 the work was taken up by the Government, placed under charge of S. Tanabe and was concluded in 1890.

The canal has a total length of 6⅞ miles, and is divided into two sections. The longer is 5¼ miles long, and carries the waters of Biwa through the hills to the suburbs of the town. The shorter, is 1⅝ miles long and connects the suburbs to the center of the city where it connects with the Kamogawa waterway. For a large part of the way the water flows through tunnels. The constant flow in the canal, available for power and irrigation is 300 cu. ft. of water per second, of which 250 cu. ft. is devoted to power purposes, while 50 cu. ft. is diverted into another canal for irrigation purposes.

At the time the canal was projected the possibility of utilizing the power which the difference in level would give, was confined to the employment of water wheels. Before the conclusion of the work however, the experiments in power transmission by electricity made in America and Europe had aroused attention in Japan, and the use of electricity was decided upon, if the reports of Messrs. Tanabe and Takagi, who were sent over to study the question, should turn out satisfactory. The report proving excellent a very complete electrical equipment was ordered from America. This water power electrical transmission, completed in 1891, was not only the first in Japan, but also one of the first of the notable ones in the world.

The pipe line consists of three pipes each 35½ ins. in diameter and 1376 ft. long. The power house is not placed at the foot of the incline, but some 400 ft. from the bottom, in a large pit excavated for the purpose. The water wheels are of Pelton manufacture, and there are now twenty in the station, placed in rows on each side of the tail race, which runs through the center. These wheels are of 120 h. p. each under a head of 100 ft., and are 8 ft. in diameter. They are controlled by ball governors and deflecting Pelton nozzles. In addition to the 2400 h. p. in the Pelton wheels, 600 h. p. more is available in the length of Kamogawa. This has five locks at each of which a 120 h. p. turbine will be located, when the demand for power warrants the extension.

The station is built in steps, the wheels occupying the lowermost, the countershafts the intermediate ones and the dynamos the top. The wheels are belted to the countershafts and these in turn are belted to the generators.

The electrical equipment, first started in July, 1891, with two Edison 80 k. w., 500 volt machines, now consists of a number of generators giving current as follows:

435 k. w. direct current at 500 volts.

250 k. w. single phase alternating current at 1000 and 2000 volts.

240 k. w. two phase alternating current at 1000 and 2000 volts.

240 k. w. three phase alternating current at 2000 volts.

The Kioto Canal Power Company, or the Sui-Ri-

ELECTRIC CAR AT KIOTO, JAPAN.

Jiniusho, operates the power transmission and distribution. Previous to the completion of the work the Kioto Electric Light Company had started a three wire electric lighting installation, with four Edison dynamos. The authorities having decided that the Power Company should control the distribution of the current for power purposes, and the Electrical Light Company that for lighting purposes, the former arranged to install the single phase alternators in its station.

The Canal Power Company is now furnishing current to 1000 h. p. in motors operating cotton mills, etc., and is engaged on the installation of some 700 h. p. additional. Its latest development is the establishment of an electric street railway system in Kioto. The service is carried out by twenty-six cars, each equipped with two G. E. 800 motors, and K2 controllers. The overhead system is carried in places on span wires, in others on brackets. The rails are of American manufacture bonded with Chicago rail bonds.

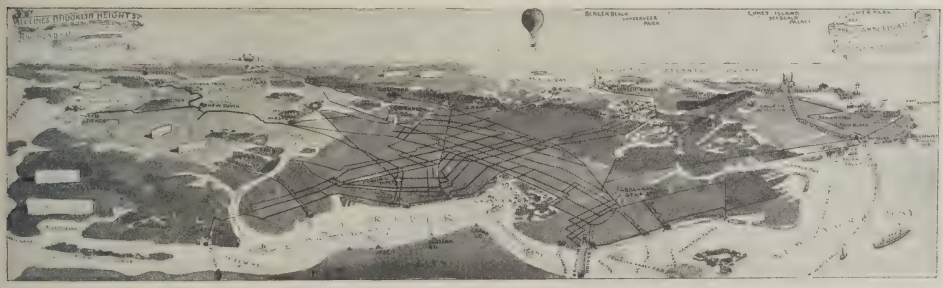
The North & South Railway Company, of St. Louis, Mo., has been incorporated by John A. Holmes, Edward C. Becker, Thos. H Rockwood, F. X. Barada and J. H. Blessing to build street railways in St. Louis. Franchises have been applied for. Capital stock, $2000.

The General Passenger Department of the Brooklyn Heights Railroad Company.

By H. Milton Kennedy.

The general opinion of the future of electric traction was well expressed recently in the words of the general passenger agent of one of the large trunk line systems running into New York. After a general conversation on local and other passenger traffic, previous to a traffic agreement between our respective roads, which was the object of the meeting, he said, "The steam roads buy the right of way through the city or country at an enormous cost, then, after building miles of railway between cities, through the most productive local sections that can be reached consistently with the direct line of survey, and cities, indicates still greater development of existing transit lines, and their great value in the transportation world. Then, as mentioned in the conversation above given, street railways are continually extending their lines into suburban territory and embracing cities, towns and villages in direct competition with existing steam lines.

On account of the heavy city travel at certain hours, and the desire of travelers to crowd on the first car of their destination that comes along, regardless of the almost immediate approach of another in which there would be seating room, large cars have also become quite a necessity throughout the entire service. And they are economical from an operating standpoint in that the crew of two men can handle many more passengers with no additional cost. Larger equipment and more speedy service, which has been the result of electrical traction, requires a better or-



BIRD'S EYE VIEW OF PLEASURE RESORTS IN BROOKLYN.
(From circular published by the Brooklyn Heights Railroad Company.)

after equipping the road with commodious and expensive rolling stock and building fine stations with all conveniences for the traveling public, the 'trolley' comes along. It 'grabs' the streets of our cities and the highways of our country, without paying anything for them, lays tracks cheaply over ready graded ground, puts on comparatively cheap rolling stock, to be operated as single and frequent cars, against our long trains and longer intervals of running time, paralleling our lines between local points, and in towns and cities, running to the very doors of our station. Here its patrons are rested or warmed or cooled or sheltered from storm and otherwise comforted. When ready, they step out and take a car to their destination at a price that we could not possibly operate under. Of course, it takes longer, but between local points, generally speaking, the cheap fare wins every time. Why I, myself, have frequently stood in one of our stations, and from there boarded a trolley car to my suburban villa, reached also by our own system, rather than wait for the next train." Thus the local business, the most profitable of all passenger traffic, is steadily and surely being lost to the steam operated roads. Then the evident tendency of the populace at large to locate in cities, and the growing demand for suburban real estate closely surrounding these

ganization and more perfect system, with rigid discipline to govern it properly. With the introduction of many trained steam railroad men into the service, and the adoption by others of its methods, the science of street railroading is becoming more closely allied to that practiced on our established trunk line systems.

It was this evolution in method, in equipment, in maintenance of way, and in general management that prompted the idea that with all the rapid strides toward the better accommodation of the public there should also be a department to educate the people how, when and where to ride, and in a general way to develop traffic in proportion to the increased facilities offered. It was also sought to bring the populace and the corporation into more congenial relations than generally exists by communication through the press, to create a popular enthusiasm for parlor car and illuminated car trolley parties and offer the most pleasing amusement at terminal pleasure resorts at a trifling cost. My own experience in handling the excursion business connected with a seashore railway, the South Jersey Railroad between Philadelphia and Cape May, Wildwood, Hally Beach and Sea Isle, demonstrated that if thousands from the city and country could be induced to ride from two to four hours and pay as many dollars for a

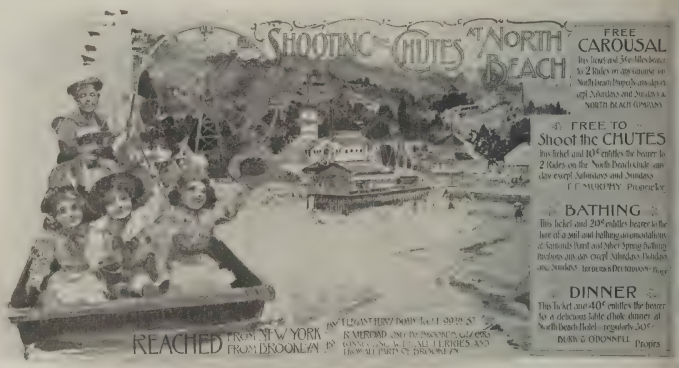
few hours' pleasure, at an additional cost, the immense population of a large city or group of cities, could certainly be more easily induced to visit the several pleasure resorts on the sea coast so close to the cities about New York at less than an hour's ride, and at a cost less than the price of a dinner on the regular seashore excursion of a steam railroad including some of the pleasures. Then the riding public of a city can be reached more directly. Again, every inhabitant of a city is a possible customer, and the sight of an attractive sign on a car passing through the street may induce persons to board a car who had otherwise no such intention. The steam roads, on the other hand, must advertise far and wide, and give their competitors a portion of the resulting business. A street railway general passenger department, the first to be established, was the result when this subject was brought to the attention of the progressive management of the Brooklyn Heights Railroad, whose foresight has since been rewarded by the success of the plan, after a year's organization.

The first idea to be developed by such a department is the creation of new business, and to increase passenger traffic by inducing new patronage which did not then exist and which would not unless developed. How? By educating the public as to the attractive features along the lines of the various divisions and the special amusements offered at the terminals. The picturesque suburban territory and the beautiful rolling country through which the lines operate are in this way brought pleasingly before the patrons, who, having been taught the delights of an invigorating outing in an open trolley car (speaking of summer now) repeat the trips with their families or friends and in turn visit all resorts reached by the various routes. These persons ride more and more, and unconsciously become the greatest advocates of any road.

Another step is to create a popular enthusiasm for trolley parties in decorated and illuminated open extension cars in summer and in handsomely equipped parlor cars in winter. Most of this traffic is usually new business. There are thousands who will be induced in this way to ride over the lines to points that they would otherwise never visit and this results in the carrying of passengers afterwards to places with which they had previously been unfamiliar.

But how can this education best be conducted? By judicious advertising, by canvassing, by the circulation of a periodical, by the distribution of an artistic and interesting pamphlet and by such other novelties or original ideas as may suggest themselves. There is a large contingent among churches, schools, clubs, lodges, societies, etc., that goes outing once or more times every year. The old form of excursion has possibly become monotonous and they are looking for something new. We have it. The steam road trips are usually too long and tiresome and quite expensive and the steamboat excursions are dependent upon tide and wind and weather, are usually overdue on the return trip, and many parents are fearful of the dangers of the sea, so that the "trolley excursion" offers the alternative. A booklet, descriptive of the many pretty groves and parks that are adapted for picnics and excursions and that are accessible, and with halftone illustrations, serves to advertise this new feature. We have already had a number of inquiries this spring, before the general pamphlet that we are preparing is ready, for groves for Sunday school excursions, and are figuring on equipping a shady portion of one of our beaches for this purpose. This will be in addition to the other groves and parks on our lines. There are also other special parties to be catered to. They are the private theatrical parties for the light opera or vaudeville performances at summer resorts and the theatre parties to the regular plays in town during the winter, the "dancing" parties to the various inns, gardens, etc., the "skating" parties, the "card" parties and the regular jovial trolley parties, with music, in special cars for the pleasures of the trip only.

These are about the lines on which the first street railway general passenger department was developed. We used most all forms of advertising such as the daily newspapers, both as "reading notices" which were inserted free, through friendly connection with the "staff," and as "paid line ads." and display page "ads." We advertised during the season of 1896 with the leading metropolitan journals, taking a full page in each at different periods. These were written up by their own reporters, on sugges-

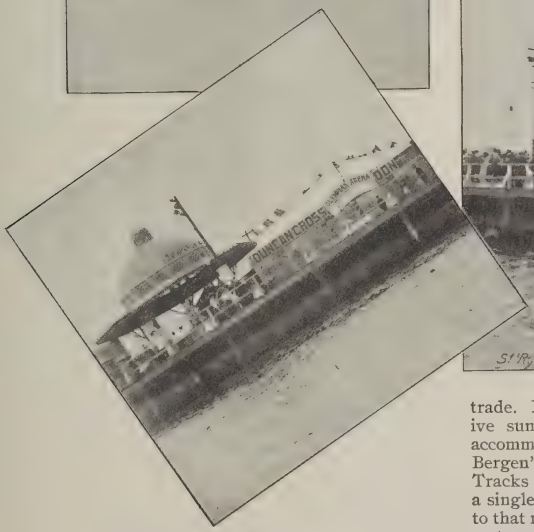


DESIGN OF SMALL CARD FOR GENERAL DISTRIBUTION.

NORTH BEACH
REACHED BY
ELEGANT FERRY BOATS FOOT E. 90TH ST. E. R.
BROOKLYN CITY R.R. CARS FROM ALL NEW YORK
FERRIES AND ALL PARTS OF BROOKLYN.

DESIGN FOR LARGE WALL POSTER.

tions from this department, after taking trips over the lines, and were illustrated by their artists. They showed pictures of the principal resorts and of parlor and illuminated special cars, and gave routes and rates of pleasure trips. It was arranged that each paper as it printed the "ad" was to give us, without charge, several thousand extra sheets. These were stored at our office so that we have about 50,000 display page "ads." to put out this season at no expense except for distribution. 8000 of these were distributed one day last month by newsboys at the Bridge and ferries and on the cars. For special occasions we use "flyers" which can be printed quickly and hung in bunches in the cars and other prominent places. Last year we put out a novelty in the form of a birds-eye view map of the city of Brooklyn and surrounding territory showing all lines of the



VIEWS AT BERGEN BEACH.

Brooklyn Heights Railroad system, emphasizing pleasure resorts at terminal points. This was done in colors and one could see at a glance the "lay-of-the-land," without studying out an intricate line map which few will do. The title was "Pleasure Trips for a Nickel or Two." We circulated 503,250 of these through the cars without any cost for distribution except for "Take One" cardboard holders which were hung in the cars. The issue cost $1000, and the "ads." on it amounted to $1150. The map in the circular is shown in the illustration on page 345.

We also tried the large poster last season, with the largest result from the smallest outlay. We employed a twenty sheet bill (9 ft. × 15 ft.), with a four sheet "changeable" on each end (that is to say, a bill, 3 ft. × 9 ft., on each end of the regular bill, printed in type and changed with the change of attractions; the colors were also different each time). This advertised Bergen Beach, which was a new resort only opened last spring. Our road in that vicinity had formerly ended at the village of Flatlands, where there was little business, except local

trade. By a joint arrangement with a syndicate an attractive summer pleasure resort, with all the features and accommodations of the old established ones, was built on Bergen's Island, in Jamaica Bay, and called Bergen Beach. Tracks were extended a distance of about 3 miles, and on a single day the first season we have carried 50,000 people to that resort. No other line extends there. Of course, the poster was not the only method of advertising employed, but it was an important factor.

This year the long established resort, North Beach (on Flushing Bay, Long Island Sound), is being advertised, having seen the result above mentioned, and we have just put on the boards a twenty sheet poster, as shown in the sketch on page 346, but printed in colors. This resort will be further advertised by the distribution of 1,000,000 of a "cut-out" card, of a design also shown on page 346. It is to be in color, and will contain four tickets, which are to be clipped off. One is for a fifty cent table d' hôte dinner for forty cents (saving the price of car fare at once), one for a twenty-five cent bathing

outfit for twenty cents, one for an extra ride free on the chute, and one for an extra trip free on the carrousel. These will be distributed at all ferries and to passengers on the cars, and will be "skimmed" from a special car, which will be sent through the city. This car will be decorated and illuminated, having one of the large North Beach posters on each side and a band of music within.

For Bergen Beach we will use one poster, the same as last year, an illuminated night scene, and a new twenty sheet poster, a day scene, along with it. This, with the "changeable," will make a stretch of paper about 9 ft. × 34 ft., done in high color.

Another important method of advertising we find is the dashboard sign. We have on special occasions printed an announcement on a sheet of cardboard in various colors and tied it on. But we are now preparing a holder for the dashboard of a uniform size (18 ins. × 24 ins.) in which all such announcement cards can be placed and be neat and uniform.

We now have on press our latest production in the form of a pamphlet, 4 ins. × 8 ins. in size, with a handsome lithographed cover and halftone illustrations within. Its title is "Where and How to Go." In it we illustrate pleasure trips and tell how to take them, besides giving a list of all transfer points, routes of all lines, night schedules, colors of night lights, etc., etc., etc.; 100,000 of these will be printed.

In addition to the foregoing the general passenger department of the Brooklyn Heights Railroad concludes such measures of finance in the advertising line as will reduce expenses by an income to offset them. The expense of printing transfer tickets was greatly reduced by securing a good price on a yearly contract for the privilege of printing the advertisement of a firm on the backs of all tickets issued. We also get any vacant property that may need it fenced in and in some cases a yearly rental in addition, also for the advertising privilege.

This department also takes up in advance any special shows that may be coming to town, such as the circus, Wild West show, etc., and influences so far as possible the location of other attractions on the lines of the company. The general passenger agent also works with the general superintendent in watching return sheets of passengers carried, headways of cars, time tables, etc., and in general traffic and the careful handling of people.

The Brooklyn Heights Railroad operates in special service three handsome buffet parlor cars, the "Amphion," "Columbia" and "Montauk" and fifteen brilliantly illuminated and gayly decorated open excursion cars seating sixty persons each. These are arranged with portable outside decorations and a separate circuit for all extra lights so that they may be used in regular service when needed. We did a business of over $20,000 in this special service alone during the first summer, 1896.

One regular parlor car route has been established between Flushing and Brooklyn, as an experiment. It has been running now over seven months. Chair coupons are sold as on a Pullman car and the conductor carries a card plan of the car on which the passengers carried are noted and turned in to the general passenger agent after each day's run. The time points are also given so that each run may be kept up to schedule time.

We hope that these remarks may afford some basis for ideas which will increase the business of other street railway companies and demonstrate the necessity for a general passenger department on all large systems.

Cost of Electromotive Power in New York and Massachusetts.

The figures in the following table are given from the last annual reports of the Boards of Railroad Commissioners in New York and Massachusetts for all or nearly all the street railway properties in those two states which operate power stations. The returns are arranged in the order of car mileage run for the year, as the magnitude of operation has theoretically an important influence on the cost of electromotive power.

Of the nineteen companies operating less than 250,000 car miles per annum four only are obtaining motive power at a cost of less than two cents per car mile; six at between two cents and three cents per car mile; five at between three cents and four cents per car mile; one at between four cents and five cents per car mile; and three at more than five cents per car mile.

NAME OF COMPANY.*	Cars owned.	Car mileage for year.	Cost of Electric Motive Power. Per car mile.	Per pas-seng'r.
Schenectady	14	70,000	.1138	.0121
Dunkirk & Fredonia	9	72,142	.0666	.0215
Gardner	6	79,058	.0523	.0112
Hoosick	8	92,231	.0198	.0050
Hornellsville & Canisteo	6	94,680	.0185	.0055
Olean	11	117,530	.0265	.0076
Leominster & Clinton	14	122,306	.0354	.0092
Pittsfield	15	130,106	.0378	.0066
Reading & Lowell	7	142,797	.0357	.0147
Greenfield & Turners Falls	13	160,078	.0219	.0050
Athol & Orange	10	163,797	.0333	.0067
Hornellsville	9	177,025	.0171	.0114
Plymouth & Kingston	12	177,876	.0299	.0081
Kingston City	11	187,650	.0409	.0074
Natick & Cochituate	15	189,767	.0322	.0081
Utica & Mohawk	8	204,306	.0255	.0093
Citizens (Fishkill)	25	213,190	.0242	.0066
Marlborough	14	220,151	.0198	.0060
South Middlesex	16	249,277	.0290	.0071
Gloucester	24	257,613	.0459	.0092
Hoosac Valley (North Adams)	29	279,480	.0292	.0061
Gloucester, Essex & Beverly	23	304,085	.0309	.0084
Ithaca	22	309,701	.0182	.0036
Watertown & Brownville	24	328,500	.0050	.0029
Braintree & Weymouth	20	329,374	.0374	.0135
Rockland & Abington	26	335,441	.0413	.0097
Wakefield & Stoneham	20	335,780	.0143	.0037
Taunton	52	340,523	.0270	.0058
Newton	32	341,244	.0224	.0044
Auburn City	28	381,985	.0104	.0041
Norfolk Suburban	28	382,962	.0416	.0077
Quincy & Boston	42	397,014	.0170	.0032
Buffalo, Bellevue & Lancaster	23	397,625	.0202	.0017
Haverhill & Amesbury	56	401,160	.0413	.0114
Newburgh	33	405,971	.0231	.0057
Middletown-Goshen	21	414,210	.0142	.0048
Geneva, Waterloo, Seneca Falls & Cayuga Lake	30	417,000		.0069
West Side (Elmira)	14	426,928	.0160	.0053
Niagara Falls & Suspension Bridge	29	444,652	.0177	.0054
Yonkers	29	445,190	.0374	.0093
Northampton	30	496,648	.0163	.0044
Elmira & Horseheads	48	505,890	.0169	.0062
Poughkeepsie City & Wappingers Falls	20	550,108	.0129	.0038
Worcester & Suburban	48	619,408	.0315	.0063
Jamestown	50	627,784	.0231	.0059
Fitchburg & Leominster	37	631,137	.0210	.0062
Interstate Consolidated	55	652,577	.0281	.0078
Union (New Bedford)	88	747,915	.0207	.0030
Holyoke	69	803,712	.0179	.0042
Utica Belt	70	827,095	.0153	.0036
Binghamton	73	839,500	.0094	.0023
Globe (Fall River)	100	1,243,051	.0197	.0039
Syracuse Consolidated	113	1,266,923	.0204	.0091
Brockton	112	1,291,633	.0240	.0050
Lowell, Lawrence & Haverhill	143	1,443,730	.0243	.0043
Syracuse Street	106	1,687,463	.0140	.0040
Lowell & Suburban	144	1,802,093	.0146	.0034
Steinway	226	1,885,638	.0147	.0042
Worcester Consolidated	139	1,929,992	.0426	.0084
Coney Island & Brooklyn	164	2,062,044	.0182	.0057
Troy	206	2,223,585	.0113	.0025
Albany	113	2,229,977	.0151	.0035
Brooklyn City & Newtown	272	2,332,536	.0188	.0033
Springfield	175	2,358,622	.0188	.0044
Union (N. Y.)	135	2,486,963	.0197	.0050
Brooklyn, Queens County & Suburban	309	3,389,491	.0220	.0048
Rochester	227	5,010,862	.0144	.0042
Lynn & Boston	519	5,379,216	.0188	.0038
Buffalo	255	6,262,500	.0178	.0012
Brooklyn Heights	1811	21,500,745	.0086	.0017
West End	2422	25,841,907	.0277	.0043

*Abbreviated.

Of the twenty-one companies operating between 250,000 and 500,000 car miles per annum, nine are obtaining motive power at a cost of less than two cents per car mile; five at between two cents and three cents per car mile; three at between three cents and four cents per car mile, and four at between four cents and five cents per car mile.

Of the ten companies operating between 500,000 and 1,000,000 car miles per annum, five are obtaining motive power at a cost of less than two cents per car mile; four at between two cents and three cents per car mile and one at between three cents and four cents per car mile.

Of the fifteen companies operating between 1,000,000 and 5,000,000 car miles per annum, ten are obtaining motive power at a cost of less than two cents per car mile; four at between two cents and three cents per car mile; and one at between four cents and five cents per car mile.

Of the five companies operating over 5,000,000 car miles per annum, one is obtaining motive power at a cost of less than one cent per car mile; three at between one cent and two cents per car mile; and one at between two cents and three cents per car mile.

The Brooklyn Heights Railroad Company has the cheapest power of any steam plant in the list, $.0086 per car mile; the Binghamton Railroad Company follows with $.0094, and among the others whose costs of motive power are especially low may be mentioned the Wakefield & Stoneham Street Railway Company, $.0143; the Auburn City Railway Company, $.0104; the Middletown & Goshen Traction Company, $.0142; the Poughkeepsie City & Wappingers Falls Electric Railway Company, $.0129; the Lynn Street Railway Company, $.0140; the Lowell & Suburban Street Railway Company, $.0146; the Steinway Railway Company, $.0147; the Troy City Railway Company, $.0113, and the Rochester Railway Company, $.0144.

It should be noted that the reports of cost of electromotive power for all the Massachusetts roads include repairs and depreciation of station plant, which is not the case with the New York roads.

Practice Versus Theory in Painting.

BY CHAS. KOONS.

Professional theorizing on any question often falls short of the results secured by every-day practice. Theory may seem to point to what might be expected under favorable circumstances, but practice shows what will result under all tests and trials. That theory is always subordinate to practice is well illustrated in two lines of one of Cowper's poems.

> Truths that the theorist could never reach,
> And observation taught me, I would teach.

A case to the point is the recent treatise by Professor Spennrath on "Protections for Iron," in which special tests were made on the wearing qualities and decay of linseed oil and special paint pigment, and an effort was made to show wherein lay the superiority of one over the other. In these tests, which were quite numerous and involved a great amount of thought, and probably more time than was really necessary, a theory was worked out that was entirely foreign to every day practical facts, and entirely opposite to views held by some eminent chemists. The tests were made by one who could not enter into the real science of the matter, on account of a lack of practical knowledge and that wisdom which only comes to those who are thoroughly acquainted with the nature of both pigments and oils. The theory worked out in the above instance was probably correct when viewed in the study or laboratory, where artificial means were used to determine the effects of heat, acids, salts, etc., but when compared with practical every-day weather exposure, the paint being mixed by experts in their line, such tests will show entirely different results.

The wear and tear of any paint substance when exposed to the natural elements is quite different from the destruction of heat and acids for a few days, on either oil or pigment, or both, when mixed in emulsion. Oil, being the medium in which the pigment is mixed, is liable to decay sooner or later, but even after it has gone there is left the layer of pigment scum that has grown into a hard incrustation. This answers for a preservative for a long time, and yet there may not be any resemblance of oil left. The same thing can be seen in the decay of varnish; the oil, being the life of the varnish to a certain degree, can be entirely destroyed, and still there may be the gum incrustation left, which preserves to a certain extent, but, of course, not in the way it did at first, nor would anyone expect it. Still, on the same grounds we could not say that when the oil decayed that was the end of the varnish, because there is life left yet, chemically speaking, in the gum that was used in the varnish, just as there would be life in the pigment, because it sticks. It may crack and do worse things, still it is preserving the surface to a certain extent.

The theory put forth by Professor Spennrath was that the pigment of an oil paint has no influence over the durability of the binding material, namely, the medium in which the pigment is mixed. To this we make an emphatic objection, and can prove to the satisfaction of anyone the falsity of the theory. If this were true, there would be no need of so many different kinds of paint pigments, and possibly the paint dealers would have no trouble in finding just what was the best, and all use it.

It is a well known fact that when any paint pigment is wet with oil of any kind, that the emulsion made by the mixture takes up to a certain degree the nature of both pigment and medium in which it is mixed. One becomes in a measure permeated with the nature of the other. Both the oil and the pigment will be found different from what they were before they were mixed: one affects the other; there are certain natural elements in certain pigments that surely add to the wearing qualities of the oil, and *vice versa*. All pigments do not have these fatty unctuous natures. For instance take graphite, it is naturally of a greasy, pliant character; that shows that it has in its make up certain natural oils that makes it better for wear than others. As the other extreme take whiting; it is void of anything resembling oil, but is easily permeated with dampness which makes it a poor paint pigment, because it does not add anything to the oil when mixed with it, but rather deters it, on account of the dampness that it gathers. The mixing of raw oil with a pigment like graphite surely toughens the pigment, so that it will last longer than it would if mixed with other oils, like nut or poppy oil, or even lard oil. This is what makes it the best for the painter's use. It has been shown by experience to be the best for the purpose.

It then stands to reason that if there be anything in a natural pigment that will help the medium in which it is mixed, to withstand the wear and tear of the elements it will make better paint than a pigment that deters, as it were, by dampness, etc.

It can be plainly seen that if the Spennrath theory were correct, there would be a revolution in the paint business. Otherwise, why the need of paint chemists, or the trouble, attention and study by painters in general, to adapting one pigment for one purpose and another for other purposes? Any practical painter knows that red lead pigment will not do for all purposes in painting, although it is one of the best, if not the best, for certain kinds of work, but there are other pigments that will wear better and last longer. It is not necessary to state that this is the science of painting, because everyone knows that there are many different kinds of natural paint pigment, and that one is preferred above another for the reason that it will wear better. This is being found out by the practical painters of the day. That is their business. It doesn't take very much of a painter either to tell whether lead will outwear lamp black, or iron mineral outwear graphite, when mixed in the same medium. It might be said with the same consistency that one fibre will wear the same as another when mixed with wool, or that one kind of grain will make as good bread as another when mixed with water. How would it do for the varnish makers to claim

that one kind of gum would do for all kinds of varnish? They use principally the same oil; still there is virtue in one gum that is not found in another, and so it goes through all products.

There are all kinds of paints, some bad and some very bad, and yet we know of very many good ones, and possibly some that are better, and still others that are the best, that stand at the top. So we see that there is quite a variety, and we dare say that all of these can be made up with the same medium and show this difference. This has been the experience of years, however much professors of chemistry have tried to prove otherwise. There is no better evidence of the quality of material than that which comes from the painter, who is continually on the watch for any lack of wearing quality in any new paint that comes out. It is to his interest to find out the why and the wherefore, the same as any other mechanic in his line; to be otherwise would be like going to a tailor to have a pair of shoes made. A thorough mechanic is better known by his work than his name in this respect.

Street Railway Parks.—IV.

AKRON, O.

The Akron, Bedford & Cleveland Railway serves a number of parks, of which the most important is that at Silver Lake. This park, which is owned by private persons, is located about 30 miles from Cleveland and contains about 25 acres, not counting the lake which covers about 100 acres. The park is also served by the lines of the Akron & Cuyahoga Falls Rapid Transit Company and the Akron Street Railway & Illuminating Company, whose cars come in over the tracks of the Akron, Bedford & Cleveland Company. The fare from Akron to the park is ten cents each way, and most of the patrons come from Akron. The rate from Cleveland is fifty cents for the round trip and twenty-five cents for children. The railway companies issue with their tickets admission coupons, which are detached at the entrance to the park. Upon the return of these coupons by the owners of the park the railway companies pay five cents each for adults and 2½ cents for children. This same admission fee is charged to persons who do not come by the electric roads.

The country surrounding the lake is rolling and extremely picturesque, and the lake itself is fed by a series of springs and has an average depth of nearly 20 ft. It is well stocked with native and cultivated fish. The picnic grounds have many attractions in the way of games, merry-go-rounds, etc., dancing, boating, water toboggan, etc. One electric launch is in operation on the lake and attracts considerable attention. It was built by the Electric Launch Company, and the owners of the park state that considerable business is done with the boat. The necessary power for charging the batteries is given by the electric railway company because the boat is so much of an attraction as to increase the number of passengers carried by the cars.

The park last summer enjoyed a large patronage from Sunday School picnics. No liquor of any kind is sold on the ground, and to this fact is accredited the continued popularity of the resort for Sunday school excursions. The different companies carry entire Sunday schools directly from their churches to the grounds.

ALLENTOWN, PA.

The Allentown & Lehigh Valley Traction Company owns one park, located about midway between the two cities of Allentown and Bethlehem. No admission fee is charged. The company has established one carrousel, and during the summer months gives at stated intervals different kinds of entertainments, theatrical and otherwise. These are considered profitable, but the company has not been as well pleased with the drawing qualities of fireworks exhibits. The company does not lease the restaurant privileges.

MANCHESTER, N. H.

The Manchester Street Railway Company leased a park property on the shore of a lake last year, and was so well satisfied with the increased receipts from traffic that more elaborate entertainments will be presented this year than during 1896. The park is situated about 4 miles from the city and there is no admission fee charged. Last year the exhibits were parachute drops, wire walking, fireworks and band concerts every Sunday afternoon and evening. The restaurant, riding gallery and steamboat privileges were leased last year by the owner of the property.

PADUCAH, KY.

The People's Street Railway Company is adding a number of improvements this year to Ramona Park, one of its suburban resorts, to which a considerable number of passengers were transported last year. At this park the company has recently completed a theatre which will be called the Casino. Here will be given theatrical entertainments of a varied character, and during the summer dramas and operas will probably be presented. No admission fee is charged to the park, but a round trip ticket, including admission to the theatre, is sold for 15 cents, with an additional charge of 5 cents for reserved seats or front rows. The stage is about 35 ft. × 25 ft. The rest of the park is attractively laid out with a large number of lawns with trees, and flowers. At night the park is illuminated by electric lights of all colors in glass lanterns, hung from the trees.

The company is also building a base ball park about one block away from the amusement park, and expects to do a large business here. The Paducah Base Ball Association is a member of the Central League and considerable interest is taken in that sport in Paducah and neighboring cities. The base ball grand stand will seat 2500 people or more.

TOLEDO, O.

The Toledo Traction Company has one of the most extensive and elaborate pleasure resorts in the country, served exclusively by an electric railway. This park is at Maumee Bay 5 miles north of the city on the lake shore. Here is situated a very extensive casino in which is located a theatre. Fifteen cents fare is charged for a round trip, including admission to the casino. Reserved seats in the theatre are sold at from 10 to 25 cents. There are also 1500 free seats in the theatre. High class vaudeville entertainments are presented and two shows are given daily. The other attractions at the park are various, and include naphtha launches, row boats, merry-go-rounds, etc., all of which privileges are leased. On July 4 a fireworks exhibit is usually given. A good idea of the traffic induced by this park is shown from the fact that during the season of 1896 400,000 passengers were carried on the cars to the park. The park is owned and operated by a separate company.

EASTON, PA.

The Easton Transit Company serves two parks, both of which are leased from the owners. One is named Island Park, and is 4 miles west of the city. The other is entitled Shawnee Springs, and is situated 2 miles north of the city. An admission of five cents was charged at Island Park, but was taken off last August. Free theatrical performances were furnished when the five cents admission was charged, but were discontinued when the park was made free. Admission was then charged to a casino located in the park where performances, musical, theatrical, etc., have been given during the past two seasons. Island Park particularly is very elaborately fitted up with every appliance installed at pleasure resorts, and has proved very popular. The company leases its restaurant privileges. While the returns in the way of traffic are considerable, the managers of the company believe that it would be advisable to separate the business of railway and park operation by leasing the latter property, and are taking steps to do so.

OTTAWA, ONT.

In addition to the park attractions of the Ottawa Electric Railway Company, described in former issues, the company is developing a new resort at the west end of the city, entitled Victoria Park. Here the company is erecting a large auditorium where it proposes to give concerts and other entertainments during the coming season. The park will be made brilliant with several thousand incandescent lights, attractively arranged.

PITTSBURGH, PA.

The Second Avenue Traction Company serves one park, which is situated about 7 miles from the center of the city. This park is known as Calhoun Park and contains over 51 acres. It is an ideal pleasure ground, easy of access and complete in all details. It possesses many natural advantages, and is thickly shaded by forest trees. A large pavilion is provided and fully equipped for dancing and dining purposes, and there are a number of refreshment booths for the accommodation of the patrons of the park. Natural springs of clear, cool water and a number of wells are scattered throughout the park. The railway company owns the park and supplies all the attractions. A pleasure railway and a carrousel have been erected on the grounds at considerable expense, but they are found to be sources of pleasure and amusement to both young and old. The company has never tried fireworks or theatrical performances as attractions at the park, but extends a cordial invitation to churches, public schools, Sunday schools, societies, etc., to hold their picnics and excursions at the park. A small charge is made for the use of the park in such cases. No admission fee is generally charged except when the use of the park is given exclusively to churches, schools, etc., for picnics to raise money for charitable purposes when an admission fee is charged at the gate. Sacred concerts are given Sunday afternoons and evenings, but the carrousel and roller coaster are closed on Sundays. The increased suburban travel going to the park has been very gratifying, and it is the opinion of the managers of the company that the park is a means of greatly increasing the passenger receipts, and to this the company looks mainly for revenue from the park. At the same time the amusements at the park have been a source of considerable revenue, and it is thought that these can be greatly increased to advantage. The receipts from these attractions, for a number of fairly good days last year, averaged $111.73 per day, while the expenses of maintenance and care were $43.25. The additions proposed during the coming season include a shooting gallery, a cinematograph and other amusements.

VIEWS IN CALHOUN PARK—PITTSBURGH.

TERRE HAUTE, IND.

The Terre Haute Electric Railway serves two parks, one of which it owns and the other is owned by the city. They contain about 25 acres each, and are situated about 2½ miles from the center of the city. The railway company's park contains a large casino building, part of which is fitted up as a theatre where high class vaudeville and theatrical entertainments are provided. An admission fee of ten, twenty and thirty cents is charged, which goes to meet the expenses of the entertainments. A riding gallery is in operation, but there are no water amusements in the park. The riding gallery privilege is leased. The company found during the last season that the theatrical performances, owing to the hard times, did not draw as large a crowd as was expected, and the casino was closed earlier than was usual. The restaurant privileges are leased, and as the company desires to have an excellent restaurant service the lessee simply pays for light and services rendered. The company states that good increase in passenger receipts can be secured from a park properly situated, but states that a park requires great tact and skill in managing, or the expenses of operation will exceed the profits of increased traffic. The desirability of a park owned and operated under railway management depends entirely on the fondness of the community for amusements.

TAMPA, FLA.

The Consumers' Electric Light & Street Railway Company serves two parks, one of which is public property and the other is leased by the street railway company. One of these parks is situated 4 miles from the city limits, and the other 1½ miles. No admission fee to either park is charged. Balloon ascensions, trapeze and high diving performances are provided at both places. The privileges at one park are leased and at the other are operated by the railway company. No fireworks or theatrical performances are given.

CLEVELAND, O.

The Cleveland City Railway Company serves one private park and three city parks. Twenty cents admission fee is charged to the private park, which is supported by the gate receipts, and fees from various amusements, and from material sold. The company states that fireworks and theatrical performances have not taken very well in Cleveland, but thinks that the parks have made a very satisfactory increase in the total receipts of the road.

LOWELL, MASS.

The Lowell & Suburban Railroad Company has gone quite extensively into the establishment and maintenance of street railway parks. One of the principal ot these is Mountain Grove Park. A special feature of this park this season will be a zoölogical garden. The animals to be exhibited include the following: pair of lions, pair of leopards, pair of striped hyenas, pair of black bears, pair of elks, one camel, one llama, two cages of monkeys with five in each cage, one large baboon, one ostrich, pair of brown pelicans, pair of white swans, cage of macaws, cage of cockatoos, three cages of small animals, a kangaroo and a large collection of small birds. There is also a bear pit and a deer paddock. In another part of the grounds the company has a large base ball field. Besides base ball games the management has arranged to have Pain produce the "Fall of Pompeii," and other exhibitions. Probably Wild West and theatrical entertainments will also be given during the season. The park is leased to Thomas Golden.

NORRISTOWN, PA.

The Schuylkill Valley Traction Company serves four parks, of which one is owned by the company and the rest are public property. No admission fee is charged. All kinds of entertainments are provided, including row boats, there being a lake on the one which is the property of the company. The boating privilege is leased by the railway company. The company has not a very high opinion of the value as traffic producers of fireworks or theatrical performances, when their expense is taken into account. The average increase in railway traffic from the park system is considered to be 20 per cent.

A new resort, entitled Plymouth Park, will be added this year near Norristown by the Roxborough, Chestnut Hill & Norristown Passenger Railway. It will contain 40 acres, all well wooded country overlooking the Schuylkill Valley. A lunch pavilion and other attractions will be established.

OPERATING EXPENSES.

An electric railway company operating in a town of 15,000 inhabitants, located in one of the Eastern States, gives the following interesting particulars in regard to the income and expenses of its park property during the last two years. In 1896, when the park was free, the rentals from various privileges amounted to $1050, of which $500 were from the restaurant privileges. The season is about four months in length. The total expenses of the park, including the rental of the ground, were $3500. During 1895, when an admission fee of five cents was charged the total receipts were $4000.

Another electric railway company, operating in a town of about 90,000 inhabitants and having a particularly fine pleasure resort, gives the following as the amount received for rentals during the past year: for restaurant privileges, $1000; for merry-go-rounds, $750; for boat privileges, $200.

Freight Transportation on the Newburgh (N. Y.) Electric Railway.

The Newburgh Electric Railway Company, whose system was described in the STREET RAILWAY JOURNAL for February, 1896, has gone quite extensively into the transportation of light freight and merchandise, and the results secured during the past year have been quite satisfactory, according to the president, Benjamin Norton. The line extends from the city of Newburgh on the Hudson River west a distance of 12 miles to Walden in the Wallkill Valley, traversing a very rich fruit and farming region.

One important item in the freight transportation business has been milk, and during the past year about 50,000 cans of milk have been taken to Newburgh for shipment by boat, principally to New York City. The milk is taken all along the route in a closed car, leaving East Walden daily about 4.30 p. m. for delivery to the night boat. During summer the car is chilled by ice, which is furnished by the shippers. The empty cans are returned on a flat car drawn behind the freight car. The rate charged is from 5 to 7½ cents per can. As the shippers place the cans on the car, and as the cans are transferred to the boat by employes of the boat company, no handling of the cans by employes of the electric railway company is required. A great deal of condensed milk is also carried, the line being not far distant from the large factory of the Borden Company. Condensed milk is packed in cases of 60 lbs. each, and a rate of seventy cents a ton is charged for transportation between Walden and Newburgh.

In miscellaneous farm products, the principal items carried have been grapes, apples, potatoes, hay, and straw. Of these the company has carried the last year about 1000 tons of hay, and during September 1896, between 100 and 200 tons of grapes were transported. The freight carried west, from Newburgh to Walden, is mostly miscellaneous merchandise. This is handled principally as an express service through the agency of the National Express Company which delivers the packages at the Walden terminus. The freight rates for this miscellaneous merchandise are classified, but average $1 a ton. This service has proved a great convenience for merchants in Walden as goods purchased in New York are shipped to Newburgh by the night boat and delivered in Walden early the next morning.

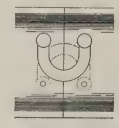
The company also does a large business with several extensive cutlery works which are located in Walden, in delivering raw material and transporting to the river the finished goods.

The company also carries the mail between the two cities and operates between three and four mail trips a day. Two regular freight trips are run during the day, and express trips are made every hour by the use of combination passenger and express cars.

While some companies have found the electric mail, express and passenger business unprofitable, this has not been the experience of the Newburgh Electric Railway Company which estimates the cost of performing its freight and express service at 38 per cent of the gross receipts.

Rail Bonding in Brooklyn.

The Brooklyn Heights Railroad Company has devoted a great deal of attention to the proper bonding of track, and has tested and experimented with a large number of different types of bonds. As a result the company is using principally this year for its angle plate joints the Atkinson rail bond. Two No. 0000 bonds are used at each joint under the angle plate, one on each side of the web, as shown in the accompanying engraving. The distance between bond holes is 3¼ ins. The rails are cross connected every 500 ft. by means of plates soldered to the rail webs and joined by a 500,000 c. m. cable. One or more cables are also run under all special work, connecting the straight rails. Overhead return feeders of the same size are used in the lower part of the city.



METHOD OF BONDING

The company last year installed 2000 Falk joints, and is well satisfied with them. No bonds are used with these joints.

LETTERS AND HINTS FROM PRACTICAL MEN.

Power Station Controversy in Chicago—II.

The STREET RAILWAY JOURNAL has received, during the last month, the following letters in relation to the criticism by Messrs Pierce, Richardson and Foster of the Chicago City Railway plant at Forty-ninth Street, and the reply by R. J. Hill, chief engineer of the Chicago City Railway Company, published in the last issue.

STATEMENT FROM MESSRS. PIERCE, RICHARDSON AND FOSTER.

CHICAGO, ILL., May 14, 1897.

EDITORS STREET RAILWAY JOURNAL:

The May issue of the STREET RAILWAY JOURNAL contains a copy of a report made by us, upon the installation as a whole, and upon the probable results to be realized by the equipment recently placed in the No. 2 Power Station of the Chicago City Railway Company, together with a criticism of our report, made by Mr. R. J. Hill, chief engineer of the railway company, to the president. To place ourselves right before you and the engineering public, we deem it desirable to make a little explanation of our connection with this subject, before taking up the criticisms made by Mr. Hill.

The editorial statement, with which the article mentioned commences, is not exactly correct. The following is the true explanation of our connection with this subject:

About four years ago the Chicago City Railway Company was installing what is now known as Station No. 1 at Fifty-second and State Streets. The equipment which was put in then, and which is there now, was not even at that date up to the most recent engineering practice, but the building of so large a plant, of an obsolete design, did not attract a great deal of attention, for the reason that just at that time, very many other large installations were going in, and among other things, the building of the World's Fair was progressing, so that the Fifty-second Street, or the No. 1 Power House did not stand out so prominently as a large enterprise as it would now. When, however, last year the Chicago City Railway Company, commenced to build the new plant at Forty-ninth and Oakley Avenue, or Station No. 2, and it was found that they were proposing to install a duplicate of the Fifty-second and State Streets Station, the expressions of astonishment were common among engineers, machinery builders and dealers, that absolutely no attention should have been paid to the recent extensive and valuable developments in steam engineering. These expressions of astonishment and of derision became so common that they attracted the attention of one of the principal owners of Chicago City Railway stock, who finally concluded that it was within the limits of possibility, that mistakes had been made in the general design and selection of machinery. This gentleman, therefore, desiring to inform himself on this subject, sent for us and instructed us to make an examination of the new station; the first installment of which was nearly completed, and to make a report to him, as to the quality of material and propriety of selection, which had been exercised in designing and building the plant. He also requested us to examine the equipment of Station No. 1, at Fifty-second and State Streets and the operation records, and inform him as to the probable results which could be expected from the new station. We were further requested to have our report prepared within the shortest possible time. We, therefore, made the inspection and report as detailed as we possibly could, in the rather limited time at our disposal and submitted it on Feb. 20.

This is a correct statement of our connection with this matter. We have no apologies to make for anything said in the report, or corrections to add to it. We did the work strictly in a professional way, just as we have done similar matters before, and as we propose to continue doing in the future, and having made the report, supposed that our connection with the subject ceased.

The only reason we pay any attention to Mr. Hill's criticism is to correct his glaring mis-statements, and for the benefit of such persons, other than engineers, who may have read Mr. Hill's article and may have been thereby misled; also in deference to the courtesy with which we were received by Mr. Hill's superiors.

We will follow Mr. Hill's groupings and in reply to the first paragraph of the communication, will say that any two stations each having horizontal tubular boilers, Murphy smokeless furnaces, single cylinder, double engines, rope drives to head shaft with a dynamo on each end are "similar," notwithstanding the fact that the units are of different sizes.

EQUIPMENT OF STATION NO. 2.

In our report under the heading of "Boilers," we, in no place, said that horizontal return tubular boilers are not economical steam generators. This type of boiler is too well known, and there are too many of them being built and installed every year to render any description necessary. Such boilers certainly *can* be set and operated to give good economy, and there are many of them so set and operated; but for a station of this size where large units are desirable, where floor space is at least of some value, where high pressures are even more desirable and where every economy should be considered, we still maintain that water tube boilers would have much better filled the requirements than the type selected. Mr. Hill instances the installation of some boilers of this type by Dr. Charles E. Emery, of New York, undertaking to prove by the fact of such installation that Dr. Emery's opinion is that they are the most economical type in use. There is nothing whatever in the extract referred to proving that such is Dr. Emery's opinion, and the largest plants ever built under his supervision are equipped throughout with water tube boilers. Any engineer of experience recognizes the fact that different conditions require different treatment and what may be a most desirable device for one situation and set of conditions is not necessarily the most desirable for an entirely different set of conditions. The conditions under which Dr. Emery installed the horizontal tubular boilers referred to are not stated, and therefore no weight whatever can be attached to his use of them in contradiction to our statement, and the same is true in the other instances quoted. The horizontal tubular boiler is a good design of boiler and, as stated above, can be set and operated to give good economical results, but it is limited in its adaptability to conditions and situations just as every other device known to mankind has its limited field. There are many situations where the writers would not hesitate one moment about adopting a tubular boiler as there are other situations where their use would not be considered for one moment. Mr. Hill could, to considerable advantage to his company, devote some time to the inspection of the large plants recently installed.

Our report stated that two valves should be placed between each boiler and the steam header. The desirability of the use of two valves in this place is perfectly obvious. Valves will leak, and large ones generally do, and always at a most inopportune time, and in our Western country where bad waters are common and frequent boiler cleaning is necessary, it certainly is poor engineering to place only one valve between a man inside of a boiler, cleaning or repairing it, and a steam header with even only 110 lbs. pressure in it.

As Mr. Hill evidently does not understand our recommendation in regard to the connection between the individual boilers and the steam header, we will state that we did not advise to make it with wrought iron bent pipe, which is unquestionably very expensive, but by the means of common wrought iron pipe and elbows, as stated in our report, allowing the expansion to be taken up by the swing of the connections on the threads of the joints, rather than by any elasticity of the material itself. This arrangement is so common and feasible, it did not occur to us that it would be necessary to explain it in detail.

HEADERS.

Mr. Hill also seems to be mixed in regard to the anchoring of the headers, and we will, therefore, further explain this. Each header should have been fastened rigidly in the center of its length. From the center each way to the end, the header should have been supported on rollers, allowing it to expand freely in both directions. The connection from one header to another should have been made in a similar manner as we have outlined for the connection from the boilers to the header itself, viz., by wrought iron pipe and elbows.

WATER PIPING.

Mr. Hill's criticism of our report in regard to the feedwater connections to the boilers is so at variance with common knowledge and practice, that an answer to it would be entirely superfluous.

ECONOMIZERS.

So far as economizers alone are concerned, we would state that no one has a higher opinion of such devices than the writers have. They are valuable adjuncts to any boiler plant which is overworked or where there is not room enough available to permit of the installation of a sufficient number of boilers to carry the maximum load without forcing.

We have, at no time, stated that economizers may not be desirable in connection with the boiler plant in Station No. 2, as at present designed, but we still maintain that if he has sufficient boiler capacity to operate the station by running his boilers at their highest economy, which should, of course, be the case in a new plant, economizers are not necessary or desirable.

In a new installation designed to fulfill certain requirements, the boilers should be installed and operated so that each one will furnish its quota of the steam required, when working at its point of greatest economy, or where the fires can be kept hottest and the gases thrown off at a temperature slightly above the temperature of the steam and the temperature necessary to maintain the strength of draft required to burn the particular kind or grade of coal to be used. Any temporary overload can be handled successfully by forcing, say, one battery, above such normal or economical point, permitting the others to run along always at such economical point

Water tube boilers of proper design may be forced above their normal or rated capacity, with a smaller loss of economy than can tubular boilers.

Temperature is an important factor in all chimney calculations, as there is nothing to cause a draft in any chimney but the difference in weight, due to the difference in temperature between the column of gas inside the chimney and a column of air of corre-

sponding height and area outside, and it is possible to increase the strength of draft in any chimney 25 per cent by simply increasing the temperature of the gases at the base of the chimney. The temperatures mentioned in our report are simply those which experience tells us are necessary to maintain proper draft with the kind of coal mentioned, and were simply cited as examples. Other coals require different temperatures. He further states that "a stack should be designed with a view to furnish ample draft almost entirely independent of the gases." This statement is absurd on its face, particularly in this instance, as it will be found by comparison that the size of his stack was taken from the standard tables of sizes, which tables are based on a minimum temperature of 450 degs. F. of the gases entering at the base. The circulation in any boiler, which is, of course, of vital importance to its economy, aside from the type, depends not upon the temperature of the waste gases leaving it, but upon the temperature of the fire, and it is perfectly feasible, and well understood by all who are familiar with, and who have had experience in designing steam boilers and furnaces, to so proportion the furnace to its boiler that a perfectly white hot fire may be maintained in the furnace, the gases leaving at a comparatively low temperature, and thereby a very high percentage of the theoretical calorific value of the fuel being realized. Further, it is a demonstrated fact that a more perfect circulation is obtained in a well designed water tube boiler than can be had in a tubular boiler; especially is this the case where it is necessary to force the boiler, which condition, as already considered, is often demanded in a power station of the class under consideration.

In the calculations as to the economy, as made in Mr. Hill's report, it is claimed that "with gases leaving the boiler at 450 degs., 150 degs. can be used to increase the feedwater temperature with an economizer from 210 degs. to 285 degs., and a saving of 12 per cent in fuel will result." A simple calculation will show that under the conditions stated, the saving, instead of being 12 per cent, will not exceed 7½ per cent, and, in fact, this is all that the economizer people claim in their published literature.

To show the fallacy of such reasoning as to reduce the temperature of the gases to 300 degs. where the same enter the stack, we have already called attention to the rules by which this stack was designed, and these rules or formulæ are all based on the minimum temperature of entering gases to be 450 degs. Now by such a reduction in the temperature, the nominal horse power capacity of the stack would be likewise decreased in the ratio of the difference between gases at the lower and at the higher temperature.

Mr. Hill makes the statement that it is an established fact that the repairs on a direct connected plant are something enormous. While with such direct connected plants as Mr. Hill has been connected or acquainted with there may have been large expenses for repairs, if he will post himself a little on this subject, and investigate the large number of direct connected power stations equipped with the type of machines which he condemns, he will find that he either previously had not investigated the subject sufficiently, or had been misinformed.

The following is a short list of modern stations, all with direct connected equipments, a number of them in or near Chicago, the operation of which stations will alone disprove his statement:

Chicago & Proviso Street Railway Company	2	750 K. W.
North & West Chicago Railway, Chicago	3	800 "
Troy City Railway Company, Troy, N. Y.	1	800 "
Citizens' Street Railway Company, Detroit	4	1,000 "
Albany Electric Railway Company, Albany, N. Y.	1	800 "
West End Street Railway Company, Boston	2	800 "
	2	1,000 "
	2	1,200 "
	2	1,300 "
	2	1,500 "
Garden City Construction Company, Chicago	4	500 "
Cass Avenue & Fair Ground Railway, St. Louis	3	800 "
Brooklyn City & Newtown Railway, Brooklyn, N. Y.	1	1,500 "
Market Street Railway Company, San Francisco	8	400 "
Metropolitan West Side Railway Company, Chicago	2	800 "
	2	1,500 "
Cincinnati Street Railway Company, Cincinnati, O.	4	800 "
Electric Traction Company, Philadelphia	5	250 "
	4	800 "
Union Traction Company, Philadelphia	3	900 "
People's Railway Company, Dayton, O.	1	800 "
Atlantic Avenue Company, Brooklyn, N. Y.	1	800 "
West Chicago Street Railway Company, Chicago	1	1,500 "
	3	1,500 "
	1	750 "
Toronto Street Railway Company, Toronto, Ont.	1	900 "

In addition to the above, the Northwestern Elevated Station intends to install three 1500 k. ws. and one 750 k. w. and the Union Loop three 1500 k. ws.; all of these to be direct connected units.

There are six claims made by Mr. Hill of the advantages of rope drive generators over direct connected units.

First.—Flexibility between engines and generators. There are two ways of taking this statement. If by flexibility he means the dividing of the electrical units so that a part or all can be run from any one or all of the engines installed, it is a point well taken; but, an examination of the arrangement of the machines at Station No. 2 will show conclusively to any engineer that he has almost, if not entirely, defeated, by his faulty arrangement, any claim to economic flexibility. Furthermore, considering the fact that Station No. 2 has twelve (12) units in engines, even though they had been direct connected units, it certainly would have been a very flexible plant as the number of separate units in a plant is the key-note to its flexibility. If, on the other hand, by flexibility, he means the interposing of a belt or rope between generators and engine, to take up shocks, we would simply quote from our original report, to wit: "That the argument is sometimes used in connection with installations of this character that it is desirable to use either a belt or rope drive from the engine to the generator in order to get a flexible connection. This argument has no force whatever to anyone conversant with the capabilities of the steam engine and experienced in these matters. The flexibility of the connection is relied upon to save the engine from damage in a sudden load. This objection is entirely without weight as any steam engine of good design is as well capable of withstanding the shocks due to sudden increase or decrease of load as is the generator.

Second.—Distribution of weight. We fail to see what advantage can possibly result with an increased number of bearing surfaces over those required for direct connected units, when the sizes of such units are no larger than those as manufactured to-day. One bearing will run certainly as cool as another provided the pressure per square inch of projected area is the same in both cases. If bearings are properly designed, one arrangement can be made mechanically as good as the other. This being so, the fewer the bearings, the better, as increasing the number of bearings unnecessarily increases the number of mechanical parts which require additional attendance.

Third.—Two per cent to four per cent friction load. What is meant by this is not clear. The losses in a direct connected set, due to friction, may be divided into that necessary to turn the engine and armature over with no load, but in an excited field, and that which may be added, due to the load when same is applied; while with rope driven units we have in addition to the above, the frictional losses in the rope, driving gear, idlers and appurtenances.

Fourth.—Do not have to disconnect generators to repair engines or *vice versa*. It is equally true that you very seldom have to disconnect the one from the other to repair a direct connected plant.

Fifth.—Thorough insulation to generators thereby lessening accidents. The manufacturers of generators will readily demonstrate to Mr. Hill that they can insulate them without placing them on insulating bases. At the present time, when it is common practice to make generators with insulation to withstand a pressure of 5000 volts or more, it is a simple matter to place sufficient insulation for only 500 or 600 volts between the conductors and the frame of a generator.

If necessary a generator could be made direct connected and at the same time could be insulated from the engine by an insulating coupling and from the earth by an insulating base, but practice has shown that such an arrangement is not necessary for generators carrying such pressures as are used in the plants under discussion.

Sixth.—His sixth claim that the life of belted apparatus is from 25 to 50 per cent greater than in direct connected apparatus, certainly emanates from his imagination, as facts and figures, which data he could have easily procured from the large central stations throughout the country, absolutely disprove same.

To fortify himself, as to some of his claims, he gives as one reason for not using direct connected apparatus, that the power house of the Union Traction Company, Philadelphia, was destroyed by fire, caused by grounding the current from the overhead traveling crane, the hook coming in contact with the commutator of one of the generators that was in operation, and states, that this plant had compound, direct connected units. What possible bearing this has on the subject, we fail to understand. The fact that it was a compound engine certainly had nothing to do with the fire and there surely would have been a fire just the same if it had been a belted plant, although he evidently condemns, and attributes the fire to, the installation of such an equipment.

He next cites that the Detroit Street Railway Company had compound, direct connected units and that they were equipped with three machines; two of the armatures being destroyed, while the third was in repair, tying up the road for several hours. If they had only had three belted units and two were destroyed and one up for repairs, the plant would unquestionably have been tied up just the same.

As to his claim that they have been tinkering with the generators of the Western Avenue plant ever since they were installed, Mr. Hill is either unacquainted with the facts, or else his statement was intentionally misleading and unfair to the manufacturers. His statement with regard to this plant can best be answered by a copy of a letter to the company furnishing these machines, written Jan. 12, 1897, which we herewith quote:

CHICAGO, Jan. 12, 1897.

During the year 1895 this company installed 7000 h. p. of your direct connected generators in its Western Avenue power house.

The first machine of 1000 h. p. capacity, started on July 2, 1895, and since that date it has been in daily operation, requiring no repairs and developing no defects, either electrical or mechanical. Apparently the life of this machine will be equal to that of shaft upon which it is mounted,

The other generators in the station of 1500 k. w. each were started subsequently, but were not satisfactory in their operation.

We understood from you that they were the first machines of this large size that you had made and that you could correct any defects that might develop in their operation. This you have successfully accomplished, and to-day the machines are giving the utmost satisfaction and are fully doing what you guaranteed.

Yours truly,

GEO. A. YUILLE,
2d Vice-President and General Manager.

OPERATION.

As to the relative cost of a compound condensing, direct connected plant, versus the equipment as installed in Station No. 2, the

figures as given by him mean nothing and are not only misleading, but absolutely incorrect. He states that the equipment as installed cost $345,000 and that a direct connected equipment would have cost $600,000. He is willing to concede a gain of 25 per cent in fuel in a compound condensing equipment over a single cylinder non-condensing, and if he will go further, and put down a fair estimate as to the cost of a plant of that size direct connected, which should not be over $450,000, he will find that the actual saving per annum is decidedly in favor of the compound condensing equipment, or for that matter, a compound non-condensing equipment would have been preferable to the outfit which he has installed.

He next quotes Mr. Blackburn on several recently installed plants with rope drive transmission and uses him as his authority for his following in the same line. As he particularly calls attention to the plant of the Edison Electric Company at Paterson, N. J., we will give a description of same. He could not have selected a plant which more thoroughly condemns the equipment at Station No. 2, and yet claims that the Paterson plant is considered to be up to the very latest practice and is the most economical light plant in America to-day, and, in that statement, we, to a large extent, agree with him, for it is equipped with water tube, high pressure boilers, compound condensing, direct connected engines for all of the street railway generators, for all of the incandescent generators and also uses two 700 h. p. engines, compound condensing, to drive the arc light dynamos. It was impossible to direct connect with the arc light dynamos, inasmuch as they have nineteen 50 lighters, running at a speed of 820 r. p. m., and four 125 light machines, running at a speed of 500 r. p. m. They therefore use a rope drive from two 700 h. p. engines to a shaft properly equipped with friction clutches and belted from said shaft to the individual dynamos. From Mr. Hill's criticisms we are led to believe that he does not thoroughly appreciate the difference between an arc light plant and a power plant, but, if he will go to any manufacturer of arc lighting apparatus, or any party posted on this subject, he can readily have explained to him why 800 and 1000 k. w. arc light machines are not made.

Next is his itemized statement as to the cost of operation, and in this connection we will refer to paragraph 2 of his report to Mr. Wheeler, in which he claims that all water passing through the meter is charged to the company and therefore should be charged to the operation of that plant. We agree with him there, but he certainly should have one charge item of water which would cover the amount used for steam purposes and another for such water as might be used for other purposes, if he intends to itemize as he has done, showing the cost of water per kilowatt of energy. According to his own figures, with regard to the operating expenses of Station No. 1, the fuel costs $.004876 and the water $.000356 per kilowatt hour. The price of coal is $1.40 per ton. The price of water is eight cents for 1000 gals., these figures being the figures given us by the company which he represents. According to these figures, he is getting a horse power of energy at the switchboard with single non-condensing engines with an expenditure of 23.31 lbs. of water. Working this back to the engine and assuming that the loss in the generator, in the wiring, in the rope transmission and in the engine will bring it down to 80 per cent efficiency, as assumed by the street railway company in their calculation, which is a fair assumption, he would be getting an efficiency of 18.65 lbs. of water per indicated horse power per hour, a claim which is absolutely unworthy of consideration, inasmuch as no engine builder of to-day would be willing to make and back up any such wild cat guarantee as an average of 18.65 lbs. of water per indicated horse power per hour, for a simple non-condensing engine. This—his estimate on water consumption—is based on the cost of all of the water which goes into the station, an assumption which would further reduce the water per horse power hour. If 10 per cent of it was used for washing out boilers and for other purposes around the building, it would bring his water consumption down to a little over 16¾ lbs. of water per horse power per hour.

Taking the question of fuel in the same way, it shows that he is using, according to his figures, 4.17 lbs. of coal per indicated horse power or an evaporative efficiency of 4.49 lbs. of water per pound of coal.

Again taking his estimate as to the cost of operation of the new station, or Station No. 2, with coal at $1.10 per ton, his figures show that he expects to get an efficiency of 16.65 lbs. of water per indicated horse power or 3.98 lbs. of coal per indicated horse power, which means an evaporation of only 4.19 lbs. of water per pound of coal which is .3 lb. of water poorer economy in his new plant than in his old. If Mr. Hill compiled his figures as to operation of Station No. 1 from data or readings taken at the plant, we would strongly recommend him to revise his methods of taking observations and keeping his records.

His claims as to the water per horse power hour are entirely outside the range of anything ever obtained before with simple non-condensing engines, even on economy tests, while at the same time his figures show that he is getting only about 4½ lbs. of water per pound of coal.

Where or how Mr. Hill got the figures given in his schedule, we are at a loss to answer, but that they are from unreliable, absolutely incorrect data, there can be no question.

Quoting the language of Mr. Hill in his last paragraph addressed to Mr. Wheeler, we would respectfully suggest "That the proper way to look at this matter can only be from a commercial standpoint, backed with *reliable* data and experience."

PIERCE, RICHARDSON & FOSTER.

STATEMENT FROM MR. W. E. BAKER.

THE METROPOLITAN WEST SIDE ELEVATED RAILROAD COMPANY.

CHICAGO, May 15, 1897.

EDITORS STREET RAILWAY JOURNAL:

I notice in your May number an article entitled "Power Station Controversy in Chicago," and while I have neither the time nor the inclination to enter into this controversy from an engineering standpoint as to the proper design of boilers, piping, engines, etc., or to question the advisability of building a non-condensing station for other companies than our own, on which point I have no knowledge of the situation or facts with which to determine the question, I have, nevertheless, been somewhat dragged into the controversy by the published statement of comparison of expenses (page 288 of your May issue) between the Metropolitan West Side Elevated station and the Chicago City Railway stations Nos. 1 and 2. The records of the Metropolitan station are published as those of the only station approximating the commercial results of the Chicago City Railway stations Nos. 1 and 2, and the intention is evidently to show that non-condensing rope driven stations, such as stations Nos. 1 and 2, are (considering interest and depreciation) more cheaply operated and with better results than a compound condensing, direct connected station. On the face of it this statement would hardly be considered correct by most engineers and their conclusion would be that either the Metropolitan station, as well as others, must be operated uneconomically or else stations Nos. 1 and 2 must be operated with extraordinary economy to reach the results tabulated in the article above referred to. We are informed that the Chicago City Railway station No. 2 is not in full operation, and therefore the statement, while it does not clearly purport to be an estimated result, is such, and this fact should eliminate it from the comparison, as results hoped for are not always realized.

As to the comparison between station No. 1 and the Metropolitan station, we are advised that the output of station No. 1 is figured from readings from half hourly observations on the ammeter and not from wattmeter records, while the Metropolitan station's output is measured entirely on wattmeter records. No fair or correct comparison of the cost of the output per kilowatt hour can be made between these two stations on the different basis of measurements of the output. The statement is also made that the result reached by the Metropolitan station is owing to the fact that the kilowatt capacity is 4500 and the output is much larger in proportion to the capacity of the station than that from station No. 1. In this connection it would be well to note that interest and depreciation on the plant can not well be estimated and divided by the output of kilowatt hours, unless the proportional output and the actual capacity of the stations compared were equal; that is, unless the same relation existed between the output and the total capacity of the two stations. In the cases mentioned we do not think this is the case. We understand that station No. 1, of the Chicago City Railway, operates eight out of ten generators of a nominal capacity of 1000 amps. each during the heavy hours, or 80 per cent of the capacity of the station, whereas the Metropolitan station operates only 50 per cent of its total capacity during the heavy hours. There is therefore an evident error in the assumed or nominal capacity of the two stations, and in fact from our observation of both stations we are of the opinion that the capacity of the stations is about as 4 is to 7; that is, the actual capacity of these stations, instead of being 5250 k. w. and 4500 k. w. respectively, should be about as 4 (for the Chicago City Railway station) is to 7 (for the Metropolitan station) and entirely different in the total figures as to the kilowatt capacity from those given.

To conclude, we state again that no satisfactory comparison can, in our judgment, be made on the figures obtained by the different systems of measurements of output in operation at the two stations.

W. E. BAKER,
General Manager.

STATEMENT FROM THE DETROIT RAILWAY COMPANY.

DETROIT RAILWAY COMPANY,
DETROIT, MICH., May 4, 1897.

EDITORS STREET RAILWAY JOURNAL:

In an article on "Power Station Controversy in Chicago," in your May issue, Mr. Hill, chief engineer of the Chicago City Railway Company, states that the Detroit Street Railway lost two of its armatures and that the third was in repair, thus laying up the cars for several hours. This statement is entirely erroneous, so far as the Detroit Railway Company is concerned, as we have never lost an armature since our station was started, and, furthermore, our entire repair bill on our six generators has never amounted to $10.

E. J. BURDICK.

S. H. BENNETT, secretary and treasurer of the Atlanta Railway Company, has recently brought out a convenient pocket circular, descriptive of the points of interest on the Atlanta Railway. The sheet contains ten pages, and mentions the best times for visiting the different resorts and points of interest along the line, with a few words of description about each. A few advertisements of local dealers are included to help defray the cost of the circular.

LEGAL NOTES AND COMMENTS.*

Edited by J. Aspinwall Hodge, Jr., and George L. Shearer,
of the New York Bar.

The Law of the Road.

One who watches the development of the electric and cable street car systems, the growth in the use of the bicycle and the decisions of our courts, respecting the rights of these and of the horse, the motor carriage and the pedestrian in the streets and highways, cannot but be struck with the fact that the law of the road is being somewhat modified to suit a changed and changing condition. We concern ourselves only with the law in respect to the trolley and the cable cars. They are larger, heavier, run at a higher speed, and in the large cities, because of their popularity, with much greater frequency than the horse car. The rails are heavier, the laying of the tracks and their disturbance by reason of sewers, electric subways and pipes are attended with much more expense.

They take more from,and they give more to,the public.

By the necessary law of their being they take a greater use of the street than ever was taken by the horse car. Might makes right in more senses than one, and any one standing upon the corner where a line of electric or cable cars crosses a line of horse cars will notice that the former have the right of way. They have it, because they take it. A sort of custom is established, and when cases arise where the legality of their action is tested in the courts we have conflicting decisions.

It is of supremest moment that street car companies pursue a policy which in the first place, will acquire for them all the rights to which they are entitled, and which are really necessary for the proper conduct of their roads, and at the same time do not attempt to seize rights beyond this and which would cause reactionary legislation either in municipal bodies or in state legislatures, taking away what they should have. Manifestly, the trolley and the cable cars have all the rights in the street that the horse car has. Have they any greater rights? Should they claim any greater rights?

Their right of way is greater than that of the vehicle in the street because of that law of their being, common to them and to the horse car, which prevents them from leaving their rails. The vehicle must turn out of their path. But, it would seem, that they should demand no rights in excess of those which have been granted through the decisions of the court to horse cars, *except where a necessary law of their operation compels them to assert greater rights;* and the instances where this is necessary apparently are few.

The most forcible illustration of one of them is found in the case of the cable car. If a cable car should meet an electric or horse car going in the opposite direction upon a single track, the cable car would manifestly have the right of way to go ahead, other things being equal, and the other car would have to retire, because by an inherent law of its operation the cable car cannot go backwards.

An illustration of some of the above remarks is found in a decision of the appellate division of the Supreme Court of New York within the last few months. There a highway was being repaired and for a distance of 400 ft. was wholly impassable, except between the tracks of an electric railway. The driver of a stage passing up the track was met by a car coming down. He motioned to the motorman to stop, but no heed was paid to him, and the car crashed into his horses and stage. The judge who tried the case held, that while there was negligence on the part of the motorman, there was contributory negligence on the part of the stage driver, because he should have ascertained whether he could pass over the 400 ft. before the car could come along, "which had a right to pass "over the track independent of him."

Here will be clearly seen the effect of the attitude which electric and cable roads have assumed, that their car tracks are wholly theirs, this judge, holding the theory that the rule was operative even where there was no room for the stage except upon the track. This view of the matter was repudiated by the General Term and a new trial was ordered. In the course of the opinion of the appellate division, the court says: "It is not neces- "sary for the purposes of this appeal to determine what "would have been the respective obligations of the plaint- "iff's driver and the defendant's motorman in regard to "the right of way if they had met without any collision in "the middle of the blockaded section of four hundred "feet," adding that it was enough for the purposes of the appeal to hold, as they did, that the collision could have been avoided by the exercise of reasonable care on the part of the motorman, and that the driver of the stage was blameless. (*Delaney* v. *R. R. Co.*, *43 N. Y. Supp. 225*; *13 App. Div. 114.*)

The question, which the court does not decide and which is raised by the above quotation from their opinion, leads to the suggestion, that, assuming that the motorman and the stage driver reached the opposite ends of the section at the same time and each saw the other, and each proceeded on his way and met in the middle of the section without a collision, that then the stage would have the right of way. For the rights of each, being the same up to that point, the question as to which should retire would be determined by the answer to the question, which could easiest retire to let the other pass. It being, of course, assumed that the team could not turn to the right or the left, by reason of the obstructions in the highway, it would seem that the electric car could more easily back the 200 ft. than a pair of horses attached to a stage coach, and therefore the car should retire. As already suggested, a quite opposite result would be obtained if the car was a cable one, instead of an electric one. But we fear that the ordinary motorman of a cable car would slowly grip the cable and press forward towards the noses of the horses with a slow but persistent and probably successful endeavor to push them back to a point where they could get off the rails.

The relative rights on a cable car and bicyclist are discussed in a recent New York case. (*Rooks* v. *R.R.Co.*, *10 App. Div. 98.*)

The policy adopted by the League of American Wheelmen in reference to the bicycle seems to be a good one. The league deprecates any effort to demand exclusive privileges for the bicycle over and above those granted to ordinary vehicles, on the ground that if they were accorded all the privileges granted to the horse and received them they receive their due meed, and obtain favor with the public by not demanding more.

The time may come, but it apparently is not yet reached, when the courts will hold that by reason of the great public convenience, or, rather, the necessity, of rapid transit in our cities along the surface highways, that the trolley and the cable have greater rights than have ever been accorded the horse car, which does not render one-half or one-fourth the service to the public that is now being rendered by the new methods of conveyance. Certainly the tendency of the decisions where they do depart from established precedents is in that direction, especially

*Communications relating to this department may be addressed to the editors, 32 Nassau Street, New York.

in the courts of first resort, whose decisions, by the way, even when they are in the first instance reversed, very seriously affect and modify the decisions of the courts of last resort.

ADDITIONAL SERVITUDE, RIGHTS OF ABUTTING OWNERS, INJUNCTION.

CONNECTICUT.—A highway is not subjected to a new servitude where an electric street railway is constructed in it by a company duly authorized.

A franchise for the construction of a street railway in a certain highway, as a part of a route particularly specified, does not authorize the use of the highway as part of a route other than that specified, by connecting it with other lines.

The owner of the fee in a highway may enjoin the unauthorized construction of a street railway therein, since the trespass would constitute a continuing injury, for which there would be no adequate remedy at law.—(Canastota Knife Co. v. Newington Tramway Co., 36 At. Rep. 1107.)

WISCONSIN.—The construction and operation, on a public street, of an electric railroad extending between two or more cities and towns, for the transportation of merchandise, personal baggage, mail and express matter, as well as passengers, imposes an additional burden, for which the abutting owner is entitled to compensation, and is not merely an exercise of the public easement previously acquired by the construction of the street.—(C. & N. W. Ry. Co. v. Milwaukee R. & K. El. Ry., 70 N. W. Rep. 678.)

ILLINOIS.—The owner of a lot abutting on a street has not such an interest in the street that he can maintain a bill for injunction against its use by a street railroad, where such use is authorized by an ordinance.—(Stewart v. Chicago Gen. St. Ry. Co., 46 N. E. Rep. 765.)

PENNSYLVANIA.—Defendant built its street railway without any authority so far as it passed through the township in which plaintiff's land was situate. Pending its construction, plaintiff filed his bill, which looked practically for compensation for interference with access to his buildings and fields. Two years after its completion, he amended his bill, to make prominent his prayer for injunction. In the meantime the township had approved and ratified the occupation of its highways. *Held*, that the decree denying injunction, and leaving plaintiff to his remedy for damages, would not be disturbed.—(Heilman v. Lebanon & A. St. Ry. Co., 37 At. Rep. 119.)

NEW YORK.—A street railroad company may enjoin another company from constructing a railroad without authority on the same street, where defendant thereby comes into competition with plaintiff, since the amount of plaintiff's damage could not be ascertained, and was, therefore, irreparable at law. Ingraham, J., dissenting.—(Cent. C. Ry. Co. v. Met. St. Ry. Co. (supra.), 44 N. Y. Supp. 752.)

NORTH CAROLINA.—The running of cars by a street railway corporation over a bridge already constructed by a railroad company over its tracks within city limits, which bridge is sufficient for ordinary public uses, imposes an additional servitude on the bridge; hence the street railway company must contribute to the maintenance thereof, and provide necessary conveniences at the intersection, as required by Code, § 1957, subsec. 6.—(Carolina C. R. Co. v. Wilmington St. Ry. Co., 26 S. E. Rep. 913.)

CONNECTICUT.—Act 1893, c. 169 § 8, prohibiting the construction or extension of a street railway from one town to another in the public highways, so as to parallel any other street railway or steam railway till the company desiring to construct such railway shall have applied to the superior court, and obtained from it a finding that public convenience and necessity require such construction, and further providing that on such application any steam railroad or street railway company that may be affected by the proposed street railway shall be made a party, confers on a company that would be affected by the construction of a parallel and rival street railway in the public highways, from one town to another, the right to be protected against it unless and until such rival has obtained the prescribed finding, and as incident thereto the right to enjoin the construction without such finding.—(N. E. R. CO. v. Cent. Ry. & El. Co., 36 At. Rep. 1061.)

NEW YORK.—The requirement of the consent of the local authorities to the "building or operation" of a street surface railroad (Const. art. 3, § 18; Laws of 1895, c. 545, amending Railroad Law, § 91) applies to the use of the tracks of one street railroad company by another as authorized by Laws 1894, c. 693 (amending Railroad Law, § 102), providing that the right to such use may be granted by the supreme court.

Such consent is not rendered unnecessary by the fact that the railroad company whose tracks are sought to be used has, because organized before the enactment of the railroad law, the right to permit the use of its tracks; since it can only be compelled to do so by proceedings under Laws 1894, c. 693, to which the consent of the local authorities is prerequisite. Parker P. J., and Landon, J. dissenting.—(Colonial City Tr. Co. v. Kingston City R. Co.. 44 N. Y. Supp. 732.)

FRANCHISES, ORDINANCES, USE OF STREETS, ETC.

MISSISSIPPI.—A street railroad company was not liable for exemplary damages for having erected in a road on which the rear end of plaintiff's lot abutted a trestle 3 ft. high, which was but 3 ft. from plaintiff's fence, where plaintiff notified the company before erection of the trestle that she would be deprived thereby of using the street, and the company promised to fill up the road so as to obviate the difficulty, and on subsequent complaints offered to remove the trestle to the opposite side of the road, and did so remove it before trial, and there was no insulting or malicious conduct on the part of the company's representatives.—(Biloxi City R. Co. v. Maloney, 21 South Rep. 561.)

NEW YORK.—A street railroad company's charter authorized it to construct a cable road on M. Street, in Brooklyn, from C. Street to Wall Street Ferry; and to construct in M. Street, and in those adjacent thereto, necessary switches or sidings for the convenient working of the road, the plans of construction to be subject to the approval of the commissioner of public works. *Held*, that where the only vacant land available for a storehouse for cars was a lot on a street which was parallel, but not the nearest one to M. Street, and the company bought such lot, it had the right, with the approval of the commissioner of public works and the consent of property owners, to construct connections on intersecting streets between its tracks on M. Street and its storehouse.—(Brooklyn Heights R. Co. v. City of Brooklyn, 46 N. E. Rep. 509.)

TEXAS.—The franchise of a street railway company is subordinate to the right conferred on the city by its charter to control the streets, construct sewers, etc.; and the city may, in the honest exercise of its discretion, locate a sewer in the center of a street, so as to suspend the operation of a street railway, without paying compensation for consequent pecuniary loss to the company.—(City of San Antonio v. S. A. St. Ry. Co., 39 S. W. Rep. 136.)

OHIO.—An ordinance adopted by a city council under section 3438, Rev. St., simply confers on a street railway company the corporate power to extend its road over a state or county road. In the exercise of the power, the right to so extend its road can only be acquired by agreement with the commissioners or by condemnation; and where a company so extends its road over a state or county road beyond the city limits, without such agreement or condemnation, its acts are unlawful, and a recovery of the damages caused to the road may be had at the suit of the county commissioners, under section 863, Rev. St.—(Citizens' El. Ry., L. & P. Co. v. Co. Com'rs., 46 N. E. Rep. 60.)

NEW YORK.—A franchise was granted to a defendant to construct its street railroad on W. Street and others, "with the privilege of laying all necessary sidings, turnouts, connections, and switches * * * in any of the above mentioned streets, and of connecting with, running on, or crossing all such other railroad tracks as may lie along or cross any of said route, streets or avenues." On one side of W. Street, at the foot of C. Street (which was not mentioned in the grant), was a ferry house. Afterwards a space at the foot of C. Street was filled up, and a new ferry house was built on the filled space, so that C. Street was extended about 180 ft. *Held*, that defendant's franchise did not include the right to lay its tracks on such extension of C. Street, for the purpose of bringing its cars to the door of the ferry house, as it had done before the change.—(Cent. C. Ry. Co. v. Met. St. Ry. Co., 44 N. Y. Supp. 752.)

NEW JERSEY.—The right to occupy longitudinally streets and highways must be given to a railroad company expressly or by necessary implication, and is not implied from a charter power to construct a railroad between designated points, without specifying the route.

A borough has no power to authorize by ordinance a railroad to occupy its streets longitudinally.—(Thompson v. Ocean City R. Co., 36 At. Rep. 1087.)

TEXAS.—Mandamus will not lie to compel a street car company to continue to operate its lines on certain streets, where its charter imposes no specific obligations, and the ordinance giving the franchise in the streets merely granted "the privilege" of constructing and maintaining street railways over the lines therein designated.—(San Antonio St. Ry. v. State, 39 S. W. Rep. 926.)

ARKANSAS.—Where a street railway had ceased to be operated, and its only value was what the rails and ties were worth in the market, and this value was realized at a sale under a trust deed, the mortgagors could claim no damages from the purchaser because, pending the right to redeem, if any existed, he tore up the track and sold the material.—(Coffin v. Batesville City Ry. Co., 40 S. W. Rep. 88.)

LIABILITY FOR NEGLIGENCE.

NEW YORK.—A finding that plaintiff was injured by defendant's negligence is sustained by evidence that a collision occurred between plaintiff's cart going in the opposite direction from defendant's trolley car, at a point where the roadway for wagons was only about 9 ft. wide between defendant's track and the outer embankment; that the car was going at a rate of 10 miles an hour, but could be stopped in 15 ft.; that plaintiff's horse became unmanageable, through fright, and that plaintiff signaled the motorman to stop when the car was 75 ft. away, but that he was not looking in the direction the car was going.—though the motorman denied plaintiff's testimony.—(Geipel v. Steinway Ry. Co., 43 N. Y. Supp. 934.)

NEBRASKA.—It is not such negligence for a passenger to stand upon the platform of a crowded street car while in motion, as will per se defeat a recovery for injuries received in consequence of the negligence of the persons in charge thereof.—(East Omaha St. R. Co. v. Godola 70 N. W. Rep. 491.)

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Special effort will be made to answer promptly, and without charge, any reasonable request for information which may be received from our readers and advertisers, answers being given through the columns of the JOURNAL *when of general interest, otherwise by letter.*

Street railway news and all information regarding changes of officers, new equipment, extensions, financial changes, etc., will be greatly appreciated for use in our Directory, our Financial Supplement, or our news columns.

All matters intended for publication in the current issues must be received at our office not later than the twenty-second of each month.

Address all communications to

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WE regret to see in the columns of an esteemed contemporary a table of statistics in which is set forth the cost of street railway labor in different cities of the United States. It is our belief that statistics of this character should not be given currency in any publication, and especially in one which is supposed to represent the street railway industry, for the reason that such statistics may be eagerly seized upon by labor leaders and demagogues in the cities where wages may not be at a maximum, and used as a club to compel increase of wages. We do not mean to urge that information of this character should be withheld from the labor force in the interests of employers, but only that the stamp of authority should not be put upon it by street railway or other journals, certainly unless accompanied by the most carefully prepared details of the local conditions and costs of living in every city represented in the table. Without explanation, ill digested statistics of this kind may easily do a great deal of harm to street railway companies by tending to "level up" burdens of labor charges. None of the companies paying the highest rates of wages are able by the publication of such statistics to reduce their wage account, while pressure may be brought to bear upon those paying lower rates to increase them. The same arguments hold true to a certain extent in the matter of publishing street railway franchise burdens in different cities, and for several years past we have consistently refused to publish statistical information of this kind.

IT is one of the axioms of railroading, and in fact of nearly every other industry, that gross business can be materially increased by judicious management. In commercial lines, any merchant would be behind the times if he did not devote a great deal of attention to seeking customers without waiting for them to seek him, and the experience of steam railroad companies has shown that traffic can be greatly promoted by a careful study of the needs of the traveling public and by the improvement of various opportunities presented from time to time by advertising, excursions, developing popular resorts, and in other ways familiar to the railroad general passenger agent. These principles are well understood by street railway managers, especially since the introduction of electric power, by which pleasure traveling has been so largely increased. No one factor has added so much to the pleasure riding on electric railroads as the establishment of parks by the railway companies. The only question is to what expense are railway companies warranted in going in the establishment and maintenance of such parks and pleasure resorts. To answer this question, the STREET RAILWAY JOURNAL has published a series of four articles concluded in this issue, and descriptive of the parks maintained by sixty or seventy different companies in this country and Canada. This series has been extensively illustrated to give an idea of the character of the parks, and a great deal of care has been taken to secure information, as far as was possible, of the character of amusements presented, their cost, the revenue derived from the leases of different privileges, and especially the amount of increased traffic so far as it could be determined, induced by the parks. It will be noticed that this reaches in some cases as high as 90 per cent of the total traffic, while nearly all of the companies report a substantial increase attributable to this cause. Pleasure riding, however, is not dependent entirely upon the existence of parks, but can be secured in other ways, and the methods of increasing the number of passengers beyond those who are really "obliged to ride" is limited only by the fertility of the manager's genius and by his ability to improve advantageously opportunities as they are presented. The Brooklyn Heights Railroad Company has considered this matter of such importance that a special official, under the title of "General Passenger Agent," has been appointed, with duties similar to those connected with the same office on steam railroads, and the results secured by this company during the first year of its experience with this department are described at length in this issue. While no pleasure resorts are owned by this company its lines reach to several, and the traffic to these has been greatly promoted by judicious exploitation, the greater part of the expense of which has been defrayed, not by the railway company, but by the owners of the attractions at the different pleasure grounds. While the work in this direction has been considerable, it does not

by any means comprise all of the avenues open to traffic promotion; in fact, it has been found that the more attention is directed to this service, the more do possibilities and means develop for adding to the gross receipts of any system. Some of the methods employed with special success are described in the article referred to, and many suggestions may be found there applicable to a greater or less extent on other roads similarly situated. The opportunities in this line are almost as great as in steam railroading, and it is possible that before long a general passenger department will be considered as necessary to street railway operation on a large scale as it now is to steam railroad service.

THERE has always been considerable difficulty in comparing the working efficiency of different power stations because of the lack of proper units at both ends of the power conversion cycle by which to rate their performances. The inadequacy of the car mile unit to measure the output of the station is too well known to require any discussion, and the kilowatt hour is now recognized as the only basis upon which the amount of energy produced by a station can be properly measured. This unit is almost ideal for this purpose as it represents the same amount of energy whether produced from a large station or a small one, and whether heavy or light cars are operated, and measurement of power in its terms can be easily made by wattmeters. The best unit for measuring the input of the station is not, however, so easy of determination. The usual one is "pounds of coal burned" with a coal burning station, and "gallons of oil used" when liquid fuel is employed. These units cannot be regarded as perfectly satisfactory for the purpose of obtaining the efficiency of the station apparatus, first, because the amount of combustible in coal varies so greatly; second, because the amount of moisture in the coal is also a variable quantity; third, because neither unit is applicable to both kinds of furnaces or to gas burning stations; fourth, because the skill in firing affects materially the efficiency figure obtained from an investigation; and fifth, because the differences in furnaces also introduce elements which may have an important influence on the results. For these reasons there is a growing movement to adopt some other units for measuring the input of energy for rating electric power plants, and of those suggested none seems so desirable as that of a heat unit based on the British thermal unit (B. T. U.) which is equivalent to the heat required to raise the temperature of 1 lb. of water 1 deg. from 62 degs. F. In practice the amount of heat taken as a basis for computation would be that required to raise all of the feedwater from its temperature to that of the steam at the boiler pressure with such allowances as are regularly made in heat tests of this character, and for ease in rating, W. S. Aldrich, in a paper "On Rating Electric Power Plants upon the Heat Unit Standard," read before the American Society of Mechanical Engineers last month, recommends the adoption as a working station heat unit, 1,000,000 B. T. U. Although not based upon the scientific standard of temperature, 0 deg. Cent., this unit seems more practicable than the calorie—the quantity of heat required to raise the temperature of 1 kg. of pure water 1 deg. from 0 deg. Cent.—as it is nearer the mean temperature of the feed water. The method of determining the number of heat units employed in the system is very simple, and should include all heat supplied to the complete plant for power, not only that for generating the steam used in the engine cylinders, but also that used in the steam jackets, feed pumps, etc., with an allowance for moisture to be determined by calorimetric measurements of the quality of the steam furnished to the engine. The efficiency figure of the station therefore, as suggested by Professor Aldrich, is output per 1,000,000 B. T. U., and would give the efficiency of the station from the point where the feedwater is introduced into the feed pump to the bus bars. On this basis the performance of the boilers and the firing is eliminated, and should the efficiency of this portion of the equipment be desired, the thermal value of the fuel must be determined; but as the human element is so important in boiler plant operation, a distinct advantage is gained by starting at a point beyond that where these factors affect the result in establishing a ratio for comparison.

The Coming Struggle for Traffic.

It certainly begins to look as if steam railroads are to "have their innings"—to borrow an expressive sporting phrase—in the contest for suburban and interurban traffic in thickly settled territory, particularly in the Eastern States. For some time past the managers of not a few important railroad systems have been watching with growing uneasiness the inroads made upon a profitable branch of their business by the many electric railways built during the past two or three years upon the highways between population centers. They have found that electric cars are certainly popular and that the public prefers to ride in them often to the extent of some loss of time, although in many cases this loss of time is more apparent than real on account of the distances necessary to be covered from individual residence points to railroad stations. They have found too, that traffic arrangements usually made by these suburban and interurban roads with the distributing systems in the cities proper, form an exceedingly important factor in the struggle for traffic, particularly where connections can be made by transfers without extra expense. The net result of the competition to date has undoubtedly been a serious diminution in the regular daily commutation and local earnings of all steam railroads paralleled by electric lines, and it is becoming evident to railroad managers that something must be done to counteract these diversions of traffic.

Among the very first in the country to recognize the tremendous importance of trolley line competition, were the directors of the New York, New Haven & Hartford Railroad Company, and President Clark in particular. For several years past, experiments in heavy electric railroading have been made by the New Haven system, and the results of the more important of these experiments are generously given to the engineering public in an article by Col. N. H. Heft, chief of the Electrical Department, which appears elsewhere in this issue, and which is one of the most interesting contributions yet made to the science and history of electric railroading. These results may be epitomized as follows:

It has been found possible to place on the trucks of a single car, without using an inch of passenger space, a motor power sufficient to propel at a high speed 250 tons

weight over 1 per cent grades and around 10 deg. curves (both grades and curves being, of course, but moderate). This quality of compactness is a most important feature of the electric system and the haulage experiments have proven conclusively that, in President Clark's own words, "electricity is not a toy to be played with, but a power to be used." The ability to handle train loads of any gross weight with one or more motor cars is not now questioned by the company.

Electric trains can be accelerated more rapidly by far than ordinary trains by a steam locomotive, this being a natural result of the constant torque of electric motors, as well as of the immense reserve power at the station which can be instantly and automatically placed at the motor terminals when called for by the motorman.

As a result of this rapid acceleration rate, it is possible to make a higher schedule speed over a road of many stations than could possibly be done by such locomotives as are ordinarily employed in this class of traffic.

The problem of braking these high speed trains has been solved as effectively as is done on trains propelled by steam power—this by means of an electric motor compressor governed automatically so as to constantly keep sufficient pressure in the tanks ready for service.

It has been found possible to use a third rail as a positive conductor instead of a trolley wire, without appreciable leakage in any ordinary weather, and without disastrous leakage even in the extreme case when a section of both third rail and service rails are covered with water. The form of third rail construction adopted by the New Haven Company is certainly admirable in its simplicity and effectiveness.

It is possible to so thoroughly connect the joints of this third rail mechanically and electrically as to make its total resistance, even for 10 or 15 miles of track, exceedingly low, so that the loss of power where the service is light is not excessive. On the line from Hartford to New Britain a single train will give a half hour service, and in practice "the lights burn high" at Hartford, over 12 miles away from the station, even when 400 or 500 amps. or more are called for in quickly accelerating the train. With a much larger number of trains, however, some form of feeder assistance would undoubtedly be required.

The danger to the public of this third rail construction has been greatly exaggerated. This is not only because the public has been warned about the danger of shocks, and has learned to avoid the tracks, but also because it is not particularly easy to get a shock unless one is trying to do so. As a matter of fact, the track laborers do not hesitate to stand on the ground and work upon the third rail in any except exceedingly wet weather.

Finally, it has been shown that the power necessary for the operation of electric trains can be produced by the expenditure of an amount of coal per ton mile hauled comparable with that required by steam locomotives, while the additional further advantage for electricity has been gained in the ability to use as fuel the "sparks," or cinders dumped from the locomotive fireboxes, and delivered at the power station at a cost of less than seventy-five cents per ton.

All these things and more have been demonstrated to the entire satisfaction of the New Haven directorate, and as a result of these demonstrations, the most comprehensive and far-reaching changes are known to be in contemplation. The company's officials do not hesitate to say that they intend to control the traffic situation in their territory by all legitimate methods, and to do this not by attempting to block competing roads by legislation, but by giving a service to the public better than can possibly be done by others. They are certainly in a strong strategic position. They own their right of way; their tracks form usually the shortest line of communication between important cities and towns in their territory; many of these lines are feeders to the main trunk systems and can be easily equipped as such with profit; and their trains can make much higher speeds than those on the highways for obvious reasons. Now if, in addition, they run their trains on regular short interval schedules, so that people may know, without referring to time tables exactly when trains will pass, and if they reduce their rates of fare to meet those of the trolley lines, there would seem to be little question that a large part of the regular daily traffic and not a little of the pleasure traffic will return to the high speed lines. These advantages and changes were brought into play at Nantasket Beach last year and will now be used with telling effect in the Hartford-Berlin installation. In the latter place the fare between Hartford and New Britain has actually been reduced to below that of the competing trolley line, while the time between the two cities is hardly more than one-third that required on the highways.

Another important element which will doubtless enter into the situation a little later will be the provision of better city and shore resort terminal facilities than are now owned by the railroad company. It is so easy to build short electric branch lines from the main stations to the business centers of the cities and towns, or to any settlements where the facilities may not be sufficiently good that there can be little doubt of the company's purposes in this direction if electricity is once generally introduced over its system. Altogether it is quite certain that the New York, New Haven & Hartford Railroad Company is about to enter upon an aggressive campaign to secure the entire interurban and a large part of the suburban traffic of Connecticut, Rhode Island and southern Massachusetts.

Of course, the engineering problems involved in operating an immense system are exceedingly complex, particularly in the matter of economical transmission of power, but these problems are much simpler in a territory of great population density, such as is found in southern New England, New York, New Jersey and elsewhere.

What the effect of these experiments in heavy electric railroading will be upon other similar systems is not open to doubt. The Boston & Maine Railroad, the Boston & Albany Railroad, the New York Central & Hudson River Railroad, the New York & Harlem Railroad, the Pennsylvania Railroad (in New Jersey and eastern Pennsylvania) and several other Eastern systems, large and small, have traffic problems much the same as those of the New Haven system, inasmuch as the proportion of their passenger to total earnings is very large, and the competition of trolley lines is serious. That these railroads will ultimately be forced to adopt electricity in place of steam for parts of their systems is almost certain, and there is no doubt that this change will be hastened by the achievements of President Clark, Colonel Heft and the manufacturing companies who have so ably furthered their plans for equipment at Nantasket Beach and Hartford.

CONSTRUCTION

The St. Anthony Falls Electric Transmission Plant.

The installation of the new plant for utilizing the water power of St. Anthony Falls, at Minneapolis, is rapidly nearing completion. The plant is the property of the St. Anthony Falls Power Company, but the entire output has been leased for a period of forty years to the Twin City Rapid Transit Company. Under this name the Minneapolis Street Railway Company, the Minneapolis, Lyndale & Minnetonka Railway Company and the St. Paul City Railway Company are consolidated. This company operates all the street railways of Minneapolis and St. Paul, a total of about 225 miles, accommodating a population of nearly 400,000 people. With the exception of 6 miles of cable road, all the lines are equipped with electricity, the power being furnished from three power houses whose combined capacity is 5000 h. p. As soon as the new plant is in running order the old power houses will be shut down, but will be kept in readiness for use in case of a breakdown at the larger station.

While the two cities are ordinarily stated as being 10 miles apart, the intervening space is building up so rapidly as to already make practically one city. The St. Anthony Falls are very nearly the center of population of the two and a more economical location for a power house with respect to the cost of feeders could not have been chosen.

The dam for securing the necessary head is thrown diagonally across the river several hundred feet below the Tenth Avenue bridge in the city of Minneapolis and a quarter of a mile or more below the large dam which supplies power to the milling district. In plan it is in the shape of an inverted V with the apex up stream, as will be seen from Fig. 6. Beginning on the west side of the river a log sluice is located next the bank for passing the logs of lumbermen down stream. Next is a bear trap to be noted later. After this comes the first section of the dam proper which is 366 ft. long, 13 ft. above the bed of the river and extending 16 ft. below the river bed. The dam throughout is of solid masonry construction, the coping and down stream face being of granite, and the remainder of blue

FIG. 1.—HIGH WATER OF MAR. 31, 1897, AT PLANT OF THE ST. ANTHONY FALLS POWER CO.

limestone brought from the company's quarries only a short distance away. The upstream face of the dam as originally built was almost perpendicular, but this is to be supplemented by stone filled crib work and an inclined timber floor for passing logs and ice over the dam during high water. The downstream face is in a series of steps over which the water falls until it strikes an apron 15 ft. wide, of railway iron laid in concrete and securely anchored.

The second section of the dam extending diagonally down stream from the apex of the V forms one side of the head race. It is 444 ft. long, 14 ft. above the river bed and of the same general construction as section one, but with a steel coping. Between this section and the last, which is only 50 ft. long and 12½ ft. above the river bed, 6000 cu. ft. To prevent rubbish and ice floating in the river from reaching the wheels, a substantial steel rack frame extends the full width of the race. To prevent the clogging of the rack an automatic rack cleaner will be installed; this will travel the full length of the rack and be operated by an electric motor directly attached to the machine. The material gathered by this machine will be deposited on a belt conveyor and discharged into a sluice which will carry it into the tail race.

The power house situated as shown in the illustrations is 250 ft. long, 57 ft. wide, without the turbine chambers which are 40 ft. wide, extending nearly the full length of the power house. The building is of fireproof construction, the framework and roof trusses being of steel fur-

FIG. 2.—VIEW OF DAM AND RIVER FROM EAST BANK

are two more bear traps similar to the one on the west side. Between the last section and the turbine chambers is another log sluice for passing out what logs get into the head race.

The three bear trap gates mentioned above are for the purpose of controlling the head of water on the turbines. They are each 50 ft. in width, of steel construction decked with wood and move between solid masonry piers 8 ft. wide, 40 ft. long and 25 ft. high. The dressed surfaces of the piers against which these gates move is clearly shown in Fig. 2. The gates will be operated by hydraulic pressure.

The head race is approximately 207 ft. wide and 600 ft. long. The second and third sections of the dam form one side and the east bank of the river the other. A head of 20 ft. will be maintained on the turbines. While the flow of the river during the recent high water reached 60,000 cu. ft. per second, the minimum flow is but 2000 cu. ft. per second, corresponding to 4000 minimum h. p. The average flow of the Mississippi at Minneapolis is, however,

nished by the Gillette-Herzog Manufacturing Company. The walls are of hollow, salt glazed tile 16 ins. thick, made by the Pioneer Fireproof Construction Company. The roof is of book tile, covered with cement and finished with roofing slate, and having a galvanized iron cornice. The height of the main walls is 35 ft., and to the peak of the roof is 51 ft.

The interior of the power house will be tastefully finished in hard wood; it is lighted by fifteen windows, 12 ft. × 25 ft. The switchboard gallery is lighted by ten windows, 4 ft. × 7 ft. The building will be heated by electricity; for this purpose it is estimated that 1000 h. p. per day will be required during the winter season.

A 20 ton traveling crane runs the entire length of the building and is operated by hand from a gallery attached to the bridge.

The capacity of the plant is 10,000 h. p. in ten units of 1000 h. p. each. Each unit consists of one 1000 h. p. General Electric generator direct connected to a horizontal shaft on which are four Victor turbines of 250 h. p.

each, 42 ins. in diameter and running at 130 r. p. m. These turbines are manufactured by the Stilwell-Bierce & Smith-Vaile Company. The ten turbine chambers are of solid and massive masonry with partition walls 4 ft. thick; the head walls separating the water from the main room of the power house are 7 ft. 6 ins. thick, of heavy limestone masonry. In these walls are set the flume head thimbles each 8 ft. in diameter, closed with heavy cast iron covers bolted to the masonry and which carry the stuffing boxes through which the wheel shafts pass to be coupled to the generator.

There are two head gates each 8 ft. wide and 9 ft. high, which admit water to each turbine chamber. These gates will be operated by a simple hoisting attachment on the roof of the turbine chamber. Each chamber has a separate and independent tail race, as wide as the chamber and 100 ft. long. This passes under the power house and discharges into the tail race below.

FIG. 3.—HIGH WATER MAR. 1, 1897.

FIG. 4.—VIEW OF POWER STATION DURING HIGH WATER OF MAR. 31, 1897.

The tail race, power house, and turbine chambers stand on a sub-foundation of concrete 2 ft. thick and 220 ft. square. In the eastern end of the power house are installed two 150 h. p. turbines to be direct connected to two exciters.

The speed regulation of the entire plant is effected by type B governors (see Fig. 7) made by the Lombard Water Wheel Governor Company. These governors are of the latest and most approved design, and are guaranteed to hold the normal speed of the plant constant, and to hold the momentary fluctuations of speed, due to large load variations, within 5 per cent from normal, under any conditions of load variation.

Those who are already familiar with the type C governor made by this company will note that there are two auxiliary cylinders on this type B governor, making in all three cylinders. The uppermost is controlled by the centrifugal balls; this actuates the middle cylinder which is in itself a large piston valve, which latter actuates the lowest cylinder which moves the water wheel gates. This type of governor gives the promptest and most powerful gate movement ensuring the closest possible speed regulation of the whole plant under the most trying conditions of load variation.

The power house is designed with a view to placing a 1000 h. p. steam engine by the side of each generator to which it may be coupled in the event of low water or injury to the turbines.

The complete electrical equipment was furnished by the General Electric Company through its representative, A. S. Huey. It is proposed to distribute current at three voltages; direct current at 600 volts for the lines in the immediate neighborhood of station, and alternating current at 3450 volts for short transmission and at 12,000 volts for long transmsision.

The immediate equipment of alternators will include five of the 700 k. w., three phase, revolving armature type. These machines will be equipped with thirty-two poles, will operate at an e. m. f. of 3450 volts and a speed of 130 r. p.

FIG. 5.—VIEW OF POWER STATION, SHOWING OPENING INTO TAIL RACE AND SLUICEWAY FOR LOGS IN FOREGROUND.

m. They are designed to be directly connected to the water wheels, and the shaft extends on both ends so as to receive the coupling for the water wheel and steam engine. The weight of the revolving part is about 25,000 lbs., and that of the complete machine 84,000 lbs.

The direct current equipment will consist of two M. P. 8-700 k. w., 600 volt railway generators, to operate at 130 r. p. m. The machines will be of the standard construction, and designed to be directly connected to the water wheel. As with the alternators, the shafts extend on both ends, for the purpose of receiving the coupling of the water wheel or steam engine. The approximate weight of the revolving part is 34,000 lbs., and that of the complete machine, 110,000 lbs. The three phase generators will be excited by means of two M. P. 6-100-280-600 volt continuous generators of standard construction.

There will be six step-up transformers, each 233 k.w., making a total of 1400 k. w. capacity, of the air blast type. The primary voltage of these transformers will be 3450, and the secondary voltage 12,000, which will be the e. m. f. of the line to St. Paul, a distance of 10 miles. The transformer ventilating device will consist of a 50 in. blower, coupled direct to the four pole motor.

There will be three substations—two in Minneapolis and one in St. Paul. At station No. 1 there will be installed two 600 k. w. rotary converters, giving a 580 volt direct current. At station No. 2 there will be one 600 k. w. rotary converter, and at station No. 3, which is located at St. Paul, there will be two 600 k. w. rotary converters. At the substations will be, of course, all necessary step-down transformers, marble switchboards and controlling apparatus, making the plant most complete in every respect. The rotaries will run in parallel with the street railway company's present generators, which are at present operated by steam.

Two-inch cables will be used for transmitting the 12,000 volt current and for lower pressure a feeder of 500,000 c. m. All feeders will be carried underground and in vitrified clay conduit. Paper insulation will be used throughout, furnished by the National Conduit & Cable Company.

The switchboard will be on the up-stream side of the building, located on a gallery over the turbine chambers, and 18 ft. above the generator floor. It will be of blue Vermont marble in twenty-four panels, each 2 ins. × 28 ins. × 90 ins. The specifications for its design make it impossible to touch a live part on the face of the board. On this gallery, which is 207 ft. × 10 ft., are also the general offices and drafting rooms. It is reached by iron stairways at either end.

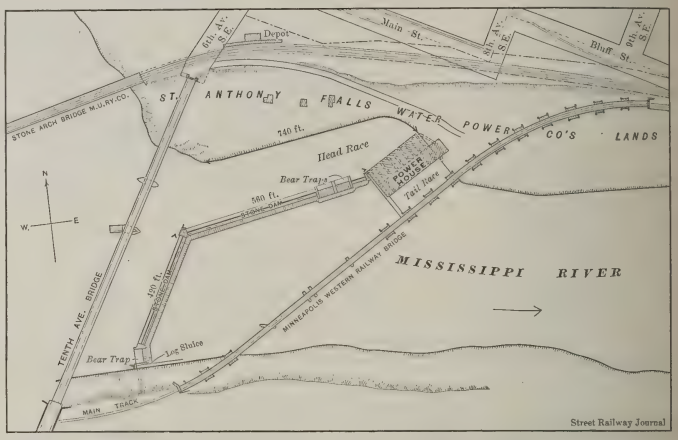


FIG. 6.—PLAN OF PLANT OF ST. ANTHONY WATER POWER CO.

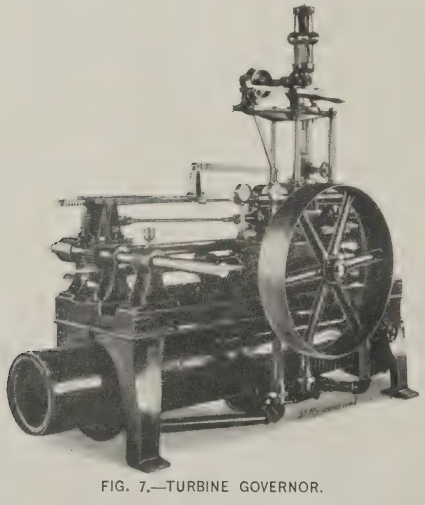


FIG. 7.—TURBINE GOVERNOR.

The promoter and engineer of this enterprise is Wm. de la Barre, M. Am. Soc. C. E., who, with C. G. Goodrich, vice-president, and E. P. Burch, electrical engineer, of the Twin Cities Rapid Transit Company, has visited almost every important electrical plant in the United States, in order to be fully conversant with the best machinery and designs. The engineering plans and details were prepared under the direct inspection of Axel Ekstrom, of the company's engineering corps. The dam has been projected for years, but actual work did not begin upon it until May, 1895. The work on the dam has been done entirely by day labor, under the supervision of Mr. de la Barre, no contracts of any nature having been let. Every step in the construction has been planned with the utmost care. The entire cost of the work is approximately $500,000, of which $300,000 is, as stated, for electrical equipment.

The Twin Cities Rapid Transit Company can itself consume only a portion of the power to be generated and the surplus will be placed upon the market.

The officers of the Twin Cities Rapid Transit Company are: president, Thomas Lowry; vice president, C. G. Goodrich; general manager, W. J. Hield; auditor, J. F. Calderwood.

Extensive Electric System near Montreal.

The construction of an extensive electric system in Montreal will soon be commenced by the Montreal & South Counties Railroad Company, of which A. J. Corriveau is one of the leading directors. According to Mr. Corriveau, the line will cross the St. Lawrence River on one of the existing bridges and will then run through twelve of the southern counties to St. John's (P. Q.) and Sherbrooke. The whole system contemplated includes 150 miles. Power will be furnished by the Chamblay Water Power Company. The capital of the company is $2,000,000.

New Track Construction in Denver.

The Denver Consolidated Tramway Company has lately relaid nearly all of its Fifteenth Street track. This track was formerly used for four cable lines of the Tramway Company, and was built in 1888. It stood up well under the cable traffic. When the cable lines were changed to electric the cable was simply taken out of the conduit and trolley wires placed overhead. The old track stood up fairly well under the low speed of the single truck cars of the then two electric lines, but when long heavy double truck cars of seven different lines began to run over this

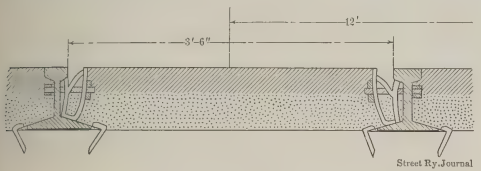


FIG. 1.—SECTION OF TRACK BETWEEN JOINTS.

piece of track, a change for the better had to be made. The cars were kept running on the old track, which was on one side of the street, while a new track was built in the center of the heaviest material and character. First a trench, 36 ins. deep and the width of the tracks, was dug and carefully squared off. In this was placed a 12 in. layer of rock and hard earth beaten down. Above this was placed a 10 in. layer of earth, pebbles, clay, sand and large rocks well tamped, and above that a 7 in. layer of concrete. The ties, which are of Texas heart pine, are 6 ins. × 8 ins. × 8 ft., and are all boiled in asphalt before being installed. The ties

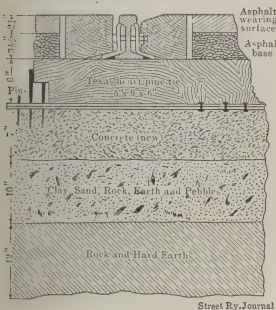


FIG. 2.—HALF SECTION OF TRACK AT JOINT.

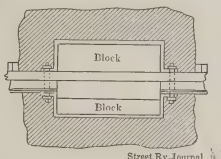


FIG. 3.—PLAN OF JOINT.

at all joints rest on a large strip of steel which is bolted to the concrete by eleven bolts. On the tie are laid 80 lb. T rails. The gage is 3 ft. 6 ins., and the distance between track centers 12 ft. The joints are bonded with the Edison-Brown plastic alloy bond, with also a small copper bond underneath the angle plates.

The method of paving to the rail is quite novel. Under and even with the edge of the head of the rail on the inside is placed a Y filler, slightly inclined toward the lower part of the web as shown. This, it is thought, gives a stronger construction than if the Y started from a straight base. Outside of the Y is an L shaped rail, with base resting on the rail base and bolted through the Y to the rail web at every other tie. The L shaped rails are 6 ins. high and run the entire length of the rail, except at the joints where stone blocks set in a steel frame bolted to the L are used.

It is the company's intention to reconstruct all old lines, and build all new ones with this new construction, which is proving so far very satisfactory.

For bridge work the company has adopted a very similar form of construction, except that as the service on the lines on which there are bridges is somewhat lighter than on Fifteenth Street, the ties are somewhat lighter and no concrete is used. The ties are of Texas heart pine 4 ins. × 7 ins., 5 ft. long and are accurately shaped on a bed plane and placed 3 ft. center to center, with holes bored wherever nuts project from the floor. The 6 in., 72 lb. T rail, filler and guard, broken at the joints, are used as on Fifteenth Street, but the tie is bolted directly to the bridge floor.

Some Methods of Testing Motors.

BY FRANK B. PORTER.

One of the most important things in the keeping in repair of street railway motor equipments should be a careful testing of the electrical resistance of different parts of the equipment at regular intervals, or when a motor is brought into the shop for overhauling or repair, so that parts that are defective may be removed and replaced by ones in good condition before further damage is done. The danger of delay in replacing defective parts may be considerable. For instance, an armature of a motor, in which a field coil is short circuited in some of its layers and is consequently of less resistance than it should be, is subjected to a much larger duty by means of working in this weak field. The extra current resulting usually causes the armature to burn out in a short time, provided the fault is not discovered and repaired, necessitating sometimes, according to the design of the armature and the extent or location of the burn-out, a complete rewinding. This may be quite expensive, to say nothing of disturbed or delayed travel on the line which often takes place when a car is crippled in service.

Repair foremen as a rule have had long experience in the behavior of motors under various conditions. To this experience should be added a clear idea of the wiring connections of the controlling apparatus and the motor, so that they will be able to test for grounds or open circuits with the magneto or a lamp circuit, and this knowledge should be supplemented by an understanding of the use of instruments and the methods of testing resistances by them. Then troubles will be readily discovered, and by a systematic application of this knowledge many accidents may be averted. Unfortunately, in some street railway shops no instruments are furnished and in others testing is regarded as experimenting, for which there is no time. In still others testing is practiced without system and at irregular or long intervals, or only where some special case seems to warrant the use of some unusual means to arrive at a conclusion. The writer in this article has endeavored to submit in a simple and practical form some of the most useful tests that are ordinarily used by electrical engineers, and can be easily applied to the equipment of street railway motors.

Fig. 1 represents the connections for measuring a low resistance by means of an ammeter and a voltmeter. This method with suitable instruments will serve to measure or test the electrical resistance of any part of a street railway motor equipment (except the insulation), the starting resistance, resistance of field shunts, resistance of field, resistance of armature, etc. Suppose X is a field coil and its resistance is sought. Connect in series with it as shown, an ammeter, c, with which to measure the current, a fuse, F, for safety, a switch, S, with which to open and close the circuit, and a resistance, R, to prevent an amount of current in the circuit that would be more than the capacity of the ammeter, c, i.e., more than it can indicate; too much current would also heat the field being tested to a much higher temperature than the surrounding air and consequently increase its resistance. Place a voltmeter, E, alongside of ammeter, c, and connect each binding post

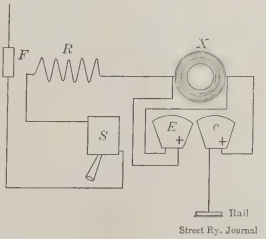


FIG. 1.

with one terminal of the field to be tested. Have the instruments connected so that the current will pass through them in the right direction. This will probably be shown by marks on one or both of the binding posts of the instruments.

To measure the resistance now close switch, S, and take a reading of both voltmeter, E, and ammeter, c; then the resistance of $X = \frac{E}{c}$, or the resistance of the field being tested equals the reading of the voltmeter, divided by the reading of the ammeter. For example, if the voltmeter reading is 30 volts, and the ammeter reading is 60 amps., the resistance of the field is $\frac{30}{60} = \frac{1}{2}$ ohm. In testing fields quite large currents can be used without heating, and the larger the current used the less the error from an incorrect reading. For if with a current of 50 amps. the person making the test should read 1 volt out of the way the error would be $\frac{1}{50}$ or .02 But with 25 amps. the error would be $\frac{1}{25}$ or .04, double the error of the first case with the larger current.

In testing field shunts, or motor starting resistance, it will be found that a large current will quickly heat the resistance under test, and it will be more accurate unless the method of correction for temperature be understood and applied, to use a current that will not materially heat the resistance being tested.

The method shown in Fig. 1, in which a suitable low reading voltmeter is used, will accurately test the total resistance of an armature, but for locating short circuited coils a somewhat different method will give better results, which is given below in Fig. 5. If an ammeter be not at hand, but a voltmeter is, resistances can be tested or measured by means of it and another known resistance, as in Fig. 2.

Connect in series the known resistance, A, and the resistance to be tested, X, and if they two have not enough resistance to prevent an excess of current, put other resistance in series with them, as R. A fuse, F, and a switch, S, should also be in series in the circuit. Now shunt the known resistance, A, as shown in Fig. 2, with voltmeter, E, and note reading; call this first reading V. Then change terminals so that the voltmeter shunts the unknown resistance, X; note reading and call it V'. If the resistance of $A = p$ then $p\frac{V'}{V}$ = resistance of X; that is, the quotient obtained by dividing the second reading by the first reading, multiplied by the known resistance equals the resistance of X. If $V = 20$ volts, $V' = 30$ volts and $p = 1.2$ ohm, the resistance of $X = 1.8$. In order to quickly change from the first to the second reading a special switch is shown at B.

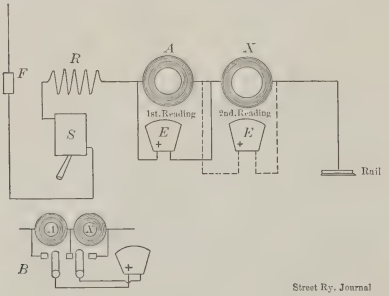


FIG. 2.

The exact accuracy of this test depends on the current and voltage being constant. If the different readings be taken with the resistances at a constant temperature the only error would be due to a variation in line voltage (i. e., power station). This error would not be important enough to destroy the value of the test, for if $R = 10$ ohms and A and $X = \frac{1}{2}$ ohm each, with a line of pressure of 500 volts, the drop in voltage around the terminals of A and X would be 22.72 + volts each. If on a second reading the line pressure had increased to 520 volts, the drop in voltage around the terminals of A and X would be 23.63 +, or a difference between the first and second reading of .91 volt or an error of almost 4 per cent; but short circuits or high resistances which are liable to occur in the motor equipment in street railway practice are so considerable, that even an error as large as 4 per cent may be neglected. If desired the result may be checked by several different readings, or if two voltmeters are available, by putting one across the circuit from trolley to rail and noting the line voltage when the readings are taken.

The nearer the resistance of A equals the resistance of X, the better the result. It is also preferable to have resistance of A of the same character as the resistance of X; for example, if X be a field to be tested, let A be a similar field, but of a known and standard resistance.

To test the insulation of an armature, field or any part of the electrical equipment of the motor, connect a voltmeter (Fig. 3) to a two-way switch whose contact points are shown at A and B, then close the circuit A, and note reading; call it H, then close circuit B, and note reading; call it G, then the insulation resistance of the armature $A = \left(\frac{H}{G} - 1\right) R$ where R is the resistance of the voltmeter, which is usually marked on the instrument or case, on Weston instruments on the inside of case cover. That is, from the quotient obtained by dividing the reading of line pressure by the reading in series, subtract one and multiply by the resistance of the voltmeter. If $H = 500$ volts, $G = 10$ volts and $R = 70{,}000$ ohms, then the insulation of $A = (500 \div 10) - 1 \times (70{,}000) = 3{,}430{,}000 = 3.43$ megohms.

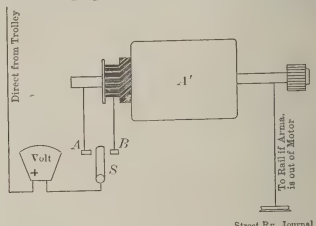


FIG. 3.

This also supposes the voltage of the line to be constant, but the error will be so small with an ordinary variation in station voltage that it need not be taken into account here.

The above test is suitable for high insulation resistances, say, above 1000 ohms, when the insulation has a very low resistance, i.e., when a high reading is noted with the voltmeter in series. A better method would be to introdnce a low reading ammeter into the circuit, in series with the insulation resistance, while the voltmeter shunts it. (See Fig. 4.) Then the formula is identical with the first case considered, the insulation resistance now equals the quotient of the reading of voltmeter, divided by reading of ammeter, i.e., insulation resistance $= \frac{E}{C}$. If the voltmeter reading = 500 volts and ammeter reading $= \frac{1}{2} = .5$ amp., the insulation resistance of A would be $500 + .5 = 1000$ ohms.

The next problem to be considered is that shown in Fig. 5, of locating a short circuited coil in an armature of a motor with a bipolar field. Connect an ammeter in series with a suitable resistance in one of the brush holders, P, connect the other brush holder, M, to rail, then take voltmeter terminals (low reading voltmeter), K and H, insulated except at the point, so that they can be held in the hand, and make contact with them upon two adjacent segments of the commutator, say, a and b, and note reading, then change the points, K and H, to commutator bars, b

and *c*, and note reading. If resistance of armature coil, *a b*, equal resistance of armature coil, *b c*, the reading will be the same in each case, and so on all around the commutator, from *a* to *b*, *b* to *c*, *c* to *d*, *d* to *e*, etc.

A short circuited coil will give a low reading, a high resistance coil a higher reading and a coil short circuited at its terminals, or at the commutator segments,

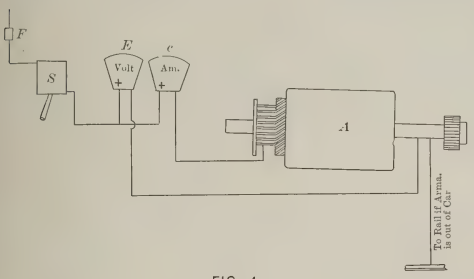


FIG. 4.

would give practically no reading when the voltmeter terminals were brought into contact. The current should be constant, but as there is an ammeter in circuit any variation could be noted and allowances made.

If the resistance of coil, *a b*, be known, then formulæ of the second case considered applies to this test, and the reading of *b c* divided by *a b* and multiplied by resistance of *a b*, equals the resistance of *b c*;

$$\text{resistance of coil } bc = \left(\frac{\text{volts } bc}{\text{volts } ab}\right) \times \text{resistance } ab.$$

The instruments necessary for these tests would be a high reading voltmeter (0 to 600 volts), a high reading ammeter (0 to 150 amps. with scale division 1 amp.), a low reading voltmeter (0 to 2 volts with scale division .01 volt), a low reading ammeter (0 to 5 amps., with scale division of $\frac{1}{10}$ amp.). As a voltmeter which read from 0 to 600 would have scale divisions of about one di-

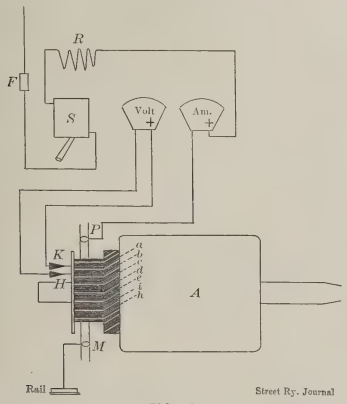


FIG. 5.

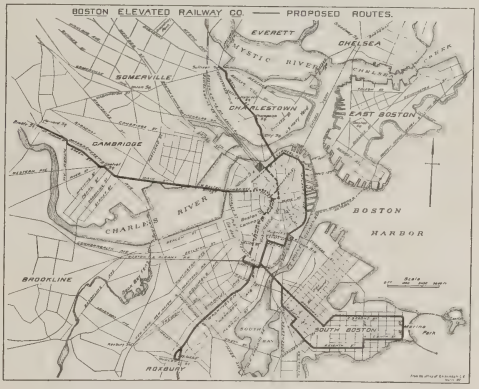
vision equal to 5 volts, it would be better to get this instrument with a double scale, one scale reading from 0 to 600 volts, and the other reading 0 to 150 volts, each scale division of the latter equal to 1 volt. By this means closer readings could be taken between 1 and 150 volts than is possible on the higher scale.

In commencing a test if some approximation of the readings is not known, it would be much safer to use the high reading instruments first. If necessary they can be removed and the low ones substituted. By varying the series resistance in a circuit the range of an instrument may be made available for many tests in any particular case. Working with as large currents as the instruments are designed for without causing a heat error, is preferable to work with weak currents and will give better results.

Elevated Railroad in Boston.

The long delayed project of an elevated railroad system in Boston now seems to be nearing consummation, and a bill covering a charter for a comprehensive system is now before the legislature and will be favorably reported. The backers of the system are the J. P. Morgan syndicate and the plan is to lease the West End system, which is controlled by the same syndicate, to the elevated railroad company.

The route, which is in part underground, but in main elevated, is shown in the accompanying engraving, the elevated portion being indicated by heavy black lines and the underground by a line made up of dots and dashes. As will be seen, the plan contemplates a loop in the business portion of the city connecting the North Union Railroad



MAP SHOWING PROPOSED ELEVATED RAILWAY SYSTEM IN BOSTON.

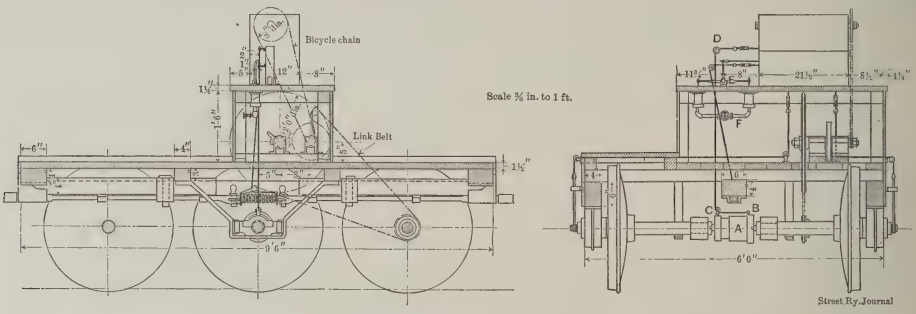
station and the South Union Railroad station and extending over Commercial Street, Atlantic Avenue, Beach Street, Castle, Tremont and Court Streets. On Tremont Street the subway will be used and a short section of new subway will be built on Court Street as shown by the dotted line. From this circuit branches will be built to South Boston, Roxbury, Cambridge and Charlestown.

According to its charter, the elevated railroad company must carry passengers between any two points for a single fare of five cents. It is also proposed to establish with the West End surface lines a system of through transfers so that passengers can transfer from one to the other without the payment of extra fare.

M. G. STARRETT, assistant chief engineer of the Metropolitan Street Railway Company, of New York, gives, in a recent issue of the *Railroad Gazette*, some interesting figures upon the operation of the Lenox Avenue conduit line of that company. In regard to the drop in voltage he states that 2⅜ miles from the station, with thirty-six cars running, the drop is 12½ per cent. On the two branches of the Lenox Avenue line, 8¼ miles of single track, there are 777,600 ft. of 500,000 c. m. lead covered cable. The leakage has been measured time and again by ammeters, with no cars on the line and in all sorts of weather, and is but a fraction of 1 per cent of the total output. Mr. Starrett also states that the cost of power is no greater, the cost of line repairs is less and the other expenses remain the same, therefore, that the total cost of operation is less than the cost of operation with the overhead trolley.

The Track Indicator Car of the Chicago City Railway.

The Chicago City Railway Company in repairing its track and roadbed is making use of a track indicator car, designed by M. K. Bowen, general manager, and briefly described by him in his paper before the American Street Railway Association last October. The purpose of the car is to aid in determining when the cost of operation over any particular line exceeds the outlay which would be necessary to rebuild it. The record obtained of the condition of the tracks is of such accuracy that it is believed that an experienced operator, quoting from Mr. Bowen's paper, will become so accustomed to the value of a knowledge of defects that a glance at the profile will tell him the money he may judiciously expend on rebuilding or repairing the track.



LONGITUDINAL AND CROSS SECTIONS OF INDICATOR CAR.

Five recording arms, with pencils at their tips, automatically trace on a moving sheet of paper the condition of the track as regards high and low joints on either rail, difference in height of the two rails, variation in gage and the pull or tractive effort required to maintain the speed of the car at an uniform rate.

The construction of the car is easily understood from the accompanying drawings. A heavy wooden platform 8 ft. × 10 ft. rests without springs on a four wheel truck. Midway between the front and rear axles is carried a third. This third axle is divided in the middle and carries a spring inserted between the inner ends, A (see cut). The spring is contained between two cups or boxes, one being large enough to slide freely over the other. These boxes have solid bottoms on which are turned cone bearings for running against the ends of the half axles. The axles being free to move in and out, the action of the spring keeps the wheel flanges pressed tight against the rails. The wire cord attached at B, and passing through pulleys at C and D, transmits any movement caused by gage variation to the recording lever. The outer ends of the half axles are also free to move up and down, and wires from the axle ends passing over a series of pulleys, as shown in the drawings, connect with the recording lever which registers the condition of the track as regards high and low joints.

The drawbar, like the third axle, is divided in the middle, the two parts being connected by a spring; the drawbar is carried on roller bearings which reduce the friction to a minimum and allow the full tractive effort to be exerted on the spring. As before, the wire leading to the recording lever is fastened at one extremity of the spring and passes over a pulley at the other.

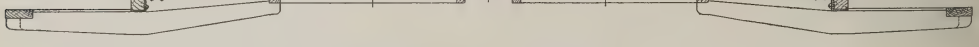
The relative difference of level between the two rails is indicated by the difference of level in two cups filled with mercury and connected by a pipe, F. The fluctuations of the mercury are indicated by two wooden plungers connected by the cross arm, E, pivoted at the center and, as in the other instances, connected by a wire to the recording lever.

The records are made on a strip of paper 18 ins. wide, which unwinds from a revolving drum at the rate of 1 ft. for each 1000 ft. of track passed over. A reproduction of records taken with the car was published in the Journal of November, 1896. As the paper unrolls an attendant marks at the proper points the names of the intersecting streets.

The indicator car weighs nearly 4000 lbs., and is drawn behind a motor car at a uniform speed of about 6 miles per hour. Under the direction of Messrs. Price and Heidelberg the car is being run over the company's lines both before and after repairs are made. A comparison of the two records will show in exact money value the saving effected.

Method for Trussing Car Sills.

The accompanying engraving shows a method for trussing car sills, designed by D. S. Moffett, superintendent of repair shops of the Brooklyn Heights Railroad Company, and employed on the 20 ft. body cars of that company. The feature of the method is in the employment of a steel Z angle plate at the end of the side sill to support the end sill. The truss rod is also bolted at the ends to the top of the end sill through this channel plate, and is not carried through the sill. This method, it is claimed, pulls up the end of the sill better than where the rod is carried through the sill, as the latter is not weakened by the transverse holes necessary by the latter method.



METHOD OF TRUSSING CAR SILLS.

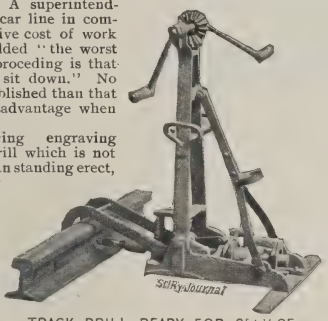
The suburban line opened during the past season between Binghamton (N. Y.) and Union, which is under the control of the Binghamton Railway Company, is proving a paying investment; the cars are well patronized and the line is very popular, especially with pleasure riders during the summer season, and even the winter traffic is far beyond the expectations of the promoters of the system. Handsome long eight wheel cars with cross seats are employed.

SCIENCE · ENGINEERING · INVENTION ·

A Convenient Track Drill.

The waste of time and labor in drilling holes by means of ratchet drills is one of the most annoying expenses incident to the bonding of street car track. The time required varies according to the size of the hole, the weight of rail and the diligence of the workman, from fifteen minutes to three quarters of an hour, and this slow process is greatly aggravated in case the work is subject to interruption by passing cars. A superintendent of a large street car line in complaining of the excessive cost of work with ratchet drills, added "the worst feature of the whole proceding is that the workman has to sit down." No fact is more fully established than that a laborer is at a disadvantage when sitting on the ground.

The accompanying engraving shows a Paulus rail drill which is not only operated by a man standing erect, but which, by rapidity of operation and quickness with which it can be adjusted to the rail, reduces the cost of drilling bond wire holes to a minimum.



TRACK DRILL READY FOR SERVICE.

Two men operating this drill can put a ⅞ in. hole through the web of an 80 lb. rail in two minutes, and during a recent case of urgent work four holes were drilled in six minutes. This is, of course, more rapid drilling than would ordinarily be required, but it shows the value of these machines in cases of emergency.

The drill can be collapsed to clear the track for a passing car in less than five seconds, leaving the bit in position so that when the drill is again thrown to an erect position no adjustment is required before the drilling can be recommenced.

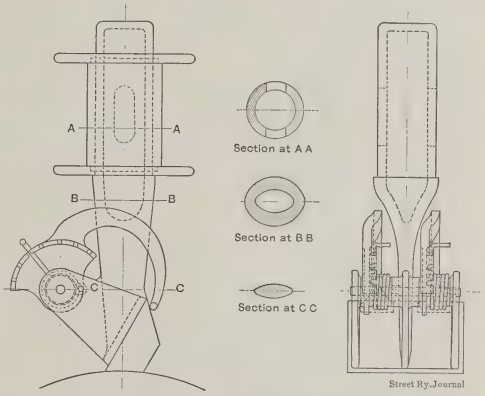
The drills are made of two patterns, the one shown above weighing 60 lbs., and the heavy base drill weighing about 90 lbs. These drills are largely used by both steam and street railroads. The drill is manufactured by the Buda Foundry & Machine Co.

DRILL COLLAPSED TO ALLOW PASSAGE OF CAR.

THE *Railroad Gazette* publishes, in a recent issue, a list of some of the recent orders for steel rails placed with rolling mills in this country since the breaking of the recent Steel Rail Association. This list aggregates 829,355 tons, part of which is estimated. The number of steam railroad companies purchasing rails in the list is eighty-two. In addition, two other companies secured options for 25,000 tons additional, and several other companies stated that additional orders would be placed shortly. One of the orders mentioned is said to be the largest single order for rails ever placed with one firm. It was from the Canadian Pacific Railroad Company for 65,000 tons, and was given to the Carnegie Steel Works. Eight thousand tons of angle plates were ordered in addition to the rails from the same mills.

New Brush Holder.

The accompanying drawings illustrate a modification of the Walker brush holder, which makes it even more substantial and simple than it was before. This improvement, which is due to the ingenuity of Prof. S. H. Short, consists in the simplification of the support for the holder proper. The old holder, it will be remembered, consisted of a U-shaped yoke carrying a rod, on which were mounted as many brush holders as were necessary. The improved brush holder does away with this yoke and the bolts and joints which it interposed in the current path to the stud. The stud and holder itself are now one casting. On the end of a suitable arm, radially adjustable with reference to the commutator, is cast a piece parallel to the commutator bars and inclined at the proper angle. The flat surface of this cross piece thus inclined is accurately finished and forms the surface against which the brushes are pressed. On the rear of this cross piece are cast lugs, which carry the notched quadrants and fingers pressing against the brushes. A helical spring fitting in various notches on these quadrants, regulates the tension. As many of these fingers as there are brushes are provided and on



SIDE AND END ELEVATIONS AND SECTIONS OF BRUSH HOLDER.

the side elevation, which is the subject of Fig. 1, the angle of the brush with reference to the commutator is shown and also how the finger presses the carbon block both against the commutator and against the finished surface of the brush holder.

These brushes can be varied in lateral position one-half their width in either direction, and thus they can be arranged staggered so as not to wear ruts in the commutator.

The whole device is really a single holder with a multiplicity of brushes which are independently adjustable.

A degree of simplicity has been reached which it will be hard to improve upon. There are but three pieces for every brush—the brush itself, the quadrant and the spring. The axle upon which the quadrants turn and the main casting are common to all the brushes, as is also the stud which fastens it to the supporting ring.

Besides much greater simplicity and cheapness of manufacture, this holder has a very much higher conductivity and rigidity and is entirely free from all joints, even tightly bolted contacts.

THE Louisville Railway Company, has just purchased fifty new Brill cars of the 30 ft. pattern. These cars will replace many of the company's smaller cars and will be operated by conductors. The company is rebuilding its Brook and Seventh Streets line with 90 lb. rails and will soon have electric cars running on the street.

The Kinetic Motor.

Stored steam as a motive power for street cars has been used with very successful results abroad, and the past experiments with the same power in this country have been on the whole quite favorable as regards the economy and efficiency of the system. The announcement that the Kinetic Power Company has entered the market with an improved motor of this character is, therefore, of considerable interest. The system employed is that developed by

THE KINETIC MOTOR.

A. P. Dodge, general manager of the company, and differs in several respects from the Lamm-Francq motors employed abroad, but in general principle it is similar. The cars are equipped with a large boiler in which hot water and steam to a temperature of 380 degs. F., corresponding to a pressure of about 200 lbs. per square inch, is introduced. The boiler is well jacketed to prevent radiation. As steam is admitted into the engine cylinders, the boiler pressure is reduced, immediately upon which part of the water passes into steam. In the Lamm-Francq motor no fire is carried on the engine, but with the kinetic motor, a very small fire, not stoked on the trip, is employed to make up for what slight heat is lost by radiation, an economy having been found to result from this step.

One of the cars of the company is shown in the accompanying engraving. This car has been in operation for a month or more on the New City branch of the New York & New Jersey Railroad for experimental tests. There are a number of long, steep grades on this road which the cars have no difficulty in surmounting while drawing a 33 ton loaded freight car as a trailer. The cars are made to run from 20 to 30 miles on one charge of steam and evaporate, with the trailer, about 38 lbs. of water per car mile.

The boiler is located above the axles, and no space available for passengers is taken up by it or the machinery. The boiler is of the tandem tubular type with capacity for 50 h. p. and carries on starting 275 gals. of water under a pressure, as stated, of about 200 lbs. per square inch. The firebox is at the rear end of the car, and its grate surface measures 20 ins. × 30 ins. Hard coal is used, and during heavy service about 4 lbs. of coal are burned per car mile, This is found sufficient, not only to compensate for all heat lost by radiation, but also to raise the boiler pressure during long stops and when running down grade. The boiler can also be arranged for burning liquid fuel, if desired. The steam dome and stack are located on the front platform, as will be seen from the engraving. In the new cars now being built the steam dome will be considerably smaller in diameter than an ordinary electric motor controller, and will occupy less room. The boiler is jacketed with 2 in. magnesia packing and there is no evidence of any heat in the car from it. The car can be operated from either end, as in trolley or cable cars.

There are two steam cylinders, each 9 ins. in diameter × 10 ins. stroke, controlled by an ordinary link motion, and connected to 30 in. driving wheels by main and side rods. The boiler pressure is lowered before it is used in the cylinders, by means of a reducing valve. The exhaust steam is carried to an air condenser located on the top of the car and having 1600 sq. ft. of air surface. This condenser is shown in the engraving, but for street use it can be surrounded by a monitor, giving the appearance of a monitor roof. The condensed water can be either pumped back into the boilers, or, as in the motor shown, flows into a tank, from which it is discharged at intervals. All of the machinery is carried on the side frames of the truck, which are cushioned over the journals, so that there is no dead weight on the axles. The total weight of the car equipped and ready for service is 29,000 lbs.

An earlier form of the kinetic motor was in operation several years ago in Chicago and was examined by a number of prominent engineers, including A. E. Dolbear, of Tufts College, and W. S. Hill, of Boston who have spoken well of the theory and operation of the system. The cost of motive power per car mile with trailer, it is estimated, should not exceed one cent.

Pipe Works in Russia.

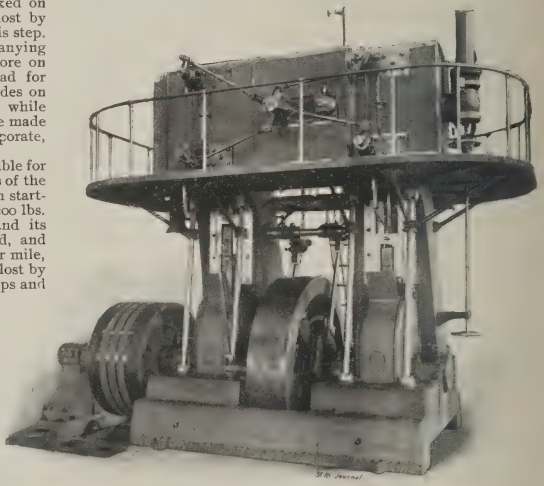
The iron pipe and rolling mill now being erected by the Russian Government at Marioupol, Russia, will occupy a mile square. Most of the machinery was sent to Russia by Morris, Tasker & Company, and the works are being constructed and will be operated under American engineers. The latter have now an 8 in. pipe mill running, a plate mill nearly finished, also open hearth furnace foundry, machine shop, brickyards, 200 houses, pumping station, etc. The electric station contains Siemens & Halske 225 k. w. machines, Ball engines, Brush arc dynamos, Babcock & Wilcox boilers, etc., all contained in a brick building 180 ft. × 80 ft.

Walter Phillips, who is in charge of the electrical installation, reports the greatest interest also in electric railways, and states that Russia will soon take a front rank in the construction of electric railroads.

Vertical Compound Electric Railway Engine.

Reference was made in the last issue of the Street Railway Journal to the vertical compound condensing engines, designed and built by the Ball & Wood Company, for La Capital Tramways Company, Ltd., Buenos Ayres, Argentine. The accompanying engraving presents a view of one of these machines, assembled at the shops before shipment.

The cylinders are proportioned for a normal load of 425 h. p., the high pressure cylinder being 14½ ins. in diameter, low pressure 30½ ins. in diameter, stroke 18 ins., and the engine is designed to operate at 175 r. p. m. The valves are of the Corliss pattern and are placed in the cylinder heads, thus short, direct ports are obtained with minimum clearance. The admission valves are controlled by



VERTICAL COMPOUND RAILWAY ENGINE.

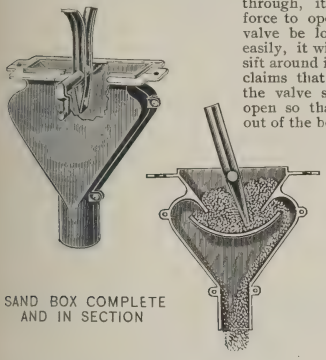
the well-known Ball & Wood governor while the exhaust valves are actuated through adjustable eccentrics.

Engines of this type, built by The Ball & Wood Company, under test have shown remarkable economy, and it is confidently believed by the builders that the engine will meet with great success in the larger central stations.

Messrs. Ahearn & Soper are building all the rolling stock, furnishing the electrical apparatus and putting up the overhead construction for the new street railway in Quebec, of which Edward A. Evans is chief engineer and manager. Westinghouse motors will be used and the roadbed construction laid with 72 lb. rails.

New Sand Box.

The Ham sand box illustrated herewith and made by the Trojan Button Fastener Company is based upon the theory that any box provided with a valve at its bottom is impracticable; that if the valve be made tight enough to prevent the sand from sifting through, it will require great force to operate it; while if the valve be loose enough to work easily, it will allow the sand to sift around it. The company also claims that if a pebble get into the valve slide, it will hold it open so that the sand will run out of the box.



SAND BOX COMPLETE AND IN SECTION

In the No. 3 Ham sand box illustrated all parts are made of bronze metal. It has an opening in the box, under which is a curved shelf. The ends of the shelf extend beyond and above the opening in the box, so the sand cannot escape by gravity. A paddle is reciprocated above the shelf, and the movement of the paddle forces the sand in each direction alternately over the ends of the shelf to the feed spout which leads to the car track. Above the paddle are two fingers which stir the sand. The connecting rod passes forward to the car platform, and is operated by a pin and bell crank lever, or by a hand lever. The working parts are extremely simple and the motions direct. The strokes of the foot or hand may follow each other so rapidly as to practically secure a continuous, but small, stream of sand, a decided advantage in hill climbing. It can be easily seen that waste is impossible in this box, as the sand flows only when the lever is in motion, and the quantity of sand is regulated.

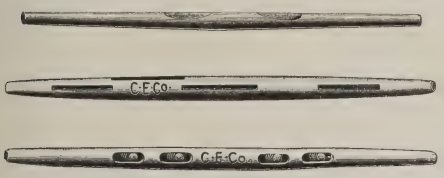
The sand hopper inside of the car and directly over the sand box, may be made of any form desired. If the space under the seats is inclosed, a square soap box or any other cheap form of construction may be employed.

Small stones, or other small substances will not interfere with the operation of this box, but will pass freely through it. It fact, the company recommends coarse in preference to fine sand, even if it contains gravel stones as large as peas, as it is less likely to pack in the box.

The manufacturers state that they have unsolicited testimonials favorable to the box, received from prominent railroad men.

Trolley Wire Splicers.

The accompanying engravings illustrate a new type of trolley wire splicer manufactured by the Central Electric Company and made of special drawn tubing to give the greatest possible strength with the least amount of metal. The splicers are made in several styles, as shown, to suit different conditions and preferences of railway engineers. The company is also making a line of feedwire splicers to fit all sizes of wire from No. 0 to 1,000,000 c. m.



TROLLEY WIRE SPLICERS.

The Central Electric Company is also carrying in stock a very complete line of motor bearings for which great claims are made. The company invites investigation as to the wearing qualities of these bearings as well as of its other repair parts, of which it carries a very complete line. Large orders have been received for apparatus recently and the company anticipates a good year's business,

New Car Coupler.

The Chicago City Railway Company has adopted the drawbar and coupler which is shown in the accompanying engravings. It was applied to the cars of the Cottage Grove Avenue line in September, 1896, and has been in constant service on that line since. It proved such a source of comfort to passengers, and fills so completely the requirements of a rigid connection, that the Indiana Avenue line was later equipped with it, and it will be applied to the cars on the State Street line, as soon as the change can be made. In the spring of 1896, M. K. Bowen, general superintendent, appointed a commission to investigate the merits of various bars in use, and to make what practical tests were necessary, in view of adopting the best in the market, for the City Railway lines. After several weeks' tests, a number of bars and couplers being put into actual service, that shown was unanimously recommended by the commission for adoption.

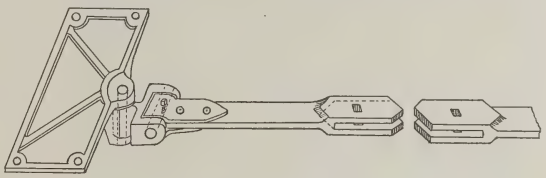
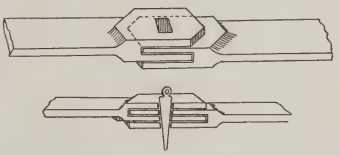


FIG. 1.—CAR COUPLER.

The back casting, by which it is connected to the car, is a skeleton frame of malleable iron, into which fits a cast clevis, forming between them and the bar a double trunnion joint, giving to the bar and head a perfectly free lateral and vertical motion. The bar is connected to the clevis, and the clevis to the skeleton frame, by 1¼ in. steel pins, made to a driving fit. The motion is so slight at this point, that by having a pefectly tight joint, the wear on pins and clevis is almost entirely overcome. The coupling head is two longitudinal projections, with V-shaped ends, with a seat between them, correspondingly V-shaped. These heads are reciprocally intermeshing, having holes conforming to a wedge-shaped pin, the sides of which are slightly out of alignment. When the heads are together, and the pin inserted, it engages alternate sides of the openings, and wedges the two heads together, as shown in Fig. 3. The object of the wedge pin was two fold; first to wedge the heads rigidly together, and second, to drop down automatically, as the pin, or sides of head wore, and take up slack. It has been found, however, from examining heads that have been in service for the past nine months, that there is no wear on the heads and pins, as the two heads are so firmly locked together, that there is absolutely no motion, consequently no wear. This device connects cars so firmly together, that the use of springs in the bar becomes superfluous, and two or more cars, in starting and stopping, become practically one, overcoming the jerk and jostle so unpleasant to passengers. It requires no link, and but one pin. The pin, with the proper taper, has no tendency to stick, and cars are coupled and uncoupled, with perfect ease.



FIGS. 2 AND 3.—METHOD OF CONNECTING COUPLER HEADS.

The bar was patented Apr. 6. 1897, by W. H. Carter, of the Chicago City Railway.

An Enterprise for Electrical Repairs.

The rapid growth of street railways, especially in the larger cities, is continually calling for changes in equipment. Machinery that was sufficiently heavy one season is found inadequate for the next, and while a company's motors, dynamos and other apparatus may be as good as when first installed they must be discarded for more powerful machines to meet the requirements of increased patronage. Realizing that the machinery which must be discarded by one company would fulfill the requirements of another, the Electrical Exchange constituted itself a middleman for the disposition of this material. The business of the company has grown rapidly from the start until its sales are now equal to that of many of the larger supply houses. For the week ending May 15, the weight of the company's sales amounted to 40 tons. It handles every form of electrical apparatus from incandescent lamps to the heaviest dynamos.

An especial feature of the company's business is its repair shop, illustrated in Fig. 1. The machines which are bought in are here overhauled by a force of men under the supervision of an ex-

pert and are put in perfect condition before being reshipped. In addition to this the company does a general repair business in electric railway and lighting lines. Fig. 2 shows a partial view of the stock room of The Exchange and gives a good idea of the lines carried.

The best index of the company's business is shown by the list of sales of the past few weeks which include the following: Marais Lumber Company, Marais, Mich., one 1000 light National alternator; Chicago Illuminating Company, Chicago, one 60 light Western Electric arc dynamo, one 750 light Slattery alternator; Mt. Clemens Electric Company, Mt. Clemens, Mich., one 50 light T. H.

MACHINE SHOP.

1200 c. p. arc dynamo; Kenosha Electric Light Company, Kenosha, Wis., one 60 light Western Electric arc dynamo; Hartford City Electric Light Company, Hartford City, Ind., one 60 light Westinghouse arc dynamo; F. D. Phelps, New Haven, Mich., one 650 light Thomson-Houston alternating generator; Harrison Electric Light Company, Allegan, Mich., one 100 k. w., 500 volt power generator; Savannah, Thunderbolt & Isle of Hope Railway Company, Savannah, Ga., 4 w.p. and 30 Thomson-Houston railway motors; Eastern Electric Equipment Company, Cleveland, O., 30 Thomson-Houston railway motors; Village of Mingo Junction, O., complete arc light plant; Leslie & Gilbert, Hopkinsville, Ky., one 1300 light Slattery alternating generator; Rockport Water Works Company, Rockport, Ind., one 1000 light Brush alternating motor; Chicago Armature Company, Chicago, Ill., one 200 light Thomson-Houston incandescent dynamo, one 3 h. p., 220 volt Jenny motor; H. E. Peltz, Cross Fork, Pa., one 225 light Sperry incandescent dynamo; R. W. Schmelz, Jacksonville, Fla., one 250 light incan-

STORE ROOM.

descent dynamo; McPherson Water & Electric Company, McPherson, Kan., one 250 light incandescent dynamo; Specialty Manufacturing Company, Milwaukee, Wis., one 20 h. p., 220 volt Belding motor; Libertyville Electric Light Company, Libertyville, Ill., one 400 light Brush incandescent dynamo; Standard Lamp Company, Marion, Ind., one 400 light Brush incandescent dynamo; also motors and dynamos of various units to a large number of other persons and corporations.

Electric Passenger Launches.

Boating in its perfection is emphasized in a new type of electric launch embodying comfort, ease and luxury, as noticeable in the accompanying illustration, which is a new type of launch built by the Electric Launch Company, shows a marked departure from the lines hitherto followed in launch construction.

The usual side seats are discarded, the floor is polished and covered with rugs, the entire boat space is occupied by movable easy chairs, a reclining steamer chair, upholstered divan, cane table and racks for books or magazines. Only in an electric launch are these pronounced features possible and they have been attained by placing all motive power, storage battery and motor, beneath the flooring, by which not only stability, but cleanliness and noiselessness are insured.

The seating space is covered with a portable awning, or fitted with easily removable awning frame having a waterproof cover and adjustable storm curtains. Both decks are made watertight, and open spaces beneath are fitted with refrigerator and lockers for supplies and refreshments for a day's cruise or outing.

Electric street railway companies are chiefly interested in these boats as passenger carriers on account of their popularity, and now that they are developing parks and pleasure resorts one of the first attractive features introduced is that of electric navigation. The capacity of the power equipment of each boat is sufficient for a continuous run of six or seven hours, which, including the landing stops and waits, is equivalent to a day's work of ten to twelve hours.

Charging current for the batteries is usually supplied direct from the trolley lines with a rheostat to regulate the amount, but sometimes a motor generator is introduced to reduce the high potential of 500 volts to the more convenient 110 volts.

ELECTRIC LAUNCH.

The list of street railway companies operating these launches is a long one and the successful financial results reported on all sides seems to insure the stability of an enterprise so successfully inaugurated at the World's Fair.

Fenders in Albany and Syracuse.

The managers of the Albany Railway have been investigating for a considerable time the question of the best fender to adopt on their cars. While accidents have fortunately been very few the need of a good fender was realized, and for over a year a comparative test of the different types of fenders has been carried on by the company. A city ordinance, however, required that the fender be approved by the Common Council before its adoption. The fender selected by the company was the Providence fender and on May 17, this was approved by the Council. The Council report is extremely laudatory to the wisdom of the railway company's selection. It states that the Council Committee thoroughly investigated the merits and efficiency as to the safety of the Providence fender, and has concluded to recommend said fender for superiority as to practicability and safety, as demonstrated by actual use in thirty-eight cities and towns throughout the United States, in which the percentage of fatal accidents was but 3 per cent, with circumstances surrounding each of said accidents which would even further reduce the said low percentage of deaths. The Committee report continues:

"We, therefore, recommend the use of what is termed the Providence car fender, and respectfully suggest to the Albany Railway Company that its application to their several cars be proceeded with as speedily as possible."

The consent of the Common Council having been secured, the railway company lost no time in entering into a contract with the Consolidated Car Fender Company, of Providence, and placed an order with this company for fenders to equip all of its cars.

The experience in Syracuse was very similar. A committee of the Common Council took up the subject very ca efully and after a rigorous investigation voted unanimously in favor of the Providence fender. This has consequently been adopted for all of the cars of the Syracuse Rapid Transit Railway Company.

Results Obtained by the Use of Economizers in Electric Railway Plants.

At the present time when the advantages and disadvantages of different systems of engineering in electric railway steam plants are being discussed, the following tests and opinions of street railway engineers and managers who have had practical experience in the use of Green's economizer, will be of interest.

A set of tests was made by George H. Barrus, of Boston, on the boilers of the Toronto Railway Company's plant at Toronto, on Aug. 21 and 22, 1895, to determine economy due to the use of Green's economizer.

This plant embraces six boilers of the Scotch marine type, the dimensions of which are 10 ft. in diameter and 14 ft. in length. Each boiler is fitted with Fox corrugated furnaces, provided with grates 6 ft. long and 3 ft. wide, and each has eighty 4 in. tubes running from end to end. The area of grate surface in each boiler is 36 sq. ft., about 40 per cent of which is air space, and the area of heating surface is approximately 1500 sq. ft. The whole plant of six boilers has 216 sq. ft. of grate surface, and approximately 9000 sq. ft. of heating surface.

Steam is used by a number of engines which furnish power for generating the electric current used by the railway. The plant is in operation under its normal conditions of work for a period of about 18½ hours each day. During this period the average amount of current generated is some 2400 amps., at a pressure of 550 volts. For the remaining 5½ hours' period the load ranges from 80 to 280 amps, one of the smaller engines being in use during the greater portion of this time. During the night period two of the boilers are kept in continuous operation, but the fires in the remaining boilers are banked. At the time of the tests all six boilers were in operation, and the fuel used was a mixture of Pittsburgh slack coal and pea and dust anthracite from the mine, in the proportions of two loads of the former to one of the latter. The fires were cleaned three times during the full run of 24 hours. At times of the heaviest load, the plant required the assistance of some of the old boilers of the station.

The fuel used on the tests was that commonly burned, that is, a mixture of Pittsburgh slack and pea and dust from the mine. The proportions were approximately 66.5 per cent of the former and 33.5 per cent of the latter on both tests. The calorific value of a sample of this coal, as determined in Barrus's calorimeter, is 13,121 B. T. U. per pound of coal and 14,875 B. T. U. per pound of combustible, the ash being 11.8 per cent. The spreading system of firing was employed, the thickness of the bed of coal being about 6 ins., and the fires were frequently broken up and leveled off.

During the progress of the tests the regulating damper in the main flue was constantly wide open, and on both tests the boilers were run at practically full capacity.

On the test with the economizer in use, 6510 lbs. of coal were used by the old boilers, and on the test without the economizer, 20,390 lbs. The water supplied to the old boilers was not measured. These boilers have no connection with the economizer, and consequently their work had no direct bearing upon the main test. The coal which they consumed, here noted, is in addition to that recorded in the table.

The data and results of the tests are given in the accompanying table, from which it appears that the saving due to the economizer represented 18.3 per cent of the coal required when the economizer was not in use, and amounted for a day's run to 21,385 lbs. or 10.7 tons of coal.

The efficiency of the plant, or the percentage which the heat utilized bears to the calorific value of the coal when the economizer was in use, was 70.6 per cent.

It may be added here that the maximum temperature of the water leaving the economizer during the trial was 253 degs.

DATA AND RESULTS OF EVAPORATIVE TESTS ON BOILERS AT TORONTO RAILWAY COMPANY.

Conditions as to Running of Economizer.	Economizer Running, Aug. 21-22, 1895.	Economizer not Running, Aug. 23-24, 1895.
1. Duration.....hrs.	19.66	19.72
2. Weight of dry coal consumed.....lbs.	95,310	104,372
3. Weight of ashes and clinkers..... "	14,417	15,932
4. Percentage of ashes and clinkers.....per cent.	15.1	15.3
5. Weight of water evaporated.....lbs.	788,717	702,610
HOURLY QUANTITIES.		
6. Coal consumed per hour.....lbs.	4,847.9	5,292.7
7. Coal per hour per square foot of grate..... "	22.4	24.5
8. Water evaporated per hour..... "	40,113	35,634
9. Equiv. evaporation per hour, feed 100 degs., pressure 70 lbs.....	40,435	36,602
10. Horse power developed, A. S. M. E. basis of 30 lbs.....h. p.	1,347.8	1,202
AVERAGES OF OBSERVATIONS, ETC.		
11. Average boiler pressure.....lbs.	120.3	119.3
12. Average temperature of feedwater at point of entering economizer.....degs.	101	96.4
13. Average temperature of feedwater at point of leaving economizer.....degs.	237	
14. Average temperature of flue gases at point of entering economizer.....degs.	620	607
15. Average temperature of flue gases at point of leaving economizer.....degs.	293	
16. Average draft suction in main flue near boilers.....ins.	.83	1.16
17. Weather and outside temperature.....	Clear. Moderate.	Cloudy. Moderate.
RESULTS.		
18. Water evaporated per pound of coal.....lbs.	8.275	6.731
19. Equivalent evaporation per pound of coal from and at 212 degs.....lbs.	9.586	7.828
20. Equivalent evaporation per pound of combustible from and at 212 degs.....lbs.	11.291	9.243
21. Weight of dry coal required to evaporate 788,717 lbs. of water supplied at 101 degs. (for 24 hours' run) based on above results.....lbs.	95,310	116,695
22. Saving of coal due to economizer for 24 hours' run.....lbs.	21,385	
23. Percentage of saving due to economizer.....	18.3	

NOTE.—The temperature of the flue gases here given does not include the night period from 12 midnight to 6 A.M.

A careful test was also made at the plant of South Chicago City Railroad Company, running fifteen days, from May 17 to May 31, inclusive, 1894, without an economizer, and fifteen days from Aug. 17 to Aug. 31, inclusive, 1894, with economizer, using oil as fuel. The regular reports filed in the office of the company show .32928 gals. oil consumed per electrical horse power hour, with the economizer and .39088 gals. oil consumed per electrical horse power hour without the economizer. In other words the saving effected by use of the economizer was 15 7/8 per cent or the saving in fuel oil per day by the use of the economizer was 450 1/2 gals.

In the report made by Robert R. Zell to the St. Charles Street Railroad Company, New Orleans, La., as to the results of operation of the economizer at the St. Charles Street power house, he states as follows: "The actual conditions as found by test show the feedwater entering economizer at 200 degs. F. with gases at 450 degs. F. The feedwater after passing through the economizer enters the boilers at 270 degs. F., and the gases leave the economizer at 290 degs. F. On a further test the feedwater entered the economizer at 202 degs. F., with gases at 480 degs. F. Water entered the boilers at 274 degs. F. and the gases leave the economizer at 300 degs. F." This plant is a condensing plant, but auxiliary feedwater heaters are used, raising the feedwater up to 200 degs. before it enters the economizer, showing that in ordinary practice it is possible to heat the feedwater as high as 275 degs. on an average by use of an economizer.

M. G. Starrrett, late chief engineer Brooklyn City Railroad, now assistant mechanical engineer for Metropolitan Street Railway Company, of New York, reports as follows in regard to the economizers at the Brooklyn City Railroad plants: "We find that while regulating the draft to secure the most perfect combustion of the coal under our boilers, the gases escape from the boilers at a temperature of 450 degs. F. The temperature is reduced in the flues and economizers to about 170 degs., to 200 degs. at the base of the chimney. By means of your economizer we raise the temperature of the feedwater from 110 degs. to 130 degs. above temperature of the water entering the economizer."

Granville C. Cuningham, manager and chief engineer Montreal Street Railroad, in his report states as follows: "We have Green's economizer in connection with twelve boilers developing about 4000 h. p. Feedwater enters the economizer from the discharge pipe of the condensers at a temperature of about 90 degs. F., and leaves the economizer entering the boilers at a temperature between 260 degs. and 280 degs. The temperature at times when the load is light is as high as 300 degs."

W. E. Baker, general manager West Side Elevated Railroad Company, of Chicago, in his report on the economizers for the Intramural Railroad, states as follows: "As to gain in temperature of feedwater made by Green's economizer; I would say that the feedwater is taken from the condenser overflow at 90 degs., and is taken into the boiler at a temperature of 230 degs."

O. S. Gaither, secretary and treasurer of the South Chicago City Railroad, reports: "In our plant where we formerly fed the condenser water to our boilers at a temperature of from 85 degs. F. to 95 degs. F., we are now enabled to put it in at a temperature of from 214 degs. F. to 224 degs. F. At times it has run as high as 250 degs. F. From this you can deduce the saving in fuel effected."

J. F. Randall, mechanical engineer of the Detroit Railway Company, stated: "Water enters the economizer at 80 degs. and left at 246 degs. on an average. The actual coal being saved was from 16 to 20 per cent.

"In electric railway power station working under the ordinary average conditions, the feedwater will range from 90 degs. to 210 degs., according to whether the plant is condensing and using auxiliary heaters or high pressure. The flue gases will average from 450 degs. to 600 degs. according to whether the boilers are worked below, at or above their rated capacity. Under these conditions the average saving of fuel by the use of Green's economizer will range, it is claimed, from 12 to 20 per cent. It has been found and verified by a number of experts in actual practice and as the results of a very great number of evaporative tests that economizer will show a saving of from 1.2 to 1.4 per cent in fuel for every 10 degs. rise of temperature in the feedwater."

STREET RAILWAY NEWS

THE largest dynamo in the world will be soon erected, it is said, in Manchester, England. It will be of 2500 h. p. and for continuous current and will be directly connected to a Musgrave engine.

THE Electric Tramway Company, of Buenos Aires, Argentina, commenced operations Apr. 22. This is the first line to be equipped with electric power in that city. F. A. Wardlaw is general manager.

GREAT BRITAIN'S production of Bessemer steel rails in 1896, was 817,476 tons, an increase of 213,138 tons over the output of 1895. The American production was 1,102,892 tons during the same period.

THE latest official reports on light railways in India gives the average dividends paid as 7½ per cent and operating expenses 53 per cent of gross receipts. These railways are from 2 ft. to 2½ ft. gage and are operated by steam.

THE Colfax Electric Railway Company, of Denver, Colo., has begun the transportation of bicyles on the front platforms of its cars. A ten cent fare is charged for each. The Denver City Cable Company also carries bicycles on the front platforms of its cars.

THE Rochester (N. Y.) Railway Company has issued an order allowing one bicycle to be carried in the front vestibule or front platform of the cars of that city when the wheel or its rider has been injured. Double fare will be charged, both for the wheel and its rider.

A TRAFFIC arrangement between Brooklyn Heights Railroad Company, and the new Long Island Electric Railroad Company has been concluded, whereby through cars will be run by the former company to Rockaway Beach, a popular summer resort. The connection between the two lines will be made at Jamaica.

THE new Union Terminal Passenger Railway station at Boston, for the steam roads running South and West will cost, it is estimated, between $10,000,000 and $11,000,000. Of this sum over $5,500,000 has already been paid for real estate and to this must be added the cost of laying tracks, estimated at 12 miles in length, supplying the interlocking signals and apparatus for compressed air and for furnishing the station.

SOME of the Metropolitan daily papers erroneously stated last month that the managers of the Manhattan Elevated Railway Company, had announced their decision to equip their lines with electric power. There has been no formal action as yet by the board of directors in reference to adopting electricity, but the company is investigating the subject very carefully with a view to employing the third rail system of traction.

A VOTE was taken last month in Toronto, Ont., upon the proposition whether cars should run on Sunday, which, according to the franchise of the company, was to be determined by popular vote. Upon two previous elections to decide this question the vote was in favor of no Sunday cars. At one held seven years ago the majority was over 2,000, and again some four years ago the majority was 900. Last month the decision was reversed by a majority of 479 out of a total vote of 32,387.

THE English electrical engineers have formed a new voluntary corps as an adjunct to the British militia. The idea of forming such a body originated with Dr. Hopkinson, during the early months of 1896, when the Venezuelan dispute was before the country. He called attention at that time to the rapid progress which had been made in the use of electricity for military purposes, such as for telegraphs, search lights, training of guns, submarine mines, etc. It is announced that Dr. Hopkinson will be appointed Major of the corps.

IN a recent issue of the New York *Times* some interesting statistics were given of the city of Greater New York. The city will have an area of about 360 sq. miles including water area, a population of 3,312,000, an aggregate valuation of nearly $4,560,000,000 and a debt of $502,500,000. The water frontage amounts to 300 miles in length and there are nearly 1000 miles of railway within the city limits. In population the city will be the second largest in the world, having 2,288,000 inhabitants less than London, and 868,000 more than Paris.

THE Humphrey street railway bill, introduced in the Illinois Legislature and about which some particulars were published in the last issue of the STREET RAILWAY JOURNAL, was rejected on final vote in the House of Representatives last month by 123 to 29. The bill proposed the establishment of a State Railroad Commission which should have control of the street railways in the different cities of the state, and that the franchises of all existing street railways should be extended for fifty years, in consideration of certain annual payments based upon gross receipts.

THE Brussels International Exhibition was officially opened May 8, but, as usual with large exhibitions of this kind, the exhibits were not complete, and it is thought that visitors will not find the exhibition in working order much before June 1. Among the exhibits is one of a mono-rail system, designed by Mr. Lartigue. The motive power is electricity. The car weighs 33 tons and, it is claimed, is adapted to speeds of from 100 to 120 miles an hour. The car is 58 ft. in length and capable of seating one hundred persons. It is built entirely of steel. The wheels are eight in number and are driven by four 150 h. p. motors.

THE Ottawa (Ont.) Street Railway Company has just constructed, at a cost of about $30,000, a new iron bridge to connect the suburb of Hull to the former terminal of the company's lines at Suspension Bridge. At a suburb at the west end of the city, named Victoria Park, it is also erecting a large auditorium where concerts and other entertainments will be given in the summer season. This auditorium will be brilliantly illuminated with several thousand incandescent lights, and the company expects that it will prove a paying attraction. Evening entertainments were given at the same place last year, but without any shelter.

PLANS have been completed for the construction of an electric rack railway from Zermatt, Switzerland, to the summit of the Gorner Grat, a well known summit from which beautiful views of the Alps are obtained. The difference in altitude between the two termini of the railway is about 5000 ft. The promoters of the line, Brown, Boveri & Company, of Zurich, propose using the three phase system similar to that which is in use on the railway in Lugano and which has been in operation about a year. The line will be in operation by April 1899. The three phase system for railway work has now been applied to two railways in Switzerland besides at Lugano—the Stanstaad-Edelberg, and that from Burgdorf to Thun.

Cincinnati Notes.

The Cincinnati Consolidated Railway Company is building many extensions to its lines this summer. The Elberon Avenue line is being extended 12 miles to the new St. Joseph Cemetery and will soon be completed. The Delta and Columbus Avenue line is being extended 4 miles to Madisonville via Hyde Park. This line will be operated as a feeder to the Delta Avenue line. The East End line is being extended to Linwood and is about finished. In many parts of the city the track is being rebuilt and relaid with heavier construction.

An addition has been made to the Hunt Street station, so that it will furnish power to operate the Vine Street cable and the Walnut Hills cable lines with electricity. One-hundred and twelve new closed cars have been purchased from the Laclede Car Company. These cars are 18 ft. in length with cushioned seats and backs.

After several years' experience with the double trolley, the company is fully convinced of its usefulness and economy, as no trouble results from electrolysis.

The Niagara Falls Convention.

Secretary T. C. Penington has issued a circular letter, giving full information regarding the next meeting of the American Street Railway Association at Niagara Falls, N. Y. The convention will meet in Convention Hall, Oct. 19, 1897, and will adjourn Oct. 22. Mr. Penington states that the Traffic Associations have authorized the sale of tickets at reduced rates—namely, a fare and one-third for the round trip. Each person desiring to procure the benefits of the reduced rates, must purchase (not more than three days prior to the date of meeting) a first class ticket (either unlimited or limited) to Niagara Falls, for which he must pay the regular tariff fare, and upon request the ticket agent will issue a certificate of such purchase properly filled up and signed by the said ticket agent.

Tickets for the return journey will be sold by the ticket agent at Niagara Falls at one-third the highest limited fare to those only who hold certificates signed by the ticket agent at the point where through tickets to Niagara Falls were purchased, and countersigned by the clerk of the convention and vised by the agent of the Passenger Association, certifying that the holder has been attending the convention. Frank J. Duffy has kindly consented to serve as clerk of the meeting for this exclusive purpose. Certificates *must be signed* and vised by agent of the Passenger Association. Under the rules of the Passenger Association it will be necessary for all persons holding certificates to deposit them with the clerk when they arrive at the hall on Tuesday, Oct. 19. He will have them signed and vised and they will be ready to return to the owners on Thursday at 1 P.M.

Papers will be read at the convention on the following subjects: "Municipal Ownership of Street Railways;" "Modern Electric Railways: Their Construction, Operation and Disadvantages;" "Application of Electricity to Railroads now Operated by Steam Power;" "The Best Method of Settling Damage Cases, and the Prevention of Accidents by the Use of Fenders and Otherwise;" "Producer Gas for Use in Street Railway Power Houses and Gas Engines;" "Storage Batteries for Street Railways;" "Discipline of Employes;" "Long Distance Transmission and the Use of Multi-phase Current for Ordinary Street Railways."

The local committee has abandoned the project of erecting a building for convention purposes, and instead, the convention will be held in an armory on Walnut Street. When enlarged as proposed the building will be 132 ft. × 132 ft.; it is now 90 ft. × 132 ft. It is within ten minutes' walk of the hotels. The steam railroad tracks are now within 200 ft. of the building, and the association has secured an agreement to have these tracks extended directly to the building, thus saving to the exhibitors all charges for cartage. A side track will be laid in front of the hall for cars, sweepers, etc.

The convention will be held on the second floor of the exhibit hall, all stairways leading up from the inside, thus insuring the attention of all delegates and visitors to the exhibits; the entire hall is to be lighted and heated during the entire presence of the exhibits. The income from sale of space will go to the American Street Railway Association. The executive committee of the association has fixed the price at ten cents per square foot, and ruled that no space of less than 100 sq. ft. will be assigned, but applicants may have as many multiples of this quantity as they may wish, all in one body. Payment for space should be made to T. C. Penington, secretary and treasurer of the American Street Railway Association, 2020 State Street, Chicago, Ill., on or before Oct. 1, 1897. Application for space should be made to H. W. Beardsley, chairman committee on exhibits, Niagara Falls, N. Y. Space must be applied for by Sept. 1. Assignments will be made as promptly as possible after that date and exhibitors notified of their location. Exhibits of like character will be grouped together, and space will be assigned in the order of application.

It is earnestly requested that all exhibits shall be in place and all work finished by Monday evening, Oct. 18, which is the evening prior to the opening of the convention. Possession of the hall can be had on Monday, Oct. 11, thus giving ample time for preparation. Watchmen will be in charge of the premises so that exhibits will be safe.

The officers of the association state that if the supply men so desire, and will designate one of their own number who will be willing to go to Niagara Falls at some short time previous to the meeting, and whose necessary expenses they will defray, the executive committee will invest him with the requisite authority to supervise the reception and placing of displays. He can arrange with local carpenters, lumbermen, etc., to the effect that there may be no unfair charges for services or material that may be necessary in arranging exhibits.

There will be hotel accommodations for all who attend the meeting. The headquarters of the Association will be at the International Hotel. The rates at the hotels will be as follows:

Hotel.	Rooms.	Rate per Day.
International Hotel	350 to 450 people,	$3.50 to $4.50
Cataract House	" " "	" "
Imperial	140 rooms,	2.50 to 4.00
Tower Hotel	35 "	2.00 to 3.00
Columbia	50 "	2.00 to 2.50
Niagara Falls House	25 "	2.00
Salt's New Hotel	30 "	2.00
Temperance House	50 "	1.50 to 2.00
Atlantique	22 "	2.00
Kallenbod	30 "	3.00
Prospect House	40 "	3.00 to 4.50

Most of the hotels are on the American plan and rates according to location of rooms. Rooms will be assigned in the order of applications received, and as far as possible in accordance with the expressed wishes of the applicants. All those who expect to be present should communicate at once with the proprietors of the various hotels named. All the hotels are within easy distance of the hall where the meetings of the Association will be held and the exhibits will be on view.

The executive committee has found the street railway managers in Niagara Falls and Buffalo enthusiastic as to the coming meeting, and so hospitable and seductive in their greetings that success is assured, the location being central and accessible, and the natural attractions wonderful beyond description. Inquiries and information already received are very encouraging and an unusually large attendance seems guaranteed.

The annual dinner will be held at the International Hotel, Thursday, Oct. 21, at 8 P.M. Tickets will be sold at the actual cost to the association ($7). The officials of the association recommend that all who propose to exhibit make their applications at as early a date as possible.

Programme for the Next Meeting of the International Tramway Association.

The tenth annual meeting of the International Tramway Association, which includes representatives of tramway companies of all European countries outside of Great Britain and Ireland, will be held in Geneva in 1898. The following is the list of subjects to be discussed.

I.

A. What in your opinion are the most desirable dimensions to be adopted for the body and platforms of tramway cars. Do you think it desirable to increase the size of either the body or the platforms for different classes of service? Give your reasons in your reply.

B. What type of car do you recommend for electric traction: 1. For cars operating with overhead wire, or underground conduit? 2. For lines operated by accumulators?

N. B. The first portion of this question has already been made the subject of a number of communications in reply to a question raised in 1896, but as yet has not been treated in a separate report. At the general meeting in Stockholm, it was decided to take up this subject at the next meeting.

II.

A. What are the advantages, and what the disadvantages of employing single and double truck cars in operating lines with local traffic?

B. Is it possible by any arrangement to successfully reduce the dead weight of the car, while increasing its capacity.

C. Have you employed cars with radial axles, and if so, what have been the results secured?

D. Give a description and furnish plans of any system which you employ.

III.

What brakes do you recommend for the following systems of operation:

First. For horse traction?

Second. For electric traction: (*a*) When single motor cars are used? (*b*) When trail cars are used?

Third. For traction by steam, compressed air, gas motors, etc.?

For mechanical traction kindly indicate if you prefer the use of a single or several brakes.

IV.

From the standpoint of best service, what is the most desirable form of boiler and engine to install in a power station?

V.

What is the best method of bonding the rails:

A. For rails buried in the soil?

B. For rails placed on the surface of the ground?

VI.

What type of track switches do you employ? Kindly furnish detailed plans. How are your switches operated? What are the advantages from the standpoint of installation? Do you consider it desirable to use switches with two movable points or with one movable point? Which of the two types do you recommend?

VII.

What progress has been made concerning traction by accumulators:

A. From the standpoint of construction, of capacity, and of reducing the weight of the accumulators?

B. From the standpoint of durability and cost of maintenance?

C. From the standpoint of their economical and practical application to tramway traction?

VIII.

What are the advantages and disadvantages actually met in practice with the different systems of electric traction.

IX.

Have you anything interesting to communicate on the application of mechanical motors to tramway traction?

Annual Meeting of the American Institute of Electrical Engineers.

The annual meeting of the American Institute of Electrical Engineers was held at New York, May 18. The new officers elected were: president, Francis B. Crocker, of New York City; vice-presidents, A. E. Kennelly, of Philadelphia, Pa.; Chas. S. Bradley, of New York City; Dugald C. Jackson, of Madison, Wis. For managers: Alexander MacFarlane, of South Bethlehem, Pa.; Gano. S. Dunn, of New York City; W. F. C. Hasson, of San Francisco; Herbert Laws Webb, of New York City; for treasurer, George A. Hamilton, of New York City; for secretary, Ralph W. Pope, of New York City.

At 7 P.M. the annual dinner was held at "The Arena." That event passed off pleasantly under the skillful guidance of Toastmaster Martin. Toasts were responded to by F. B. Crocker, F. W. Jones, M. I. Pupin, C. E. Emery, A. E. Kennelly, Ralph W. Pope, J. W. Lieb, Jr., Herbert Laws Webb, Nelson W. Perry and Joseph Sachs. The exercises were interspersed with instrumental and vocal music by George Heli Guy and Charles McL. Paine.

Meeting of the Canadian Electrical Association.

The seventh convention of the Canadian Electrical Association will be held at Niagara Falls, Ont., June 2-4, 1897, at Dufferin Café, Queen Victoria Park. The meeting will be called to order at 2 P.M., June 2. The list of papers to be presented to the convention is as follows: "Day Loads for Central Stations and how to Increase Them," J. A. Kammerer, Toronto; "Submarine Cables—Dealing more especially with the Actual Experience in Cable-Laying and Maintenance in this Country," D. H. Keeley, Ottawa; "Determination of the Heating Power and Steam Producing Value of Coal from a Preliminary Examination." Wm. Thompson, Montreal; "Water Driven Plants," John Murphy, Ottawa; "The Commercial Aspect of Electric Railways," C. E. A. Carr, London, Ont.; "Accumulators: Their Application to Central Station Lighting and Power," W. A. Johnson, Toronto; "Why some Lighting Plants do not Pay," F. C. Armstrong, Toronto; "Steam End of an Electric Plant," A M. Wickens, Toronto.

The programme of social events is very attractive and includes trips to Queenston and Lewiston, visits to the power stations at Niagara Falls, and a banquet to be held at Dufferin Café on the evening of June 3.

Meeting of the American Society of Mechanical Engineers.

The spring meeting of the American Society of Mechanical Engineers was held at Hartford, Conn., May 25-28, and was largely attended, about 500 being present. The business meetings were held at Unity Hall and the convention headquarters were at the Allyn House. A number of papers on mechanical subjects were presented. The social programme included visits to the principal manufactories in Hartford and South Manchester, a trip to New Britain by the new electric line of the New Haven Railroad, etc.

Electrical Equipment of the Alley "L" in Chicago.

During the last month the South Side Rapid Transit Company, owner of the Alley elevated railway system, let a number of contracts for electrical equipment.

The power station engines will be furnished by the E. P. Allis Company, and will consist of four cross compound condensing engines, each of 1200 h. p. capacity under conditions of highest possible economy, but capable of developing 2000 h. p. each if necessary. There will be eight Babcock & Wilcox water tube boilers with 4000 sq. ft. of heating surface each, giving a rating of 500 nominal h. p. each. The boilers will have wrought steel headers and will be provided with the Babcock & Wilcox chain grate bars.

The Westinghouse Electric & Manufacturing Company will furnish four direct connected generators of 800 k. w. each.

Elevated Railway Electric Equipment in Brooklyn.

Both of the elevated railway systems in Brooklyn are seriously contemplating the equipment of their lines with electric power. The officials of the Brooklyn Elevated Railroad Company state that several plans have been submitted to them and they are convinced that electric equipment will be more economical than steam. It will also give a much more efficient service, enabling the company to run single cars at frequent intervals throughout the day and to connect its motor cars in trains during the rush hours of the morning and evening.

The officials of the Kings County Elevated Railroad also state that they are engaged upon the consideration of electrical equipment, and while neither company has yet made contracts for motors, both companies may have something important of this kind to announce within a month or two. The Sprague system of the equipment of individual cars is favored by both companies.

Important Contracts.

The Central London Underground Railway Company has just contracted with the British Thomson-Houston Company for the equipment of its lines with the American built dynamos and motors of the General Electric Company. This is the most important contract yet closed across the water and the selection of American apparatus at a price said to be nearly or quite $100,000 above the bids of European manufacturers, is a tribute to the perfection which has been reached in this country in electric railway apparatus. The total contract price is about $450,000.

The General Electric Company has also closed a contract through its Australian representative, Arthur W. Jones, for the equipment of the Government tramway system of Sidney, New South Wales. This contract calls for twenty-eight car equipments and four 850 k. w. generators and the contract price is about $200,000.

New Railway in New Jersey.

The line of the Union Traction Company, of Rutherford, N. J., was opened last month. This line extends at present from Rutherford to Arlington, but will soon be completed to Hackensack, making a part of a belt line connecting with its feeders the principal towns in New Jersey within a radius of 20 miles from New York City. The opening of the road on May 13, was largely attended, and the guests were taken by special cars over the route from Rutherford to Arlington, and afterwards entertained by the company at its power house at Rutherford. Many congratulations were extended to the officers of the company and to the chief engineer, C. J. Field, upon the smooth running of the cars and the excellence with which each portion of the system had been equipped.

A New Catalogue.

The Standard Air-Brake Company, of New York, has just issued an entirely new catalogue of its apparatus which is gotten up, as usual in an exceedingly handsome shape. Among the special features, of this catalogue are a number of clear and handsome cuts of cars equipped with the company's air-brakes in this country and abroad, an interesting chart showing the revolution of car wheels of various diameters at given speeds per hour and distance traveled per second at varying speeds, and short treatises on the company's single acting, direct axle driven compressor, its single acting geared axle drive compressor, motor driven compressor and automatic current controller, together with the controlling apparatus, trailer equipments, detail appliances, and pipes and pipe fittings.

The book was designed and text prepared by General Manager Wessels, who has found time amid business pressure to go very carefully into the subject of air-braking, with his well known vigor. The company has just received another order, in addition to the one from the colonies elsewhere noticed, which will keep the concern busy for some time

Notes From England.

(*By our London Correspondent.*)

The City of Birmingham Tramway Company is rather awkwardly situated at present. Last year Mr. Ross and Mr. McKenzie, who came over from Canada, arranged with the Town Council of

Birmingham and the Central Tramways Company of that city, whereby they got a lease of the lines for twenty-one years, and the new company was thereupon formed. This body had an understanding that most of the lines, except the six miles of cable track, should be equipped on the trolley wire system, while a few miles in the center of the city should be provided with electric conduits. Now, however, the Town Council has decided to go in for a conduit system over all the lines, except, of course, the existing cable road. The company consequently says that if the heavy capital expenditure required for conduits all over is to be incurred, it must have a longer lease in order to recoup itself. The Town Council objects to an extension of the lease, but further negotiations are promised. There is now a talk of trying a closed conduit system. Nearly all the lines at present are operated by steam locomotives, but 6 miles have for years been run by cable at huge profits and 6 miles have worked by storage batteries at heavy loss.

James Ross, of the City of Birmingham Company, seems determined not to be content with tramway work in one town, for he, with the support of others, has made an offer to the Birkenhead Town Council to form a company to take over the tramways of Birkenhead and Wirral on a twenty-one years' lease, and equip and work them by the trolley method. The Town Council is considering the offer.

The Imperial Tramways Company, after a long series of negotiations, has secured the assent of the local authorities concerned to the introduction of electric traction on the overhead wire system on a route extending from Middlesborough to Norton via Stockton. This is a distance of 11 miles, and the lines will nearly all be double track. The company has worked about 3 miles of horse tramways in Middlesborough for some years. The line will be the longest electric road yet built in Great Britain. The franchise will be for twenty-one years.

Further extensions of electric lines are in prospect in the Isle of Man. A bill has just passed the House of Keys (the Manx Legislature) for the construction of a road from Laxey to Ramsey. The cost is to be £100,000. The extension of Douglass Southern Electric Tramway to Port Soderick has been completed.

A concession, important as showing how the wind blows, has been made by the Board of Trade in regard to the Dublin Electric Tramways. I have previously noted how the Board reduced the speed of the cars. Originally the complete journey took an hour. The Board of Trade stepped in and said that an hour and twenty minutes must be occupied. Now however, in response to many complaints, the Board has reduced the time to seventy minutes, and it is hoped a further concession will yet be made.

Both electric and gas traction companies are active just now in negotiating for the purchase of tramways or acquiring leases to work them. Town councils are also active in carrying out purchase arrangements.

Foreign Notes.

Barcelona, Spain.—Applications will be received on June 8, at the Spanish Government Office of Works (Direccion General de Obras Publicas) at Madrid for a concession for electric railways or tramways between Barcelona and the neighboring places. About $10,000 will have to be deposited by the undertakers as a guarantee.

Beauvais, France.—An electric railway is projected in this place. M. Moulun, an electrical engineer who has recently installed tramways at Fontainebleau, Nevers and other places, has been engaged to report upon the project.

Birkenhead, England.—James Ross, of the Birmingham City Tramways, has proposed the installation of an electric trolley system here, to connect with the Birmingham system.

Brussels, Belgium.—The Brussels Tramway Company has requested permission from the Government to construct a new overhead electric line.

Bucharest, Roumania.—The Roumanian Government invites tenders for the supply of 55,000 double bell porcelain insulators and other porcelain telegraphic fittings. Applications should be made to the "Direction of Posts and Telegraphs," Bucharest, and bids are to be in by Aug. 20.

Caen, France.—A special commission appointed by the Municipal Council to consider the question of an electric railway grant has voted unanimously in its favor and the concession will be given to a Rouennaise company.

Chalons-sur-Marne, France.—An electric railway is projected here between Little Mourmelon and Great Mourmelon.

Dublin, Ireland.—Application was made on Apr. 21, by the Dublin & Lucan Steam Tramway Company to the Grand Jury of the County of Dublin, for permission to operate its line by electricity, the name of the company being also changed to The Dublin & Lucan Electric Railway. The overhead system is to be used. Permission was given and the company expects to commence work in June or July. The line will be laid with Vignole rail on wooden ties, according to the American practice.

Dusseldorf, Germany.—The city of Dusseldorf has called for proposals for the construction of an electric street railway in that city. It is intended to substitute electricity for horse power on the present lines. The proposals are to be in by July 1, 1897.

France.—The Société d'Exploitation des Procédés Electriques "Walker" has just secured a contract for seventeen electric motor cars for the Paris-Romainville electric tramway.

Glasgow, Scotland.—At a meeting of the members of the Corporation of Glasgow recently, it was decided to commence the electrical equipment of the tramway route from Mitchell Street to Springburn, as recommended by the report of the tramway committee.

Hamburg, Germany.—A "Tramway Technical Exhibition" is to be held in Hamburg from Aug. 5 to Aug. 9, under the auspices of the Verein Deutscher Strassenbahn und Kleinbahnverwaltungen. This society announces a general meeting to be held at the exhibition on Aug. 6, and Aug. 7.

Hanover, Germany.—The directors of the Hanover tramway system have recently published a report, in which they give their experiences with accumulators. This on the whole has been satisfactory. The cost of maintenance for 1896 averaged $10 per car per month. This includes the cost of renewing the plates.

Hull, England.—The Hull Corporation, which owns the tramways system in this city, has voted to equip the system with electric power.

Japan.—It is stated that in Japan the following street railways are to be constructed to complete organization with an aggregate capital of something like $3,500,000; the Fushimi Electric Railway, a line 28½ miles long, running from Fushimi to Nishinomiya; another line, 5½ miles long, between Inamimachi and Demachi; the Tokio circuit tramway, a line 44½ miles long, in Tokio. All these lines will require materials and rolling stock.

Metz, Germany.—The tramway company of Metz has decided to equip its line with electric power. It is believed that the construction will be completed this summer. The company will operate cars on the belt line connecting Moulins, Metz and Montigny.

Monaco.—A franchise for an electric road has been given to M. Henri Crovetto.

Montpellier, France.—A decree has been issued, permitting the establishment of an electric railway in this place. The speed of the cars will be an average of 12 k. m. per hour, and trains of three cars each will be run. The concession has been issued to Messsrs. Cauderey and Valette.

Paris, France.—The Compagnie Générale de Traction et d'Électricité has been established with a capital of 17,500,000 fr., for the installation and purchase of electric lines, power and lighting plants. The incorporators are MM. Georges Chaudoir, M. Adolphe Dupont-Recloux and Jules Nagelmackers, all of Liége, and MM. Hulbert Henrotte, Jacques de Guntzburg, Louis Laveissière, Firmin Rainbeaux and Georges Renard, all of Paris.

THE annual meeting of the Compagnie Générale des Omnibus de Paris was held Mar. 30. A dividend of 55 fr. per share was declared for the year.

Puebla, Mex.—H. J. Brennan, of Carbondale, Pa., and E. R. Springman, of Philadelphia, are interested in the building of a 25 mile electric railway in Puebla.

Roubaix, France.—The annual meeting of the tramway company of Roubaix and Tourcoing was held Mar. 28. A dividend of 30 fr. was declared per share.

Russia.—The French Ambassador at Saint Petersburg is quoted by the *Moniteur Officiel du Commerce* as saying that during the present year there will be a great development of electric railway traction in Russia. Several roads have already been built. Among those now in course of construction or about to be built are roads at Sebastopol, Rostow on the Don, Novorossisk and at Elisabethgrad.

Saint-Ouen, France.—M. de Brancion has petitioned for a concession for an electric railway here. The system to be used is the Diatto, which is somewhat similar to the Claret-Vuillemier surface contact system.

Shanghai, China.—There are excellent opportunities for American railway builders in China, according to R. Van Berger, formerly principal of Noble's School at Tokio, Japan. The municipal government has called for bids to build an electric railway within the limits of the foreign concession, and the Imperial Government desires offers for a line between Shanghai and Woosung, a distance of 12 miles.

Strassburg, Germany.—The Strassburger Strassenbahn Gesellschaft is proposing the addition, during the coming year, of seventy-six electric cars and an extension to its lines of 55 km. At present the company is operating about fourteen cars.

News Notes.

Albany, N. Y.—The Albany Railway has filed its acceptance of the franchise to operate a line in Rensselaer.

Amherst, Mass.—O. A. Harlow, of Miller's Falls, Mass., has been appointed superintendent of the Amherst & Sunderland Railway Company.

Boston, Mass.—The West End Street Railway Company will build a new car house at Mt. Auburn, on the site of the old car house. The new house will accommodate forty cars.

Bridgeport, Conn.—The Bridgeport Traction Company, will begin at once the work of extending its lines from Southport to Westport.

Bridgewater, Mass.—The Selectmen of Bridgewater have granted a franchise to the directors of the Bridgewater, Whitman & Rockland Street Railway Company for an electric railway from Bridgewater to the East Bridgewater line.

Brockton, Mass.—The Railroad Commissioners have certified the Brockton & East Bridgewater Street Railway Company to the Secretary of the Commonwealth as having fulfilled all the conditions requisite for a charter, and the Secretary has issued one upon that certificate. The directors of the company are W. L. Douglas, John J. Whipple, William Jones, C. C. Merritt, George J. Morse, M. C. Hinds, Joshua Dean. The capital stock is $50,000 and, the road is to run from East Bridgewater through West Bridgewater to Brockton.

Brooklyn, N. Y.—The Brooklyn *Eagle* says it is generally understood that the Kings County Traction Company will declare a 1 per cent dividend on or about July 1 and continue paying quarterly dividends thereafter of an equal amount.

Cumberland Hill, R. I.—Senator Thomas A. Jenckes is the promoter of an electric railway from Cumberland Hill to Lonsdale, passing through Ashton and Berkeley. A charter will be applied for at once. The estimated cost of the road is $67,000, and the population along the route to be served is from 2500 to 3000.

Detroit, Mich.—The Town Council of Sandwich has decided to grant a franchise to the company organized by J. A. Randall, of Detroit, to construct an electric railway through the town, with the understanding that construction work on the road is to commence immediately. The new road will be constructed at one side of the road from Windsor to Amherstburg.

Doylestown, Pa.—The proposed new trolley line to connect Willow Grove and Doylestown will be constructed by the Wetherills, of Chester.

Exeter, N. H.—The Board of Trade of this place recently approved the building of a new electric road to Hampton Beach. A charter for this work has been given to a company composed of the following gentlemen: James F. Shaw, of Boston; F. W. Breed, of Lynn; G. Ward Cook, of Haverhill; J. W. Ferguson, of Boston; E. Moody Boynton, of West Newbury; and E. P. Shaw, Jr., of Boston. It is claimed by this syndicate that capital is already promised for the building of the road.

Fallsburg, N. Y.—The Fallsburg & Monticello Railroad Company has filed an amended certificate changing the route of its road.

Galesburg, Ill.—The Galesburg Electric Motor & Power Company is preparing to extend its lines.

Gardner, Mass.—Permission has been granted the Gardner, Westminster & Fitchburg Street Railroad Company to lay its tracks on the state road at Westminster.

Lima, O.—A company is being formed at Lima, composed of capitalists from Lima and Cleveland, for the purpose of building an electric line from this city to the Lewiston reservoir, a distance of 24 miles.

Lowell, Mass.—The Lowell & Suburban Street Railway Company, is preparing to make a 4 mile extension to its line.

Madison, Wis.—The Chippewa Valley Electric Railway Company has been incorporated for the purpose of acquiring and operating a street railway, light and power plant in the Chippewa Valley. Capital stock, $100,000. Incorporators, A. J. Kieth, W. C. Donovan and C. E. Kelsey.

Marion, Ind.—Work has been commenced on the lines of the Indianapolis, Anderson & Marion Electric Railway Company. This company has recently been reorganized and put in sound financial condition. Frank Mans, of Indianapolis, is president of the reorganized company, N. J. Clodfelter is vice-president and general manager, and W. R. Pearson, of Fairmount, is superintendent.

New York, N. Y.—The Brooklyn Bridge Bill, signed by the Governor recently, authorizes the Bridge Trustees to suspend the operation of the present railroad on the bridge, and if fully carried out, as is intended, will allow a passenger to ride from any point in Brooklyn to New York City, or vice versa, for the one fare of five cents on any railroad contracting to run its cars over the bridge. The law provides that within sixty days the Trustees shall prepare plans and specifications regulating the operation over the bridge of the cars of such corporation or corporations with whom it may contract, as it shall deem best adapted to promote the public comfort and convenience.

Nyack, N. Y.—The Christian Alliance Syndicate, of Nyack, is now arranging to establish an electric railway from a point near South Nyack station to Nyack Heights.

Oneonta, N. Y.—The Oneonta & Otego Valley Railroad Company has been incorporated to operate a street surface railroad from Oneonta to the intersection of the stage road leading from Oneonta to Laurens. The capital is $100,000, and the directors are Frank Gould, A. D. Getman, A. C. Lewis, Parker Wilson and others, of Oneonta.

Pasadena, Cal.—At a meeting of the stock and bondholders of the Pasadena & Los Angeles Electric Railway Company, held recently, the following directors were chosen: P. M. Green, F. C. Bolt, C.W. Smith, H. H. Markham, George F. Kernaghan, M. H. Sherman and George H. Barker. All of these directors are members of the Reorganization Committee. P. M. Green was elected president of the company; C. W. Smith, vice-president; E. C. Webster, second vice-president; F. C. Bolt, treasurer, and H. I. Chatfield, auditor. The offices of the company will be transferred from Los Angeles to Pasadena.

Quebec, Can.—The City Council has decided to permit the Quebec District Railway Company to build two tracks on St. John Street, outside the gate.

Red Bank, N. J.—The Atlantic Highlands, Red Bank & Long Branch Electric Railway Company has begun work on the extension of its lines to Long Branch, a distance of 1¼ miles. Through cars will run to Pleasure Bay and Asbury Park over the line of the Atlantic Coast Electric Railroad as soon as the new road is completed.

St. Louis, Mo.—The St. Louis & Suburban Railway Company has applied for a franchise to the Board of Trustees of Kirkwood to extend its lines from Jackson to Kirkwood and run from there over the Highlands Scenic Railroad to Meramec Heights.

Springfield, Mass.—The work of building the lines of the Springfield & Southwestern Street Railway Company will be begun this week at Suffield Center and Rainbow. One hundred men will be put to work at first and more added as the work progresses.

Uxbridge, Mass.—The promoters of an electric road between Uxbridge and Milford report that they are receiving excellent encouragement and that the road is practically assured. It is to be run from Main Street through Wheelockville, Mendon, Spindleville, Hopedale and Milford.

Washington, Pa.—A meeting was held recently at McDonald, Pa., in the interest of the Carnegie-Canonsburg Electric Railway. P. D. Hoey was elected chairman and T. D. Curran secretary of the meeting. The capital stock of the company will be $250,000, and a committee, headed by Edward McDonald, of McDonald, Pa., was appointed to secure rights of way and solicit subscriptions.

Personals.

Mr. Henry Strelitz has been elected secretary of the Marion (O.) Street Railway Company.

Mr. D. N. McBrier, vice-president of the Ball Engine Company, was in New York recently, and reported business excellent.

Mr. O. A. Harlow, of Miller's Falls, Mass., has been appointed superintendent of the Amherst & Sunderland Railway Company.

Mr. John A. Wolford has been made superintendent of the Marion (O.) Street Railway Company to succeed Mr. George E. Turner, resigned.

Mr. Gustav E. Kissel, of Kessler & Company, has been elected president of the Dry Dock, East Broadway & Battery Railroad to fill the vacancy caused by the death of Mr. R. Kelly.

Mr. M. S. Connors, superintendent of the Columbus, Hocking Valley & Toledo Railroad, has been elected general manager of the Gallipolis & Point Pleasant Street Railway Company.

Mr. John N. Beckley, has resigned the office of president of the Rochester (N. Y.) Railway Company on account of other business claims. Hon. Frederick Cook has been elected in his place.

Mr. Kennedy Crossman has been elected president of the Citizens' Street Railroad Company, of Indianapolis. The general superintendent, treasurer and electrician were re-elected at the last meeting of the directors.

Mr. T. T. Johnson has been appointed superintendent of the Ironton Electric Railway Company, of Ironton, Mich., in place of Col. J. R. Cooke, who has resigned to give his entire attention to the management of the electric illuminating plant in that city.

Mr. F. H. Hebblethwaite, of Manaos, Amazonas, Brazil, was in New York last month. Mr. Hebblethwaite has been engaged in railroad engineering in Brazil and is now contemplating the installation of a short electric line at Manaos. During his stay in this country he inspected a number of electric railway systems.

Mr. Jno. B. Hicks, who has been identified with the railway trade for many years, and has represented the extensive interests in this country of R. J. Clark & Company, Ltd., varnish manufacturers of London, has been appointed general manager of the railway department of the Pratt & Lambert Company, as a result of the purchase of the controlling interest in that company by the leading stockholders of R. J. Clark & Company, Ltd. Mr. Hicks' department will be located in the new Woodbridge Building, corner of John and William Streets, New York.

Mr. Frank X. Cicott, who is well known in electrical and street railway circles, both in this country and abroad, will organize in the early future a European company to handle American apparatus as general agents. Having had several years of commercial

and journalistic experience in Europe, he is familiar with the conditions there, and possesses exceptional facilities for embarking in a project of this kind. Mr. Cicott has held a number of important positions with electrical companies in this country, and is at present connected with the Ansonia Brass & Copper Company, with which he will sever connections July 1 to make the necessary arrangements for his new business.

Mr. Edward J. Wessels, general manager of the Standard Air-Brake Company, sails for Europe on the steamship "Majestic" on June 2, to remain for several months. Mr. Wessels is now almost as well known in European capitals as in America from the extensive business which has been done by his company abroad since his last trip in its interests. Mr. Wessels has been in the street railway manufacturing business less than six years, but has in that time achieved an enviable reputation as a shrewd and sagacious business man thoroughly alive to the interests of his company, and his pioneer work in the manufacture of braking apparatus is now generally recognized on both sides of the water. Mr. Wessels' family will be located at their summer cottage in Belmar, N. J., until his return.

EDWARD J. WESSELS.

H. MILTON KENNEDY.

Mr. H. Milton Kennedy, general passenger agent of the Brooklyn Heights Railroad Company, the first street railway company to establish such an office, is also the youngest member of the American Association of General Passenger and Ticket Agents. He belongs to a family of physicians, his father and grandfather having been doctors, and is himself a graduate in pharmacy and studied at the College of Physicians and Surgeons in New York. On the death of his father, however, he decided to enter the railroad business and begin his career in the spring of 1894 as excursion agent of the South Jersey Railroad, with headquarters in Philadelphia. The quick results obtained by him in the development of traffic in this capacity and his general railroad ability promoted Mr. Kennedy to the position of general freight and passenger agent of that company, which he held until recently when he resigned to accept the position which he now holds with the Brooklyn Heights Railroad Company. It was the conception of the possibilities of increasing passenger traffic on street railroads and otherwise attaining beneficial results by the establishment of a separate department to develop these features as on steam railroads that led to the adoption of the passenger department of the Brooklyn Heights Railroad Company. The results secured by this department have been remarkable and point to the wisdom on the part of the directors in paying special attention to it and to the selection of Mr. Kennedy as an executive.

Obituary.

EDWARD F. BRADFORD, of the Bradford Belting Company, of Cincinnati, O., died suddenly Apr. 22. The cause of death was apoplexy. Mr. Bradford was well known in electrical circles and highly esteemed by his many friends.

JOS. H. RHOMBERG, president of the Dubuque (Ia.) Street Railway Company, died on May 17. Mr. Rhomberg, was a native of Austria, and sixty-four years of age. He was a pioneer in the railroad business and soon after the war built the first railroad along the Mississippi River, the Chicago, Dubuque & Minnesota Railroad, of which he was president.

AMONG THE MANUFACTURERS.

The Wagner Electric Manufacturing Company, of St. Louis, has recently brought out a new line of direct current motors and generators up to about 20 h. p.

The C. L. Pullman's Center Vestibule Car Company, of Chicago, has moved its office from the Fisher Building to rooms 653 to 655 Rookery Building, Chicago, Ill.

The Ohio Brass Company, of Mansfield, O., has equipped all the cars of the Colfax Electric Railway Company, of Denver, Colo., with United States heaters.

The General Electric Company, of Schenectady, N. Y., held its annual meeting at Schenectady, May 11. The old board of directors was unanimously re-elected. At the meeting 210,000 shares were represented.

The Stilwell-Bierce & Smith-Vaile Company, of Dayton, O., has secured the contract from the Electric Light & Power Company, of Dolgeville, N. Y., for the power house, wheels, etc., to be erected this season at High Falls.

The National Air-Brake Company, of New York, has equipped all the cars of the Union Traction Company, of Rutherford, N. J., with its air-brake equipment. These have been given a number of severe tests and have worked very satisfactorily.

The Standard Underground Cable Company, of Pittsburgh, has moved its New York office to rooms 506-8-10 Telephone Building, 18 Cortlandt Street. Here the company has secured much more desirable spacious apartments than it had previously.

The Crane Company, of Chicago, has secured the order for high pressure valves and piping for the Cleveland & Lorain Street Railway through its representative, G. A. Hurd; also the connections for the new engines, high and low pressure, for the People's Railway, of Dayton, O.

The Automatic Block Signal Company, of New York, is introducing an electric block signal for single track roads, operated automatically by the car. The connections are operated by the trolley wheels, and indicate not only that a car is in the block, but also in which direction it is moving.

McIntosh, Seymour & Company, of Auburn, N. Y., have opened an office for the sale of their products in New York City and contiguous territory in the Havemeyer Building, room 1211, 26 Cortlandt Street, the Pierce & Miller Engineering Company having ceased to handle their engines on May 20, last.

S. C. Strock, dealer in ties and poles, heretofore at 50 Broad way, New York, has removed to the New Bowling Green Building, 11 Broadway. Mr. Strock reports that the strongest evidence of the revival of business is apparent in his line, and that orders have been larger and of a better nature than for a long time past.

The Union Car Company, of St. Louis, is building thirty 30 ft. open cars for the Consolidated Traction Company, Pittsburgh. These cars are nine bench and of the regular standard type of this company. They will be finished throughout in white maple, and are roomy and well lighted. They will be mounted on McGuire trucks.

Hirsch Brothers & Company, bankers and brokers, of Chicago and New York, make a specialty of street railway securities. The firm has financed during the past two weeks a bond issue of $100,000 for the Waterloo & Cedar Falls Rapid Transit Company, and also an issue for the Mason City & Clear Lake Railway Company, of Mason City, Ia.

The Safety Car Heating & Lighting Company, of New York, has closed a contract with the Baltimore & Ohio Railroad Company for the equipment of the entire B. & O. S. W. systems. New plants for the generation of Pintsch gas for supplying the cars have been erected at Baltimore, Washington and Pittsburgh. The company also has plants at other cities.

The American Impulse Wheel Company, of New York, has published a pamphlet descriptive of its Cazin power wheel. This is a new water wheel for the use of force jets, and has a number of advantages over other wheels designed for this work. The pamphlet contains full diagrams of the wheel and a number of valuable tables and formulæ for calculating water power, etc.

The Standard Air-Brake Company, of New York, closed the month of May by securing an additional order from the colonies for twenty-eight air-brake outfits for electric motor and trail cars, and another order for additional motor car air-brakes. In view of the fact that its air-brakes have been in use in the colonies for nearly three years, this latest order emphasizes the success of the apparatus.

The St. Louis Iron & Machine Works, St. Louis, Mo. are building the following rolling mill engines for the Consolidated Steel & Wire Company, for its Pittsburgh, Pa. plant. One tandem compound condensing rolling mill Corliss engine of 1800 h. p., also one cross compound condensing rolling mill Corliss engine of 2200 h. p. capacity. This shipment will weigh 300 tons, and will require sixteen cars to transport it.

Pratt & Lambert, varnish makers have moved their office to the works, 15 to 23 Fourth Street, Long Island City, Greater New York, where they have just completed an extensive addition, increasing their storage capacity and providing suitable accommodations for their clerical force. The railway and trade sales departments are located on the third floor of the Woodbridge Building, at the corner of John and William Streets, New York.

The Ball Engine Company, of Erie, Pa., has recently supplied to the Hammond Building, of Detroit, Mich., the engines for an isolated electric lighting plant. The dynamos were furnished by the General Electric Company. The Harper Hospital, of Detroit, Mich., has also recently put in its own electric plant, consisting of two engines built by the Ball Engine Company, Erie, Pa., direct connected to General Electric Company dynamos.

The Laclede Car Company, of St. Louis, reports among late orders one for one hundred closed cars for the Pittsburgh Traction Company, also an order for twelve open cars for the Pikesville, Reistertown & Emory Grove Railroad Company, of Baltimore. Hale & Kilburn reversible spring seats will be used in these cars. The Laclede Company has just shipped to Charleston, S. C., twenty-four closed cars. These were also fitted with the Hale & Kilburn "Walkover" seats.

The Dorner & Dutton Company, of Cleveland, O., is the title of a new company recently organized in that city to manufacture and deal in street and electric railway supplies. The incorporators are J. H. Van Dorn, E. J. Leighton, H. H. Hodell, W. A. Dutton and H. A. Dorner. The new company will commence operations in a new shop built expressly for it and equipped with a number of gear machines and will be able to turn out a very large amount of gears and pinions.

Giles S. Allison, who is well known in street railway circles through his connection with the St. Louis Register Company, has accepted the management of the Eastern street railway department of the Hildreth Varnish Company, 18 Broadway, New York. This company manufactures all kinds of varnish for both inside and outside use, coach japan, size, etc., and all of its products are fully aged and carefully tested by a competent expert before shipping. Mr. Allison has the best wishes of his many friends in this new line.

J. W. Gorman, of Boston, Mass., the well known proprietor of theatrical and amusement attractions for pleasure resorts and street railway parks, has recently published a pamphlet describing the different attractions managed by him. These are of a very varied character and include minstrel troupes, athletic and comedy entertainments, jugglers and other amusement troupes, which have enjoyed great success at fairs and summer resorts. Mr. Gorman has had an experience of ten years in this line and is well qualified to select popular amusements and insure good management.

The Moore Electrical Company, of Newark, N. J., presented a demonstration of the results obtained by D. McFarlan Moore, in vacuum tube lighting in its laboratory in Newark, May 27. Mr. Moore, as will be remembered, has presented similar exhibitions before the American Institute of Electrical Engineers, and the National Electric Light Association, in New York. As a worker in a comparatively unknown field, Mr. Moore deserves great credit for the remarkable results which he has secured, and his system of vacuum tube lighting promises to have a wide commercial application.

The Deoxidized Bronze & Metal Company, of Bridgeport, Conn., is receiving numerous large orders for its deoxidized genuine No. 1 babbitt metal, and recently, by a queer coincidence, the same mail brought orders from Portland, Me., and Portland, Ore. This company's rapidly increasing business has made it necessary to open a New York office. This office is situated at 133 Liberty Street, where will be found D. C. Sanford, secretary of the company, who gives the New York office his personal attention. Deoxidized genuine No. 1 babbitt has won and holds an enviable reputation for lining motor, armature and axle bearings, and one trial has convinced most trolley roads of its superiority.

The Bemis Car Box Company, of Springfield, Mass., states that on Apr. 21, the United States circuit court of appeals, rendered a decision in the case of the Bemis Car Box Company, against the Boston & Revere Street Railway Company, affirming the interlocutory decree of the circuit court granting an injunction and accounting against the defendant for infringing upon claim 1 of patent No. 239,702, for a car axle box invented by Sumner A. Bemis. The defendant was using a box patented and owned by the J. G. Brill Company and the suit was defended by this company. Fish, Richardson & Storrow, of Boston, were attorneys for the complainants. Francis Rawle of Philadelphia, was counsel for the defendant.

The Columbia Electrical Supply Company is the title of a new company recently formed in New York by the consolidation of the business of T. M. R. Meikleham and the Chapin-Douglas Electric Company. The company's main store and office is at 329 Fourth Avenue, and its branch office, with stock, is in the Electrical Exchange Building, No. 136 Liberty Street. At the downtown office the company will carry a small, but complete, line of electric light and house goods supplies for the convenience of customers. The company is sales agent for the General Electric Company, and the Partrick & Carter Company for New York is the principal. Messrs. Meikleham & Douglas all well and favorably known.

The Simonds Manufacturing Company, of Pittsburgh, Pa., has recently purchased the old shop of the Westinghouse Machine Company, located at Twenty-fifth and Liberty Streets and has just finished moving its machines and stock to these shops. The company reports a large number of orders on its books and anticipates putting in new gear machines, both cutters and turning lathe. The company asks the indulgence of all persons who have suffered delay in shipments on account of moving, and is now ready to make shipments with its usual promptness. The new shop covers three times the floor space that was in the old shop, and by means of the large traveling cranes running through the shop, much larger work can be handled.

The American Engine Company, of Bound Brook, N. J., has just begun the shipment of its new direct connected generating plants, in which the American-Ball engine is combined with the company's new line of six pole generators. The company is now installing a 75 k. w. plant at No. 7 East Seventeenth Street, New York, in the building of Deitsch Brothers, and a 35 k. w. plant in the building of the *Evening Wisconsin*, of Milwaukee. In addition to this it has orders from the Philadelphia *Enquirer* for a 100 k. w. plant; the Buffalo *Evening News* a 35 k. w. plant; the Phelp's Publishing Company, of Springfield, Mass., two 35 k. w. plants; the New York *Tribune* a 75 k. w. plant, and the World's Dispensary Medical Association, of Buffalo, a 25 k. w. plant.

The Okonite Company, of New York, recently brought an interesting suit in the Supreme Court of New York against Holmes, Booth & Haydens. The complaint showed that in June, 1895, Holmes, Booth & Haydens sold to the Okonite Company 300,000 lbs. copper at 12¼ cents. and after delivering 50,509 lbs., stopped further delivery. The Okonite Company then, in September, 1895, purchased elsewhere the balance of the copper at 14 cents and then sued Holmes, Booth & Haydens for about $4500 the difference. Holmes, Booth & Haydens denied the contract. An order discontinuing the suit was entered in the Clerk's Office on the 21st., and on enquiry it is understood that Holmes, Booth & Haydens paid the Okonite Company about $2800 for a settlement.

The Swarts Metal Refining Company, of Chicago, on Apr. 8 announced the removal of its main office to No. 20 North Desplaines Street, corner Eagle, where its facilities for handling larger quantities of metal are greatly improved. The company has shown a wonderful growth during the past few years. Starting from modest beginnings, it has to-day a host of customers in every state and territory in the Union, a good export trade, and is in all probability as widely known as any firm in the same line of business. The company has gained its prestige within such a short space of time by fair and square treatment of customers, liberal advertising and by making fortunate purchases which made low quotations possible. The company extends to all an invitation to call at its new quarters.

The Columbia Machine Works, of Brooklyn, N. Y., is doing an excellent business in the manufacture of gears, pinions, trolley wheels, armature bearings, brake handles, and other miscellaneous street railway supplies. Among its customers it numbers not only the principal lines of Brooklyn and vicinity, but also many other companies in other sections of the country, who have expressed themselves as well pleased with the apparatus supplied by the Columbia Machine Works. The shops are equipped with modern high grade machinery and are well fitted for turning out the highest class of work. In fact, the company does not confine itself to street railway supplies, but also does a large amount of other high class machine work including the manufacture of a good many bicycle parts and has as high a reputation in other industries as in the manufacture of street railway parts.

W. W. Whitcomb, of Boston, Mass., has recently patented an improved headlight which by introducing reverse reflectors will throw the light rearward and light up the front of the dasher without obstructing the vision of the motorman. As now constructed, a headlight serves only to throw the light out upon the track ahead, that the motorman may avoid obstructions and accidents. Most cars have the place of destination in large letters on the front of the dasher which can only be seen, when it is dark, as the car approaches a street lamp or gets the reflected light of a car coming in the opposite direction. By the introduction of reverse reflectors with openings in the casings of the headlight, the light is reflected back or outside on to the dasher, plainly revealing the places of destination or route of the car. These reflectors can be placed outside or inside of the casing. Provisions are also made for such openings without the aid of reflectors and the openings will be arranged so as not to interfere with the vision of the motorman.

The Fiberite Company, of Mechanicville, N. Y., manufacturer of the Medbery material, is furnishing a most complete line of street railway overhead equipment, using aluminum bronze metal, combined with a composition that is absolutely waterproof, practically indestructible, of great tensile strength and of the highest electrical resistance. This company makes everything that pertains to overhead equipment of electric railways, and the fact that the works are in operation, running twenty-four hours a day, is proof of the high standing of the products. For over six years this material has been on the market, and its popularity is due to its superior insulating qualities. In order to meet the wants of a certain class of trade the Medbery Company is also furnishing a full line of malleable iron fittings, combined with the Medbery insulation. The Medbery knife switches, well known among central station men, the Medbery motor switches, switchboards, panelboards, as well as high potential switches for street railways are finding a ready sale through the country.

The Hunt Air-Brake Company, of New Kensington, Pa., reports an increasing demand for its well known type of air-brakes. During the last month the company has received a number of orders. Among these one is an order from the Johnson Company, of Lorain, O., for air-brake equipments, making the third article which has been placed for Hunt air-brakes by this company, a good indication of the satisfaction which the air-brake equipments give. The company has also received a second order from the Wilkesbarre & Northern Railway Company, of Wilkesbarre, Pa., for trail car brakes, and one for an automatic motor brake equipment from the Washington, Alexandria & Mt. Vernon Railroad Company, Washington, D. C.; also an order for two equipments from the Winsted Railway Company, of Winsted, Conn. The company has two experts on the road equipping cars, and is receiving many inquiries for information concerning its system of brakes, and for the pressure necessary to be carried on cars of various lengths. G. E. Pratt, general manager of the company, is to be congratulated upon the success with which his efforts in the introduction of this brake have been followed.

The Composite Brake Shoe Company, of Boston, has had a remarkable success with its brake shoes. These are of cast iron with wooden plugs inserted into cavities in the tread of the shoe and have been in extended use on the electric railways for the past three years. They have been adopted by practically all the railway companies of New England including the largest systems, as well as many others outside of New England. This shoe was included in the Master Car Builders' recent official tests of brake shoes and showed the highest co-efficient of friction of all the shoes in the test as reported by the committee. For heavy steam railroad service, however, it was shown that cork plugs would stand the excessive heat better than wood. Brake shoes having cork inserted in the tread and flange have been in service on some Eastern railroads, including the Boston & Maine during the past eight months under the most severe conditions that could be had, and in no instance has a cork worked out. The effect of heat is to cause them to swell and expand. Cork has even more elasticity and resistance than wood and gives a braking effect not obtainable in any other known shoe. add personal

The Ohio Brass Company, of Mansfield, O., reports the volume of business done so far this year as being considerably greater than that for the same period of a year ago, and that the contracts on hand for future deliveries this season exceed in size and number those held by the company at any other time during its business career. The reputation which this company enjoys in this country has extended abroad to foreign ones, and in consequence the company is receiving many orders from its agents for its electric railway specialties, the utility and practicability of which are being recognized by foreign engineers. Two large orders received within the past month, one from Japan and the other from Mexico, for Walker ears, evidences the fact that the fame of this ear as a support for trolley wires has extended beyond the bounds of the United States, where its reputation is already widespread. The Ohio Brass Company, which is the sole manufacturer of this article, has recently brought out several modified forms of the ear used on straight line suspension, which are adapted for feeder, strain and splicing purposes, so that the trolley wire can be equipped with Walker ears throughout. These several new designs will be illustrated in the supplemental catalogue of the company, which is now being prepared for issue.

The Berlin Iron Bridge Company, of East Berlin, Conn., is working full time and reports that spring business is opening up in quite a brisk manner. This company has on hand a large number of contracts including a water tower at North Berwick, Me., large school building at East Albany, N. Y., steel framework for the Providence Institution for Savings, at Providence, R. I., steel framework for the new Waterbury Savings Bank, at Waterbury, Conn., large addition to the Waterbury Farrel Foundry & Machine Company, at Waterbury, Conn., an addition to the boiler plant of the Bay State Brewery, in South Boston, Mass., steel trusses for the Opera House at Corinth, N. Y., steel work for the new Public Library Building, at Providence, R. I., an addition to the boiler plant of the Connecticut Hospital for the Insane, at Middletown, Conn., new pumping station for the York Water Company, at York, Pa., addition to the boiler plant of the Dunnell Manufacturing Company, at Pawtucket, R. I., fireproof building for the Guggenheim Smelting Company, at Perth Amboy, N. J., steel framework for a church, at Bartlett, N. H., besides bridges at Charlemont, Mass,, large steel bridge for Somerset County, N. J., a steel bridge for the town of Coventry, Conn., steel highway bridge for the town of Hermon, N. Y., large city bridge at Vergennes, Vt., large bridge for the S. D. Warren Company, at Cumberland Mills, Me., and highway bridge at Wilmington, N. Y. It is gratifying in these times to find at least one concern which is fairly well employed.

New Publications.

THE CONSTITUTION AND BY-LAWS OF THE STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA.

The constitution and by-laws adopted by the Street Railway Accountants' Association at its meeting in Cleveland, O., Mar. 24, 1897, have been published by the executive committee in pamphlet form. A list of the members is also given.

ELECTRIC TRAMWAYS AND RAILWAYS. H. Scholey. 62 pages. Illustrated. Cloth. Published by H. Alabaster, Gatehouse & Company, London. Price. 2s.

This is a brief description of the present method of operating vehicles electrically, with short accounts of one German and several English installations. The book contains fifty-three illustrations. The author is assistant editor of the *Electrical Review*, London.

OLENTANGY PARK. Published by the Columbus Street Railway Company: Columbus, O. Thirty-six pages. Illustrated.

This is a good example of the handsome pamphlets descriptive of street railway parks now being published for distribution by a number of street railway companies. The book is printed on highly calendered woodcut paper, and contains a large number of very handsome half-tone engravings of Olentangy Park, views of some of the city parks and the state institutions in Columbus.

HYDRAULIC CEMENT, ITS PROPERTIES, TESTING AND USE, by Frederick P. Spaulding. 12 mo. 265 pages., 34 illustrations. Published by John Wiley & Sons. Price, $2.

This is an important book for all engineers who have to employ hydraulic concrete and cement in construction work. The properties and ingredients of the different limes and cements are described, and considerable space is devoted to the different methods of testing cement and mortar. In the appendix the cement specifications of five prominent engineers are given.

ACCOUNTICS. April issue. Vol. I, No. 1. Published by the Accountics Association, 88 Wall Street, New York.

This new paper aims to advance the science of accounting and to secure a proper recognition of it as an element of business. It will be conducted under the immediate supervision of the publication committee of the Institute of Accounts, but will present month by month an outline of the work of the accountants societies and a review of current accounting literature. The editor is A. O. Kittredge, formerly editor of *The Office*, until recently editor of *Business* and at present co-editor of the *Lawyer and Credit Man*, of New York.

DERRAH'S STREET RAILWAY GUIDE FOR EASTERN MASSACHUSETTS. Published by R. H. Derrah, 286 Washington Street, Boston. 44 pages with map. Price, ten cents.

This is a handy guide showing the different routes available for street railway passengers in the eastern part of Massachusetts, and gives an excellent idea of the vast network of electric lines in and about Boston. The map shows that these furnish not only local transit, but opportunities for through transportation between all the important cities in the northeastern part of the state. Mr. Derrah has done a very valuable service in compiling these particulars, and one which could be adopted for both the benefit of street railway companies and the public in other parts of the country. The guide has been indorsed unanimously by the Massachusetts Street Railway Association.

THE MATERIALS OF CONSTRUCTION, by J. B. Johnson, C. E. Large octavo. 800 pages, 650 illustrations, 11 plates. Published by John Wiley & Sons, New York. Price, $6.

This is a most comprehensive and valuable publication, and aims to cover the present knowledge on the subject of the strength of materials. All sources have been availed of in the collation of these data and where possible the results have been shown graphically by diagrams instead of in tabular form. In this way the law of relationship is made more clear than is possible when tables are used. The work is divided into four parts: the first is entitled "Synopsis of the Principles of Mechanics Underlying the Laws of the Strength of Materials" and the behavior of materials under tensile, compressive, shearing, cross bending stresses with resiliency, etc., is considered. The "Manufacture and General Properties of the Materials of Construction" are treated in Part II, the materials discussed being cast and wrought iron; steel; the minor metals, as copper, zinc, tin and their alloys, etc; lime, cement, mortar and concrete; brick and timber. Part III covers "The Methods of Testing the Strength of Materials", and Part IV, "The Mechanical Properties of Materials of Construction as Determined by Actual Tests."

Trade Catalogues.

GORMAN'S AMUSEMENT ATTRACTIONS. Published by J. W. Gorman, Boston, Mass. 32 pages. Illustrated.

THE CAZIN WATER WHEEL. Published by the American Impulse Wheel Company. New York. 86 pages and table. Cloth. Illustrated.

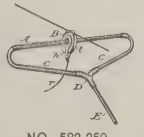
List of Street Railway Patents.

U. S. PATENTS ISSUED APR. 27, TO MAY 18, 1897, INCLUSIVE.

APR. 27.

ELECTRIC CONNECTION.—Harold P. Brown, New York, N. Y. No. 581,263.

An electrical connection consisting in the combination with two conductors joined together and furnished with a hollowed or confined space or receptacle between them, means for clamping or binding the two conductors firmly together, and a plastic alloy or amalgam confined in the space or receptacle between the conductors and forming an electrical connection between the conductors.

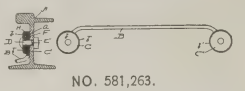


NO. 582,259.

TRACK CLEANER.—Wm. M. Brown, Johnstown, Pa. No. 581,264.

In combination with an electric railway car and current collecting devices beneath the car, a current conveyer in electrical connection with the source of supply, magnets carried by the car, the current conveyer being within the magnetic fields of said magnets,

a second set of magnets carried by the car, the current conveyor being without the field of said last mentioned magnets.



NO. 581,263.

RAIL BRAKE.—David W. Davis, Detroit, Mich. No. 581,270.

In a car, the combination with the axles, the bifurcated brace or support journaled thereon, and the brackets secured thereto, of the lever rods pivoted to said brackets, the depending brake shoes pivotally connected with said lever rods, the coiled springs secured to said lever rods and to the brace, the transverse bar connecting the free ends of said lever rods, the rod secured to said brace, the cam lever journaled thereon bearing upon said bar, and the coiled spring secured to said lever.

UNDERGROUND TROLLEY CONDUIT.—John D. Griffen, New York, N. Y. No. 581,281.

Consists of a main trench formed by yokes, with supports secured to said yokes within the trench, in combination with a casing secured at one edge to said yoke and held upon said supports, the opposite edge of the casing being curved upward toward the top of the trench.

CAR BRAKE.—Geo. B. Damon and Gardner W. Pearson, Lowell, Mass. No. 581,415.

CAR BRAKE.—Robt. Rice, Detroit, Mich. No. 581,429.

The combination with a main braking device independent of the supporting wheels of the truck and comprising a wheel and a retarding device therefor, of a second brake on one of the truck supporting axles under control of the brakeman and adapted in its operation to furnish the power for operating the main braking device.

BRAKE MECHANISM.—Herbert E. Putney, Toledo, O. No. 581,490.

In a brake mechanism for electric cars, the front and rear axle gears secured thereon, friction levers arranged upon each side of the gears having brake shoes upon each end, and a differential screw tapped through screw threaded orifices of like pitch with means controllable by the brake shaft for advancing or retracting the screw.

CAR GATE.—Paul E. Collins, Boston, Mass. No. 581,536.

The combination of a gate bar and pivotally movable actuating hub therefor, said gate bar being loosely connected with said hub for independent angular movement thereon, and a fastening device for connecting said hub and gate bar together.

CONTROLLER FOR ELECTRIC CARS.—S. W. Huff, Baltimore, Md. No. 581,557.

In a current controller, the combination of two relatively movable plane parts, a series of terminals to be connected, suitably spaced apart on one of said parts, and a corresponding series of bridging contacts carried by the other of said parts each projecting into a space between two adjacent terminals and pressed against the opposed faces of the same.

RAIL BOND.—Henry S. Newton, Syracuse, N. Y. No, 581,562.

In a one-piece rail bond, end pieces having large, smooth contact faces covered with tin or solder, holes therethrough corresponding with the fishplate bolt holes through fishplate and rail and a wide, thin connecting wire.

CAR FENDER. Chas. H. Shoemaker and Edwin W. Bittner, Lock Haven, Pa. No. 581,624.

CAR FENDER. John W. Angell, Owosso, Mich. No, 581,646.

CAR FENDER. Jas. F. Butler, Philadelphia, Pa. No. 581,657.

MAY 4, 1897.

STREET CAR FENDER.—David Leib, Columbus, O. No. 581,741.

ELECTRIC RAILWAY.—H. C. Reagan, Jr., Philadelphia, Pa. No. 581,769.

The combination of an electric motor, an air compressor and an air storage reservoir, pipes leading to and from said reservoir, and having connection with a discharge chamber of the compressor and with the valve chest of the latter respectively, an electromagnet suitably supported, and connections common to said motor and magnet.

MOTOR CAR TRUCK.—Henry Tesseyman, Dayton, O. No. 581,792.

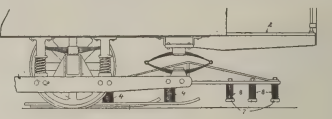
In a car truck, the combination of half-elliptic springs having their center bearings attached to the side bars or sills at or near the ends thereof, their outer ends having bearings against suitable surfaces on the under side of the car body, and adjustable means for supporting the inner ends of said springs, whereby the tension of said springs may be regulated to accommodate varying loads and conditions.

CONTROLLER FOR ELECTRIC MOTORS.—H. P. Davis, Pittsburgh, Pa. No. 582,114.

MAY 11, 1897.

ELECTRIC TROLLEY DEVICE.—Wm. M. Brown, Johnstown, Pa. No. 582,259.

In a trolley device for electric railways, in combination, an upwardly pressed tube having a longitudinal opening, a member adapted to move longitudinally along said tube and bearing on the inside thereof, and a contact maker mounted upon said moving member.



NO. 581,264.

SWITCH FOR STREET RAILWAY TRACKS.—Chas. R. Osborne, Danbury, Conn. No. 582,309.

TROLLEY WIRE HANGER.—John E. Atwood, Stonington, Conn. No. 582,337.

In combination, a trolley wire, clamping plates extending along the wire and having jaws for partially embracing the same, bolts extending transversely through the plates for locking them to the wire, a supporting wire, insulating plates above and below the supporting wire, a bearing plate located above the upper insulating plate and locking bolts having their heads seated in the clamping plates and engaging the said insulating and bearing plates for securing the supporting wire and trolley wire together.

SUPPORT FOR TROLLEY WIRES.—Edw. J. Cook, Cleveland, O. No. 582,344.

The combination with a trolley wire of greater diameter in one direction than in the other direction, a trolley ear having a chambered groove with an opening less than the diameter of said chamber, said wire being adapted to be inserted into said groove when turned to an unusual position, and be held in said groove by the sides thereof when turned to the normal or supporting position.

STREET CAR BRAKE.—Wm. G. Price, Chicago, Ill. No. 582,371 and 582,372.

A brake mechanism for vehicles comprising a friction device on the axle for actuating the brakes, a fixed stop on said axle, a variable bridge interposed between the friction device and fixed stop, an actuating device connected at one end with said bridge, and at the other end with a part which bears a fixed relation to the car axle with reference to the movement of the car axle along the length of the car body.

CAR FENDER.—Wm. Haslam, Lowell, Mass. No. 582,422.

CAR FENDER.—Chas. H. Weeden, New Sweden, Me. No. 582,562.

MAY 18.

ELECTRIC RAIL BOND.—Geo. H. Scott, Worcester, Mass. No. 582,698.

DASHER HEADLIGHT.—William W. Whitcomb, Brookline, Mass. No. 582,800.

The combination with a headlight carried by the dasher of a railway car, of a reverse reflector attached to and co-operating with said headlight to intercept a portion of the rays of light from said headlight and reflect them back above the said headlight onto the dasher, but below the top of the dasher.

BRAKE HANDLE.—Moses G. Hubbard, Jr., Chicago, Ill. No. 582,822.

The combination with a shaft having a series of teeth upon one portion thereof, of a rotably mounted handle, a movable member mounted in said handle, and means for automatically and positively forcing said movable member into engagement with the teeth on said shaft by the rotation of the said handle.

RAIL BOND.—Fred H. Daniels, Worcester, Mass. No. 582,849.

A flexible rail bond, comprising a flexible body portion, and two terminals or ends made separate from the flexible body portion and secured thereto by pressure to be substantially integral therewith.

TROLLEY FOR ELECTRIC RAILWAYS.—Sidney H. Short, Cleveland, O. No. 582,882.

The combination of a trolley arm, having two insulated diverging sockets and two metal forks inserted in said sockets, with a contact roller journaled in said forks and consisting of two metallic end sections, and an intermediate insulating section.

APPARATUS FOR BRAKING AND STOPPING STREET CARS ON STEEP GRADES.—Edwin Maginn, Pittsburgh, Pa. No. 582,935.

The combination with a car, of a broad shoe arranged beneath the same and having rows of projections or teeth as specified, means for suspending and raising said shoe, and pawls or stop rods which are pivotally connected with the bottom of the car, and inclined toward the end of the same, their lower ends resting free on the shoe, and engaging the projections thereon, as shown and described, whereby, when the shoe descends, the said rods drop with it and slide thereon and lock with projections at whatever point the shoe stops.

We will send copies of specifications and drawings complete of any of the above patents to any address upon receipt of fifteen cents. Give date and number of patent desired. THE STREET RAILWAY PUBLISHING COMPANY, HAVEMEYER BUILDING, NEW YORK.

DIGEST OF CONTENTS.—JUNE, 1897.

Abkürzung des Inhalts—Juni 1897.

"*Der Elektrische Eisenbahnbetrieb auf dem New York, New Haven & Hartford Bahnnetze.*" *von N. H. Heft* . [Page 329.]

Eingehende und werthvolle Mittheilung des Leiters der elektrischen Abtheilung einer der reichsten und unternehmendsten Eisenbahnen in Amerika, deren System sich über 4800 k. m. erstreckt, und welche jährlich über 150,000,000 Francs Brutto-Einnahme erreicht. Vor ungefähr drei Jahren erwach die Direktion zu der Thatsache, dass der Wettbewerb der elektrischen Strassenbahnen in der Umgegend die Einnahmen ihres Vorortbetriebs wesentlich beeinträchtigte, und beschloss sich eine Strecke von 16 k. m. in Nantasket Beach, mit elektrischer Kraft auszurüsten um die Personenwagen mittels elektrischer Motoren zu befördern. Diese Versuchseinrichtung erwies sich so erfolgreich, dass eine andere Strecke von Hartford nach Berlin, von einer Länge von 20 k.m., vor Kurzem vollendet wurde. Das "dritte Schienen" System wird verwendet, und wird gegenwärtig der für einen 30 Minuten-Betrieb verlangte Strom über die dritte Schiene zugeführt; die Rückleitung geschieht mittels den anderen Schienen ohne wesentlichen Kraftverlust. Der Zeitraum zwischen den Zügen wurde bedeutend vermindert, und ein regelmässiger halbstündlicher Dienst eingeführt, wodurch ein Fahrtenplan überflüssig wurde. Dieser Artikel beschreibt die verschiedenen Versuche welche in Nantasket Beach stattfanden, mit Tafeln über die Geschwindigkeit, Kraftverwendung, u. s. w., und wird von hohem Interesse für alle Fachmänner sein.

Die Kioto Wasserkraft und elektrische Strassenbahn-Einrichtung [Seite 340.]

Betrieb.

"*Die Transportations-Abtheilung der Brooklyn Heights Railroad Company,*" von H. Milton Kennedy, General Passenger Agent der "Brooklyn Heights Railroad Company" . [Seite 341.]

Da die Möglichkeiten für die Entwickelung des Verkehrswesens bei elektrischen Strassenbahnen viel grösser als bei Pferdebahnen sind, hat sich die "Brooklyn Heights Railroad Company" entschlossen, einen speciellen Beamten anzustellen, der sich lediglich um die Förderung des Verkehrs zu beschäftigen hat. Die angewandten Methoden sind denen durch die Dampfbahnen verwendeten ähnlich, und bestehen hauptsächlich in der Anzeige von Vergnügungsanlagen, in der Beförderung für die Errichtung von Theatern und ähnlichen Vergnügungslokalen in der Nähe der Bahnstrecke, Miethung von Speciellwagen durch Klubs, Privatgesellschaften, u. s. w., und in der Herstellung des vortheilhaftesten Fahrplans nach Uebereinkommen mit der Direktion. Die Kosten der durch den Agenten der Strassenbahngesellschaft geführten Reklame werden grösstentheils durch die Eigenthümer der entlang der Bahnstrecke gelegenen Vergnügungslokalen getragen. Etliche der verwendeten Methoden und die dadurch erzielten Ereignisse werden durch den Transportations-Agenten ausführlich beschrieben.

"*Kosten der elektromotorischen Kraft in den Staaten New York und Massachusetts*" . . . . . [Seite 344.]

"*Praxis contra Theorie in Malerei*" von Charles Koons [Seite 345.]

Kritik von dem Malermeister der "Laclede Car Company," über einen neulichst erschienenen Vortrag des Professors Spennrath, Direktor der Technischen Schule in Aachen, in welchem der letztere die abnützende Eigenschaften des Leinöls und der Farbestöffe bespricht. Der Verfasser behauptet, dass der Farbestoff eines Olanstrichs den grössten Einfluss über die Dauerhaftigkeit des Körpers besitzt, mit welchem er gemischt wird, und dass die praktische Erfahrung der amerikanischen Waggonfabriken in starkem Gegensatz mit den durch Prof. Spennrath in seinen Untersuchungen erreichten Folgerungen ist.

"*Strassenbahnen-Parke,*" *IV* . . . . . [Seite 346.]

Fortsetzung einer Reihe von Artikeln über den Betrieb und die Erhaltung von Parkanlagen, welche durch Strassenbahngesellschaften als Veranlassung für Verkehr betrieben werden. Ueber den durch die Parken herbeigebrachten Verkehr, die Kosten der Erhaltung, und die ausser den erhöhten Betriebseinnahmen entstandenen Einkünfte werden nähere Mittheilungen gegeben.

"*Güterbeförderung auf der Newburgh, (N. Y.) elektrischen Strassenbahn*" . . . . . [Seite 348.]

Verzeichniss der Anzahl der während dem letzten Jahre durch diese Bahn beförderten Güter, welche durch eine landwirthschaftliche Gegend läuft. Es werden täglich zwei Güterzüge gefahren. Milch bildet die meistbeförderte Waare, und wurden davon ungefähr 50,000 Kannen während dem vorigen Jahre transportirt. Verschiedene andere Produkten welche befördert wurden bestanden aus Trauben, Aepfeln, Kartoffeln, Heu und Stroh. Ueber die Tarife und die Kosten des Transportbetriebs werden nähere Mittheilungen gegeben.

"*Schienenstossverbindung in Brooklyn*" . . . [Seite 348.]

Kurze Beschreibung der durch die "Brooklyn Heights Railroad Company," der bedeutendsten Strassenbahngesellschaft in Brooklyn, angewandten Methode für die Verbindung der Schienenstössen für den Rückstrom.

"*Streitfrage über Kraftstationen in Chicago.—II*" . [Seite 349.]

In der vorigen Nummer des STREET RAILWAY JOURNAL wurden eine Kritik durch eine Firma von Ingenieuren in Chicago über die Bauart der neuen Kraftstation der "Chicago City Railway Company", sowie eine Erwiderung seitens des Chefingenieurs jener Bahn veröffentlicht. Die erwähnte Station ist von der Hochdruck-Type, und verwendet seilgetriebenen Generatoren. In dem vorliegenden Artikel erscheint eine Erwiderung zu der Rechtfertigung des Chefingenieurs durch die Firma welche die ursprüngliche Kritik machte. Es werden auch Briefe über den nämlichen Gegenstand von dem Chefingenieur der Westseiten Hochbahn in Chicago und von einem der Ingenieuren der "Detroit Railway Company" veröffentlicht. Die ganze Streitfrage ist von dem Standpunkte der Ingenieurkunst höchst interessant.

"*Rechtswesen.*" . . . . . [Seite 352.]

Leitartikeln.

"*Veröffentlichungen des Arbeitsbureaus*" . . [Seite 354.]

"*Betriebsentwickelung*" . . . . . [Seite 354.]

"*Der Anschlag der elektrische Kraftstationen auf die normale Hitzeinheit*" . . . . . [Seite 355.]

"*Der kommende Kampf für den Betrieb* . . [Seite 355.]

Erörterung der Zukunft der elektrischen Strassenbahnen und der Wirkung welche die Ausrüstung von Vollbahnen mit elektrischer Triebkraft auf Klein- und Strassenbahnen haben würde.

Oberbau.

"*Die St. Anthony Falls elektrische Kraftübertragungs Anlage*" [Seite 357.]

Ausführliche Beschreibung der bedeutenden Anlage zur Benutzung des St. Anthony Wasserfalls auf dem Mississippi für elektrische Kraftübertragung nach Minneapolis. Die Arbeiten werden unter der Leitung der "Twin City Rapid Transit Company" geführt, deren Bahnnetz, von einer Gesammtlänge von 362 km., vollständig durch diese Wasserkraft betrieben wird. Der Damm erstreckt sich stromaufwärts in einer V-förmigen Gestalt, und bildet eine dessen Seite eine Seite des Hauptgerinnes. Die den Damm bildende Seite ist 111 Meter lang, und die Seite entlang des Gerinnes ist 135 Meter lang. Das Wasser fällt auf die Turbinen von einer Höhe von 6 Meter. Während der Fluth läuft der Strom mit einer Geschwindigkeit von 1700 m^3 per Sekunde. Der Minimalstrom beträgt 53 m^3 per Sekunde, einer Minimalkraft von 4000 H. P. entsprechend. Jedoch beträgt der Durchschnittstrom des Mississippis in Minneapolis 160 m^3 per Sekunde. Specielle, durch elektrische Kraft betriebene Verfahren werden für die Reinigung des Stahlzahnrahmes in dem Hauptgerinne verwendet.

Die Kraftstation wird aus zehn 1000 P. S. Maschinen, mit speciellen Wasserrad-Regulatoren bestehen. Die Generatoren werden mit den Turbinendeichseln direct gekuppelt, und werden aus zwei 1000 P. S. Gleichstrommaschinen, für den Betrieb der naheliegenden Linien, bei einem Druck von 600 Volts, und aus acht Drehstrom-Maschinen bestehen. Der Strom theils der letzteren wird auf 3500 Volts für kurze Transmission, und der des übrigen Theils auf 12,000 Volts für entfernte Transmission gebracht werden. Rotations-Transformatoren werden in den Nebenstationen eingerichtet, um diese Spannung zu vermindern und den Drehstrom in Gleichstrom zu transformiren. Die Zuleitungen werden sämmtlich unterirdisch geführt.

"*Neuer Oberbau in Denver.*" . . . . . [Seite 361.]

Beschreibung eines neuen schweren Bahn-Oberbaus, für Strassen und Brücken geeignet. Es werden in Asphalt gelegten T-Schienen verwendet.

"*Neue Verfahren für die Prüfung von Motoren,*". von Frank B. Porter . . . . . [Seite 361.]

Beschreibung, mit Tabellen, einiger praktischen Mittel um mit gewöhnlichen Apparaten den Widerstand verschiedener Theilen eines Motores, den Widerstand der Isolirung, die Stelle der Kurzschlüsse, u. s. w., zu prüfen.

"*Der Bahnprüfungswagen der Chicago City Railroad Company*" [Seite 364.]

Beschreibung eines Wagens, welcher niedrige Schienenstösse, Schienenausdehnungen und dergleichen auf einer Bahn workommenden Defecten automatisch anzeigt.

"*Verfahren für die Verbindung von Wagenschwellen*" [Seite 364.]

Wissenschaft. — Baukunst. — Erfindungen.

"*Ein zweckmässiger Oberbau-Drillbohrer*" . . [Seite. 365]

Beschreibung eines neuen Drillbohrers, mittels welchem ein aufrecht stehender Mann Löcher in eine Schiene bohren kann. Es wird beansprucht, dass in dieser Weise eine bessere Arbeit erzielt wird, als wenn sie in sitzender Stellung erfolgte. Bei dem Uebergang

eines Wagens kann der Bohrer mittels einer besonderen Einrichtung heruntergelassen werden, ohne dass dessen Spitze aus der Schiene entfernt wird.

"Neuer Bürstenhalter" . . . . . [Seite 365.]

Beschreibung einer neuen, von der Walker Company angefertigten Gattung von Bürstenhalter für Strassenbahn-Motoren. Die Bürsten erhalten verschiedene Stellungen, um die Kollektoren nicht abzunutzen. Der Halter ist sehr einfach beschaffen, und von grosser Leitbarkeit, da er aus einem einzigen Stück besteht.

"Der Kinetic Motor" . . . . . [Seite 366.]

Beschreibung einer neuen Dampflokomotive mit rauchloser Feuerung, dem Lamm & Francq System ähnlich, mit dem Unterschied dass der Motor mit einem kleinen Ofen versehen ist, und dass die sämtliche Maschinerie sich unter dem Wagenkasten befindet. Der Zylinder ist mit einem Anfangsdruck von 13 Atmospheren geladen, und verbraucht ungefähr 10 kg. Wasser per Wagenkilometer. Eine Luftcondensionsmaschine ist auf dem Dache getragen. Das Gesammtgewicht des abgebildeten Wagens beläuft sich auf 13,160 kg.

"Elektrische senkrechte Verbund-Maschine" . . [Seite 366.]

Beschreibung einer senkrechten Verbund-Maschine mit Condensation, welche für die "La Capital Tramways Company" in Buenos Aires, Argentinien, gebaut wurde. Die Maschine ist mit Cylindern von je 378 mm. und 774 mm. und einem Hub von 457 mm. versehen. Corliss-Klappen werden verwendet.

"Arbeitsleitungs-Splissungen" . . . . . [Seite 367.]

Beschreibung eines neuen Verfahrens für die Verbindung von Arbeitsleitungsenden.

"Neuer Sandkasten" . . . . . [Seite 367.]
"Neue Wagenkupplung" . . . . . [Seite 367.]
"Firma für elektrischen Reparaturen" . . . [Seite 368.]
"Schutzvorrichtungen in Albany und in Syracuse" . [Seite 368]
"Elektrische Booten" . . . . . [Seite 368.]

Beschreibung einer neuen Gattung von elektrischen Booten für Personenbetrieb.

Ergebnisse durch Anwendung Oekonomie erzeugenden Apparaten" [Seite 369.]

Uebersicht der mit Dampfapparaten in Kraftstationen erzielten Erfahrungen.

Mittheilungen über Strassenbahnen.

"Die Niagara Falls Konvention" . . . . . [Seite 371.]

Programm für die vom 19. bis 22. Oktober d. J. in Niagara Falls stattfindende Generalversammlung des Amerikanischen Strassenbahnvereins, mit den durch die Dampf-Eisenbahngesellschaften getroffenen Massregeln, um den beiwohnenden Mitgliedern ermässigte Fahrpreise zu sichern.

"Programm der nächsten Generalversammlung des Internationalen Permanenten Strassenbahnvereins" . . [Seite 371.]

Programm für die zehnte jährliche Generalversammlung des Vereins, welche in 1898 in Genf stattfinden wird.

"Elektrische Ausrüstung der Brooklyner Hochbahn." [Seite 372.]
"Mittheilungen von England" . . . . . [Seite 373.]

Table des Matières—Juin 1897.

La traction électrique sur le réseau du "New York, New Haven & Hartford Railroad," par N. H. Heft . . [Page 329.]

Article important et de grande valeur, par le chef de la division électrique de l'un des chemins de fer américains les plus prospères et les plus entreprenants, dont le réseau s'étend sur une longueur de 4800 km. dans la partie la plus peuplée des Etats Unis, et dont les recettes brutes annuelles s'élèvent à plus de 150 millions de francs. Il y a quelque trois ans, la direction s'aperçut que la concurrence des chemins de fer électriques dans ce territoire menaçait fortement son service de banlieue et interurbain, et se décida à introduire la traction électrique sur une section de 16 km. à Nantasket Beach, afin de faire marcher ses trains de voyageurs au moyen de moteurs électriques. Cette première installation réussit à tel point qu'une autre section de 20 km. reliant Hartford avec Berlin, vient d'être completée et mise en exploitation. Le système à "troisième rail" est employé, et à l'heure actuelle le courant nécessaire pour un service de trente minutes est transmis par le troisième rail, le circuit de retour se faisant par les deux autres rails sans perte d'énergie considérable. L'intervalle entre le départ des trains a été considérablement réduit, et un service régulier a lieu de demi-heure en demi-heure, supprimant ainsi l'emploi d'horaires.

L'installation d'énergie hydraulique et le tramway électrique de Kioto . . . . . [Page 340.]

Service.

Le service du mouvement de voyageurs de la "Brooklyn Heights Railroad Company", par H. Milton Kennedy, Agent Général du mouvement de la "Brooklyn Heights Railroad Company." [Page 341.]

Les possibilités qui existent pour le développement du trafic étant bien plus favorables sur les lignes de tramways électriques que sur les lignes à traction animale, ont décidé la "Brooklyn Heights Railroad Company" à créer un emploi spécial dont le titulaire est exclusivement chargé d'étudier les moyens propres à amener un accroissement du trafic. Les méthodes employées dans ce but sont similaires à celles en usages sur les lignes de chemins de fer, et consistent principalement dans la publicité donnée aux lieux de plaisir desservis par les tramways électriques, en s'entendant avec les propriétaires de théâtres et d'autres établissements publics pour la création de locaux analogues à proximité du réseau de la compagnie, en encourageant la location de voitures spéciales par les clubs et sociétés, et en arrangeant de concert avec l'administration le service de départs le plus avantageux. Les frais de la publicité faite par l'agent de la compagnie sont supportés en graude partie par les propriétaires de divers établissements desservis par les tramways. Quelques-unes des méthodes usitées, ainsi que les résultats obtenus, sont décrits en détail par l'agent chargé du service.

Coût de l'énergie électrique dans les Etats de New York et de Massachusetts . . . . . [Page 344.]

Cet article comprend une table donnant le nombre de voitures, le parcours annuel et le coût de l'énergie électrique par voiture-ruille et par voyageur sur 71 lignes de tramways dans les états de New York et de Massachussetts.

La pratique contre la théorie en peinture, par Charles Koons. [Page 345.]

Critique dirigée par le chef de l'atelier de peinture de la "Laclede Car Company" contre un récent article du Professeur Spennrath, Directeur de l'Ecole Mécanique d'Aix-la-Chapelle, sur les propriétés destructives des pigments de couleurs à l'huile de graine de lin. L'auteur prétend que le pigment d'une couleur à l'huile exerce une influence considérable sur la durée de la substance avec laquelle il est mélangé, et que le résultat pratique des expériences acquises par les constructeurs de voitures de tramways en Amérique est en désaccord complet avec les conclusions tirées par le Professeur Spennrath de ses recherches sur ce sujet.

Parcs de tramways, IV . . . . . [Page 346.]

Suite d'une série d'articles parus dans les numéros précédents sur l'exploitation et l'entretien des parcs par des compagnies des tramways dans le but d'amener un mouvement de trafic vers les banlieues. Il est donné différentes vues, accompagnées de statistiques, de l'accroissement amené dans la circulation par les parcs, des frais d'entretien, et du revenu dérivé par les compagnies en sus de l'augmentation dans les recettes.

Transport de marchandises sur le tramway électrique de Newburgh, N. Y. . . . . . [Page 348.]

Cet article passe en revue le mouvement des marchandises légères transportées sur cette ligne dans le courant de l'année dernière. Deux trains de marchandises circulent par jour. Le lait constitue l'un des principaux articles faisant l'objet de ce traffic, environ 50,000 jattes ayant été transportées durant l'exercice. En fait d'autres produits transportés les principaux furent: raisins, pommes, pommes de terre, foin et paille. Les tarifs de transport et les frais d'exploitation du service de marchandises sont aussi énumérés.

Joints de rails à Brooklyn . . . . . [Page 348.]

Courte description des méthodes d'éclissage adoptées par la "Brooklyn Heights Railroad Company," la ligne la plus considérable à Brooklyn, pour effectuer le circuit de retour par rails.

Controverse au sujet de certaines stations centrales à Chicago, II. [Page 349.]

Le numéro précédent du STREET RAILWAY JOURNAL publiait une critique faite par les chefs d'une maison de construction de Chicago au sujet de l'érection de la nouvelle station centrale de la "Chicago City Railway Company," ainsi qu'une réponse de l'Ingénieur en Chef de cette compagnie. La station est à haute tension et equipée avec des générateurs actionnés par câble. Dans le présent article est donnée une réponse à la défense de l'Ingénieur en Chef de la compagnie par la maison de construction qui publia la critique originale. Il est aussi donné des lettres sur le même sujet par l'Ingénieur en Chef du Métropolitain de Chicago et par l'un des ingenieurs de la "Detroit Railway Company." Toute cette controverse est très intéressante au point de vue technique.

Jurisprudence. . . . . . [Page 352.]

Articles de Fond.

Publication de statistiques du travail . . . [Page 354.]

Le développement du trafic . . . . . [Page 354.]

L'influence des installations d'énergie électrique sur l'unité normale de chaleur . . . . . [Page 355.]

La lutte pour le trafic à venir . . . . . [Page 355.]

Discussion de l'avenir des chemins de fer électriques et de l'influence que l'adoption de la traction électrique sur les chemins de fer de grand parcours exercera sur les petites lignes et sur les tramways.

Construction.

L'installation de transport de force de St. Anthony Falls [Page 357.]

Description détaillée de l'importante station centrale d'énergie électrique installée aux chûtes de St. Anthony sur le Mississippi, et qui a pour objet de fournir la force électrique à la ville de Minneapolis. Les travaux sont conduits sous la direction de la "Twin City Rapit Transit Company" dont le réseau, d'une longueur totale de 362 kilomètres, sera entièrement actionné par cette force hydraulique. Le barrage a la forme d'un V, s'étendant en amont, et l'un des côtés constitue le cours latéral de la chûte. Le côté qui forme le barrage proprement dit a une longueur de 111 mètres, et le côté latéral de la chûte mesure 135 mètres. L'eau se précipite sur les turbines d'une hauteur de 6 mètres. Dans la saison des grandes eaux le débit de la rivière est de 1700 mètres cubes par seconde, le débit minimum est de 53 mètres cubes par seconde, correspondant à une minimum de 4000 chevaux. La moyenne du courant du Mississippi à Minneapolis est toutefois de 160 mètres cubes par seconde. Des appareils spéciaux, mûs par l'électricité, sont employés pour enlever du châssis en acier de la tête de chûte la glace et les détritus flottant dans la rivière.

La station centrale comprendra dix unités de 1000 chevaux chaque, avec régulateurs spéciaux. Les générateurs seront directement accouplés aux arbres des turbines, et consisteront en deux machines à courant continu de 1000 chevaux pour actionner les lignes les plus rapprochées à une pression de 600 volts et de trois alternateurs triphasés. Le courant d'une partie de ces derniers sera élevé à 3500 volts pour la transmission à courte distance, et de la partie restante à 12,000 volts pour la transmission à grande distance. Des transformateurs rotatoires seront installés dans les sous-stations, pour réduire cette pression et transformer le courant alternatif en courant continu. Les feeders seront tous posés souterrainement.

Nouvelle construction de voie à Denver. . . [Page 361.]

Description d'une nouvelle construction de voie à grand transport en usage dans les rues et sur les ponts. On se sert pour cette construction de rails à T placés dans de l'asphalte.

Quelques procédés pour l'essai de moteurs, par Frank B. Porter. [Page 361.]

Description, accompagnée de diagrammes, de moyens pratiques pour éprouver à l'aide d'instruments ordinaires la force de résistance des différentes parties d'un moteur, la résistance d'isolation, l'emplacement de courts circuits, etc.

Chariot du voie du Chicago City Railway . . [Page 364.]

Description d'un chariot qui enregistre automatiquement toutes les jointures de rails défectueuses, élargissements de voie, et autres imperfections qui peuvent se produire dans la construction d'une voie.

Procédé pour la jointure de poutrelles de voitures . [Page 364.]

Science — Génie — Inventions.

Nouveau porte-balai . . . . . [Page 365.]

Description d'un nouveau genre de porte-balai pour moteur de tramways électriques, inventé par la Walker Company. Les balais sont disposés de diverses façons, de manière à éviter l'usure des commutateurs. Le porte-balai est de construction excessivement simple, et de très grande conductivité, étant fait d'une seule pièce.

Perceuse de rail perfectionnée . . . . . [Page 365.]

Description d'une nouvelle machine à percer des trous dans les rails, qui peut être manœuvrée par un homme se tenant debout. Il est dit que le travail obtenu de cette manière est plus parfait que celui exécuté par un homme assis. Un arrangement ingénieux permet de laisser tomber l'appareil au passage d'une voiture, sans qu'il y ait lieu de retirer du rail la pointe de l'instrument.

Machine électrique verticale compound pour chemins de fer [Page 366.]

Description d'une machine verticale compound à condenseur construite pour la compagnie de tramways "La Capital" à Buenos Aires, République Argentine. La machine a des cylindres de 378 mm. et 774 mm. de diamètre, avec une course de piston de 457 mm., et est pourvue de soupapes Corliss.

Le moteur "Kinetic" . . . . . [Page 367.]

Description d'un nouveau moteur à vapeur surchauffée dans les cylindres, similaire sous certains rapports au système Lamm & Francq, sauf que le moteur est pourvu d'un petit foyer, et que la machine est placée sous le plancher de la voiture. Le cylindre est chargé à la pression initiale de 13 atmosphères, et consomme environ 10 kg. d'eau par voiture-kilomètre. Un condenseur à air est placé sur le toit. Le poids de la voiture dont l'illustration est donnée est de 13,160 kg.

Compagnie de réparations électriques . . . . [Page 367.]
Nouvelle caisse à sable . . . . . [Page 367.]
Joints de fils de trôlet . . . . . [Page 367.]

Description d'un nouveau procédé pour joindre les extremités des fils de trôlet.

Nouvel accouplement de voitures . . . . . [Page 367.]
Emploi de protecteurs à Albany et à Syracuse . . [Page 368.]
Bateaux de transport électriques . . . . . [Page 368.]

Description d'un nouveau type de bateau électrique.

Résultats obtenus par l'emploi d'économisateurs . [Page 369.]

Résumé des expériences faites avec les économisateurs à vapeur dans les stations centrales.

Faits Divers.

Programme de la prochaine convention de l'Union Internationale des Tramways . . . . . [Page 371.]

Programme de la dixième convention annuelle de l'Union Internationale Permanente des Tramways, qui aura lieu à Genève en 1898.

Convention de Niagara Falls . . . . . [Page 371.]

Programme de la prochaine convention de l'Association Américaine de Tramways, qui aura lieu à Niagara Falls du 19 au 22 Octobre 1897, et réglement adopté par les compagnies de chemins de fer à vapeur, à l'effet d'assurer aux participants le parcours á prix réduits.

Equipement électrique des chemins de fer élevés à Brooklyn. [Page 372.]

Notes d'Angleterre . . . . . [Page 373]

Lista de Materias—Junio 1897.

La tracción eléctrica sobre la red del "New York, New Haven & Hartford Railroad," por N. H. Heft . . [Pág. 329.]

Eso es un artículo importante y valioso por el jefe de la división eléctrica de uno de los más prosperos y progresivos ferrocarriles de América, cuya red extende sobre 4800 kilómetros en la parte más poblada de los Estados Unidos, y cuyas recetas en bruto son más de 150,000,000 pesetas por año. Algunos tres años despues, la dirección reconoció que la concurrencia de los ferrocarriles eléctricos en este territorio amenazaba de afectar su servicio suburbano y de corta distancia, y se resolvió de instalar la tracción eléctrica sobre una sección de 16 km. á Nantasket Beach, y mover sus coches de pasajeros por medio de motores eléctricos. Esa instalación original fué tan dichosa, que una otra sección de 20 km. entre Hartford y Berlin ha sido abierta recientemente. El sistema del "tercero carril" es el empleado, y está transmitida ya toda la corriente necesaria para un servicio de 30 minutos por el tercero carril, el retorno de corriente se haciendo por los dos otros carriles sin gran perdida de potencia. El intervalo de tiempo entre los trenes ha sido reducido considerablemente, y un servicio regular de media hora en media hora está establecido, suprimiendo el uso de horarios. En este artículo son dados diagramas de las experiencias hechas á Nantasket Beach, con tablas de velocidad, consumo de potencia, etc., y de gran interes para ingenieros.

Instalación de potencia hidráulica y tranvía eléctrico de Kioto. [Pág. 340.]

Descripción de un tranvía eléctrico á Kioto, Japon, y de la obra hidráulica que provee la corriente para el funcionamiento de la estación central.

Operación.

La división general de transportación de la "Brooklyn Heights Railroad Company," por H. Milton Kennedy, Agente General de Transportación de la "Brooklyn Heights Railroad Company" . . . . . [Pág. 341.]

Estando mucho más favorables las posibilidades para el desarrollo del tráfico sobre los tranvías eléctricos que sobre los á tracción animal, la compañía del "Brooklyn Heights Railroad" se ha decidido á establecer un servicio especial, el cual consiste exclusivamente en promover el tráfico. Los métodos empleados son semejantes á los usados por las compañías de ferrocarriles á vapor, y consistén principalmente en emprender parques públicos llegados por los carros, contraer para el establecimiento de teatros y otros lugares de diversión en proximidad de la línea del tranvía, animar el arriendo de carros por clubs y sociedades, y arreglar con la dirección el mejor horario. El costo del servicio de esta división está cubierto en mayor parte por los propietarios de lugares de diversión llegados por los carros. Algunos de los métodos usados, y los resultados obtenidos por medio de ellos, son describidos por el agente en cuidado del servicio.

Costo de la potencia eléctrica en los estadas de Nueva York y Massachussetts . . . . . [Pág. 344.]

Ese artículo incluye una tabla mostrando el número de coches, el desarrollo anual, y el costo de la potencia eléctrica por milla de carruaje y por viajero sobre 71 líneas de tranvías en los estados de Nueva York y Massachussetts.

Práctica contra teoría en pintura, por Charles Koons . [Pág. 345.]

Crítica por el jefe de los talleres de pintura de la "Laclede Car Company" sobre un reciente tratado del Profesor Spennrath, director de la Escuela Técnica de Aix-la-Chapelle, en respecto de las propiedades destructivas de colores de aceite de linaza. El autor pretende que los colores de una pintura de aceite influyen considerablemente sobre la duración de las sustancias mezcladas con el color, asímismo que las experiencias prácticas de las firmas américanas de construcción de carruajes contradicen determinadamente las conclusiones del Profesor Spennrath en consecuencia de sus estudios.

Parques administrados por compañías de tranvías, IV . [Pág. 346.]

Continuación de una série de artículos publicados en números precedentes sobre la explotación y el mantenimiento de parques por compañías de tranvías para causar un aumento en el trafico. Son dadas estatisticas del importe de trafico causado por los parques, así como del costo de mantenimiento, y del rédito obtenido de ellos separadamente del aumento en el trafico.

Transportación de mercancia sobre la "Newburgh (N. Y.) Electric Railway Co." . . . . . [Pág. 348.]

Cuenta del importe de mercancias transportadas durante el año último por esa compañía, cuyo desarrollo pasa á través de un condado rural. Dos trenes de mercancias circulan cada día. El principal producto transportado consta de leche, de cuyo cerca de 50,000 jarros fueron expresados durante el año. Otros productos principales constarán en uvas, manzanas, patatas, heno y paja. Las tarifas de transportación y los costos del servicio de mercancias son también indicados.

Enlazamiento de carriles en Brooklyn . . . [Pág. 348.]

Breve descripción de los métodos adoptados por la "Brooklyn Heights Railroad Company," la más importante línea de tranvías en Brooklyn, para enlazar carriles para el retorno de corriente.

Controversia sobre el sujeto de estaciones de fuerza motriz á Chicago. —II . . . . . [Pág. 349.]

Fué publicada en el último número del STREET RAILWAY JOURNAL una crítica por una firma de ingenieros de Chicago sobre la construcción de la nueva estación motriz de la "Chicago City Railway Company," así como una contestación á esta crítica por el Ingeniero Jefe de esa compañía. La estación es una de alta tensión, y empléa generadores movidos por cables. En el artículo que parece en el presente número, está publicada una contestación á la defensa del Ingeniero Jefe de la compañía por la firma de ingenieros que había publicado la crítica original. Parecén también cartas sobre el mismo sujeto por el Ingeniero Jefe de la "Metropolitan Westside Elevated Railroad Company" de Chicago, y por uno de los ingenieros de la "Detroit Railway Company." La entera controversia es muy interesante del punto de vista de la ingeniería.

Jurisprudencia. . . . . . [Pág. 352.]

Artículos de la Redacción.

Publicación de estatisticas . . . . . [Pág. 354.]

La extensión del tráfico . . . . . [Pág. 354.]

Influencia de las instalaciones de potencia eléctrica sobre la unidad normal del calor . . . . . [Pág. 355.]

La lucha para el tráfico . . . . . [Pág. 355.]

Discusión del porvenir de los ferrocarriles eléctricos y del efecto de la aplicación de la tracción eléctrica á los ferrocarriles principales sobre los ferrocarriles, ligeros y los tranvías.

Construcción.

Instalación eléctrica de St. Anthony Falls para la transmisión de potencia motriz . . . . . [Pág. 357.]

Descripción detallada de la importante instalación establecida á St. Anthony Falls, sobre el Mississippi, para transmitir la potencia eléctrica á Minneapolis. Los trabajos son conducidos soto la dirección de la "Twin City Rapid Transit Company," cuya red de 362 kilómetros de longitud será obrada enteramente por esta fuerza hidráulica. El dique está en forma de V, y extende hácia arriba del rio, uno de los lados constituyendo un lado de la corriente. El lado formando el dique mide 111 metros de longitud, y el á lo largo de la corriente mide 135 metros. La altura de la caida arriba de las turbinas es de 6 metros. Durante la marea alta, la corriente del rio es de 1700 metros cúbicos por segundo. La corriente minima es 53 metros cúbicos por segundo, y corresponde á un minimo de 4000 caballos. Pero la corriente media del Mississippi á Minneapolis es de 160 metros cúbicos. Se empleán procedimientos especiales, obrados por electricidad, para limpiar el bastidor de acero de la corriente, y remover el hielo y escombro.

La estación central será provista de diez máquinas de 1000 caballos cada una con reguladores especiales de ruedas de agua. Los genera lores serán acoplados directamente á las turbinas, y constarán de dos máquinas de corriente continua de 1000 caballos, para suplir las líneas cercanas á una presión de 600 volts, y de ocho máquinas á corriente alternativa. Una parte de la corriente de esas será elevada á 3500 volts para transmisión corta, y el residuo á 12,000 volts para transmisión á grande distancia. Transformadores de rotación serán colocados en las estaciones auxiliares, para reducir la presión y transformar la corriente alternativa en corriente continua. Todos los feeders son subterráneos.

Algunos métodos para la prueba de motores, por Frank B. Porter. [Pág. 361.]

Descripción, con diagrámas, de métodos utiles para probar con instrumentos ordinarios la resistencia de varias partes de un motor, la resistencia del aislamiento, la situación de circuitos cortos, etc.

Nueva construcción de vía en Denver . . . [Pág. 361.]

Descripción de una nueva construcción de vía para tráfico fuerte empleada en calles y sobre puentes. Se emplean carriles á T colocados en asfalto.

Método de coyuntura de madera de coches . . [Pág. 364.]

Carruaje indicador de vía del "Chicago City Railway." [Pág. 364.]

Descripción de un carruaje para registrar automáticamente los empalmes imperfectos, la estención de los carriles, y otros defectos que pueden occurrir en una construcción de vía.

Ciencia. — Ingeniería. — Invenciones.

Taladro de carril ventajoso . . . . . [Pág. 365.]

Descripción de un nuevo taladro para barrenar agujeros en carriles, el cual puede ser maniobrado por un hombre levantado. Se dice que de esa manera el trabajo se hace más bien que cuando el hombre está asentado. Por medio de un procedimiento ingenioso, el taladro puede ser abajado al pasaje de un carruaje, sin que sea necesario retirar del carril el punto del taladro.

Nuevo portabruza . . . . . [Pág. 365.]

Descripción de un nuevo tipo de portabruza para motores de tranvías eléctricos, diseñado por la Compañía Walker. Las bruzas son dispuestas de varios modos, para evitar que se consumen los conmutadores. El aparato es muy simple, y de grande conductividad, pues consta de una pieza única.

El motor "Kinetic" . . . . . [Pág. 366.]

Descripción de un nuevo motor de vapor de agua caliente casi similar al sistema Lamm & Francq, á excepción de un pequeño hogar llevado por el motor, y la colocación de la maquinaria soto el piso del carruaje. El cilindro está cargado con una presión inicial de 13 atmosféras, y consume cerca de 10 kg. de agua por kilometro de carruaje. Una máquina de condensación de aire está llevada sobre el tejado. El peso del carruaje ilustrado es de 13,160 kg.

Máquina eléctrica vertical compound . . . [Pág. 366.]

Descripción de una máquina vertical compound de condensación que fué construida para la compañía de tranvías "La Capital," de Buenos Aires, Argentina. La máquina posée cilindros de 378 mm. y 774 mm., con una carrera de émbolo de 457 mm., y está provista de valvulas Corliss.

Empalmaduras de alambres de trolley . . . [Pág. 367.]

Descripción de un nuevo procedimiento para empalmar las extremidades de alambres de trolley.

Cajas de arena . . . . . [Pag. 367.]

Nuevo enganche de carruajes . . . . . [Pág. 367.]

Descripción de un nuevo enganche adoptado por la "Chicago City Railway Company" para acoplar carruajes motores con carruajes remolcados. La juntura se hace por medio de un bastidor de hierro maleable, con doble conjuntura entre la barra y la cabeza, en modo que se asegura un movimiento lateral y vertical perfectamente independiente. Cada cabeza de coyunture está provista con dos proyecciones longitudinales terminándose en forma de V. Las cabezas se ajustan entre ellas y son provistas de agujeros conformando á una clavilla en forma de cuña. Cuando la clavilla está colocada en posición, las cabezas son juntadas con rigidez.

Compañía para reparaciones eléctricas . . . [Pág. 367.]

Aparatos de protección en Albany y Syracuse . . [Pág. 368.]

Ordenanzas municipales en Albany y Syracuse habiendo requirido la instalación de aparatos de protección sobre todos los carruajes de tranvías de ambas ciudades, fuén mandadas comisiones para pesquisar los varios tipos de *fenders*, y ambas recomendaban el mismo aparato, el cual ha sido adoptado por las compañías de tranvías en esas ciudades.

Lanchas eléctricas de transportación . . . [Pág. 368.]

Descripción de un nuevo tipo de lancha eléctrica.

Resultados obtenidos con economizadores . . . [Pág 369.]

Resúmen de las experiencias obtenidas con el empleo de economizadores de vapor en las estaciones centrales.

Noticias sobre Tranvías.

La convención de Niagara Falls . . . . [Pág. 371.]

Programa de la próxima convención de la Asociación de Tranvías en América, la cual será tenida á Niagara Falls, los 12-22 Octubre.

Programa de la próxima convención de la Unión Internacional de Tranvías . . . . . [Pág. 371.]

Programa de la decima convención anual de la Unión Internacional Permanente de Tranvías, la cual será tenida á Ginevra en 1898.

Instalación eléctrica sobre los ferrocarriles aéreos de Brooklyn. [Pág. 372.]

Anuncio de la determinación de las dos compañías de ferrocarriles aéreos en Brooklyn, de adoptar la tracción eléctrica en sus líneas.

Notas de Inglaterra. . . . . . [Pág. 373.]

Financial Notes.

Albany, N. Y.—The Albany Railway has recently announced that it will make a new bond issue to cover the expenses of the extensions to Cohoes and Rensselaer, which the company is building. The bonds will be general mortgage, 5 per cent. gold bonds, authorized $750,000, issued $375,000, in escrow for future extensions and additions and to retire prior liens, $375,000. These bonds will mature in fifty years.

Baltimore, Md.—The Falls Road Electric Railway Company has completed all arrangements and awarded contracts for the construction and equipment of the extensions to its lines, which comprise about 13 miles of double track. The company will add 500 h. p. to its power house and has purchased fifteen open and twenty-five closed cars. The company has also closed negotiations for consolidating its lines with the Pikesville, Reistertown & Emory Grove Railroad Company. The new company for which a charter has been secured will be known as the Baltimore & Northern Electric Railway Company, and it will operate a fast through line from the center of the city of Baltimore to Reistertown and Emory Grove. Extensive improvements are to be made that will involve the expenditure of a large sum of money. The entire work will be finished by Sept. 15, including the branch lines to be built. The financial details of the new company were arranged through the Maryland Trust Company. The capital stock is $1,000,000, and the company is authorized to issue bonds to the amount of $1,250,000, but only $1,100,000 will be issued at present. These will be used in part for providing funds for the large amount of new work which is to be done and supplying the additional equipment. The bonds to be issued will be 5 per cent gold bonds, running fifty years and secured by a first mortgage on the entire property, with the Maryland Trust Company as trustee. An underwriting syndicate has been formed to handle the new issue and the amount has been largely oversubscribed.

Bangor, Me.—The Bangor, Old Town & Orono Electric Railroad reports for the year gross earnings of $66,450. Of this sum $12,000 has been paid in dividends, $7500 in interest and $1000 in extension and further equipment.

Birmingham, Ala.—The plans of the Birmingham Railway & Electric Company include the equipment of its Ensley line by electric power as a substitute for steam, the power now in use. The company owns forty-five electric motor cars, fifteen locomotives, thirty-six steam passenger cars and six freight cars. Its annual report shows that the company is hauling about 5,000,000 passengers and 200,000 tons of freight a year. Other particulars of this line were given in our last issue under the heading of "Birmingham, Mich.," instead of Birmingham, Ala.

Brockton, Mass.—The Railroad Commissioners have approved an issue by the Brockton, Bridgewater & Taunton Street Railway Company, of $100,000 capital stock.

Brooklyn, N. Y.—The Coney Island & Brooklyn Railroad Company has authorized the issue of $1,500,000 5 per cent, fifty year, gold bonds. Of this amount, it is proposed to use $700,000 for the retirement of the present first mortgage of $300,000 and the $400,000 certificates of indebtedness. Both of these amounts will fall due on July 1, 1903. There will be $650,000 of the bonds deposited with the Brooklyn Trust Company, as trustee, to be held until such time as it is thought advisable to issue them for extensions or some similar improvement. They are likely to remain unissued for a long time, The remaining $150,000 of the new issue have already been sold to a New York firm of bankers, and are to be delivered and paid for on July 1.

Buffalo, N. Y.—The Buffalo & Depew Railway Company has been incorporated to build an electric railway from Depew and Lancaster to Buffalo. Directors, Wm. B. Cutter, Augustin Smith, Geo. A. Ricker, John H. Baker, H. P. Bissell, J. H. Metcalf, Geo. C. Riley, Jos. Murphy and Fred. M. Turner.

Chicago Ill.—The Calumet Electric Railway Company at a meeting held recently elected the following directors: John C. McKeon, Geo. E. Adams, John Farson, Chas. R. Corwith and E. A. Frost. This road is now in the hands of John C. McKeon as receiver.

Attendants at the Electric Light Convention.

All central station managers of the United States living west of Buffalo, who expect to attend the annual convention of the National Electric Light Association, at Niagara Falls, June 8–10, will find in the Lake Shore & Michigan Southern Railway the most desirable route for reaching Niagara Falls. This railway is the only double track line between Buffalo and Chicago, and traverses the richest and finest portion of the Central States; and in the opinion of those experienced in travel it has no superior in quality of roadbed, punctuality and elegance of service, and in the comfort and care of its patrons.

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Goshen, Ind.—The capital stock of the Indiana Electric Railway Company has been increased from $25,000 to $110,000.

Indianapolis, Ind.—The stockholders of the Citizens' Street Railroad Company elected a new board of directors on May 11, and retired all the old directors (including Murray A. Verner and H. Sellers McKee) except W. J. Turner. The new directory consists of W. W. Kurtz, Kennedy Crossman, R. H. Rushton, W. C. Huston, Joseph B. Neff, F. Dundore, and W. J. Turner. Mr. Crossman was subsequently made president, W. F. Milholland, secretary and treasurer, and Miller Elliott was appointed superintendent. It is understood that this change was made because of the dissatisfaction of the Philadelphia capitalists, who control the company, with the present management, and that the new officers will at once change the policy of the company toward the city and attempt to secure an extension of franchise.

Johnson City, Tenn.—The property of the Johnson City & Carnegie Street Railway Company has been placed in the hands of J. E. Brading as receiver. This road has not been in operation for some time, but it is now thought that cars will be run within a few days.

Liberty, N. Y.—The Liberty & Jeffersonville Electric Railroad Company has been incorporated with a capital stock of $120,000. It is reported that men and teams are already drawing ties and poles, and it is expected that the road will be completed early this summer.

Monterey, Mexico.—Negotiations for the purchase and consolidation of the street railways of Monterey, and their equipment with electric motive power by an American company have been closed.

Montreal, Can.—Albert J. Corriveau, who is representing the capitalists of the Montreal & Southern Counties Railway Company, is reported as stating that work on the company's lines will be begun during the present season. As to the equipment, he said that the rails for the lines will be of steel and 65 lbs. weight. Open and closed, passenger, mail, baggage and express cars of the best make will be used and heavy substantial trucks. Power will be furnished by the Chambly Water Power Company.

New Haven, Conn.—The Winchester Avenue Railroad Company has been authorized to increase its capital stock to an amount not to exceed $1,000,000. The company may extend its line through Second Avenue, West Haven.

New York, N. Y.—At a meeting of the directors of the Dry Dock, East Broadway & Battery Railroad Company, Gustav E. Kissel, of Kessler & Company was elected president in place of R. Kelly, who died recently. At an adjourned meeting the usual quarterly dividend was not declared on account of the depressed state of business lately.

New York daily papers state that a controlling interest in the Central Crosstown Railroad Company has been bought by parties who are identified with the Metropolitan Traction Company.

The Third Avenue Railroad Company has declared a quarterly dividend of 2 per cent.

Oswego, N. Y.—F. H. Tidman, receiver of the Lake Ontario & Riverside Railway Company, has applied for permission to borrow $50,000 on receiver's certificates for the purpose of purchasing new motors and otherwise properly equipping the road so as to place it on a paying basis, and also to pay wages due employes.

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Geo. W. Bacon, M. E.
Geo. H. Davis, M. E.

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FREDERICK H. TIDMAN, receiver of the Lake Ontario & Riverside Street Railway Company, has been authorized by the court to issue receiver's certificates for the purpose of extending and improving the property and paying certain claims held against the road. It is stated that the Knickerbocker Trust Company, of New York City, will take the certificates.

Pasadena, Cal.—The Los Angeles Safe Deposit & Trust Company, as trustee, has filed a suit against the Pasadena & Mt. Wilson Railway Company to foreclose its mortgage, and applying for its sale to justify the mortgage indebtedness.

Rochester, N. Y.—John N. Beckley, president of the Rochester Railway Company has resigned his position in order to devote more of his time to private business matters. Frederick Cook has been elected to succeed Mr. Beckley. The Rochester Railway Company at its last annual meeting decided to try the experiment of selling six tickets for twenty-five cents.

St. Louis, Mo.—It is reported that the Citizens' Railway Company is about to purchase the lines of the St. Louis County Street Railway Company.

Trenton, N. J.—Advanced statistics relating to the street railways of New Jersey are given in a supplemental report just issued by the State Board of Assessors for 1896. The report shows the total receipts of all the street railroads in the State for the year to be $5,770,171, against $5,056,598 in 1895, an increase of $713,573. The expenditures were $3,546,168, against $3,431,931 in 1895, an increase of $114,236, and dividends paid $124,220, against $117,320, in 1895, an increase of $6,900.

Warren, Mass.—The Warren, Brimfield & Wales Street Railway Company has been organized and temporary officers chosen as follows: president and treasurer, I. L. Currier, of Worcester; clerk, Joseph G. Hastings, of Warren; board of directors, I. L. Currier, George E. Tarbell, John M. Drake and William L. Curtis, of Warren, Charles S. Tarbell and Orus E. Parker, of Brimfield, and Herbert E. Shaw, of Wales. Capital stock, $150,000, all of which has been subscribed. The company intends to take all legal steps for obtaining a charter and franchise from the several towns this year and to begin construction work early next spring.

Westbrook, Me.—The Westbrook, Windham & Harrison Railway Company has been organized by the election of the following officers: president, J. C. Scates; vice-president, C. B. Woodman; treasurer, C. M. Waterhouse; clerk, J. H. Tolman; directors, Arthur W. Merrill, Wm. M. Bradley, of Portland; R. D. Woodman, C. M. Waterhouse, J. H. Tolman, C. B. Woodman, J. C. Scates, of Westbrook. The capital stock is $300,000.

Westfield, Mass.—The Board of Railroad Commissioners have granted the petition of the Woronoco Street Railway Company, to increase its capital stock to $100,000 and the funded debt to $70,000. The new securities will be used to defray the expenses of making several extensions to the line.

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Westfield, N. Y.—The directors of the Westfield, Mayville & Chatauqua Motor Railroad Company, which was recently incorporated, are John C. Waldo, James V. Waldo, Charles C. Minton, William L. Minton, Harlan W. Gibbs, Willis U. Baldwin and C. R. Cipperly. The principal office will be at Westfield, and the road is to run from Barcelona to the Chatauqua assembly grounds.

Worcester, Mass.—The Worcester & Marlboro Electric Street Railway Company organized under its charter at a recent meeting by electing the following officers: president, J. Russel Marble; vice-president, Otis E. Putnam; clerk, Robert P. Clapp; directors, J. Russel Marble, Otis E. Putnam, John C. MacInnes and Rufus S. Woodward, of Worcester; C. O. Green, of Shrewsbury, George L. Smith, of Westboro, and S. Reed Anthony, of Boston. The company has a gang of 150 men at work building the road at the Marlboro end and the poles and ties have been distributed over the entire length of the line to Worcester, so that the work will be pushed as rapidly as possible.

Yardley, Pa.—The stockholders of the East Penn Traction Company have decided to increase the capital stock from $350,000 to $416,000, and to issue bonds to the full amount of this stock. The company is now operating in Buck's county, and it is intended to extend the route. Twenty-six miles of track will be laid to connect Morrisville with Doylestown and adjacent points in the eastern part of the county. The general office of the company is 1345 Arch Street, Philadelphia.

Baltimore & Ohio Notes.

Mr. David B. Martin, manager of passenger traffic of the Baltimore & Ohio Railroad, has decided to secure an entirely new series of scenic views of the line. He has secured the services of Mr. Wm. Dinwiddie, a noted photographer of Washington, whose skill in that line of photography is unexcelled, and Mr. Dinwiddie is now engaged in taking the necessary observation before he begins the real work. A caboose car will be fitted up for his use, and he will probably be kept busy all the summer. The new photographs will be used for advertising the picturesque Baltimore & Ohio, and no expense is to be spared in getting the very best effects possible. ***

The Baltimore & Ohio Railroad Company has decided, on its spring time card, to shorten the time an hour on its day trains from Pittsburgh to Cincinnati and to put buffet sleeping cars on the night trains, an improvement which will no doubt, be very greatly appreciated by the patrons of the line. ***

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We have issued a folder containing sample colors of Alcatraz Asphalt Paints, which tells briefly of their points of superiority. Will be sent to any one interested upon application, together with any other information desired.

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ELECTRICAL ENGINEERING DEPARTMENT
University of Illinois

Street Railway Journal.

Vol. XIII. *NEW YORK AND CHICAGO, JULY, 1897.* *No. 7.*

ELECTRIC RAILWAY PRACTICE IN EUROPE.—II.

Progress in the electrical equipment of tramways and light railways in Europe shows no signs of abating. As a result of the object lessons furnished by the lines which have been installed, and as the really unobjectionable features of a properly installed electric system are realized, the prejudice against the use of overhead wires is gradually disappearing, and, while the supervision exercised by the authorities over the character of the installation is much more rigorous than in America, the regulations imposed

Complete data as to the total mileage of tramway lines in Europe are exceedingly difficult to obtain, owing to the fact that the statistics reported by the companies in the different countries are not upon the same points, and in several of the countries but little distinction is drawn between urban tramways and light railways. What is probably the most complete attempt to compile the statistics of the tramways in all of the different European countries was recently undertaken by Ernest Gerard, engineer

MOTOR CARS ON UNDERGROUND SECTION AT KARLSKASERNE STATION—BUDAPEST.

are not of such a character as to seriously interfere with the installation of economical systems.

As is well known, tramway development has been by no means as extensive *per capita* in Europe as in America; the reasons for this are various and have been discussed at length in previous issues of the STREET RAILWAY JOURNAL. The social advantages of a liberal urban transportation system in the way of distributing the population over a large area are, however, now becoming well recognized abroad, and undoubtedly this factor is having an important effect in the change in sentiment among the municipal authorities in permitting the use of electricity as a motive power.

of the Belgian state railways. The results of this compilation are published in a recent issue of the "Bulletin of the International Railway Congress," issued at Brussels, and show a total mileage of tramway and light railway track in Europe of 9138 miles. Among the different countries, Italy led with 1865 miles, owing largely to the large number of light railways operated by steam power. Germany came next with 1487 miles. England and Ireland followed with a total of 1396 miles, and France with 1297 miles. The other countries in the order of their mileage are as follows: Belgium, Holland, Austro-Hungary, Russia, Spain, Switzerland, Portugal, Roumania, Denmark, Sweden and Norway, Servia, Turkey. This order

and the figures given above are based upon the statistics, in most cases, of 1895.

In the April issue of the STREET RAILWAY JOURNAL, descriptions were given of some ten different electric railways recently installed in Europe; the countries represented included Germany, France, Switzerland, England and Belgium. In the following pages will be found de-

SINGLE TRUCK MOTOR CAR—BUDAPEST.

scriptions of a number of additional electric lines in Europe, with the methods adopted in power station, track and overhead line construction, together with a general idea of the financial results which have followed the introduction of electric power when its employment has been over a length of time sufficient to determine the economy resulting from its adoption.

BUDAPEST.

The city of Budapest possesses a peculiar interest to electric railway engineers from the fact that here was installed the first extensive conduit electric railway, which was successful, from both an electrical and financial standpoint. The city is the capital of Hungary and, next to Vienna, is the largest city in the Austro-Hungarian empire. As its name implies, it is composed of the two cities of Pest and Buda, which are located respectively on the left and right banks of the Danube. The two towns are connected by several bridges, are united under one municipal government, and had in 1890 a combined population of 506,384. Of the two sections of the city, Buda is much older; in contrast with it, Pest is essentially a modern town, and contains many fine streets and squares, magnificent quays, etc.

BUDAPESTER ELEKTRISCHE STADTBAHN GESELLSCHAFT.

The conduit system has been in operation in Budapest since July 30, 1889. At that date a short section, built by the Siemens & Halske Company, was put in operation over the Barossgassen, an important street, for the Budapester Elektrische Stadtbahn Aktiengesellschaft. The line covered 2.52 km. of street, and had a length, measured as single track, of 4.13 km. The success of the system can be gaged by the number of conduit lines put in operation by that company during the two years following the opening of the first section. They were as follows:

		Length of line.	Length of track.	Opened.
I. Baross	Street.	2.52 km. = 1.56 mi.	4.13 km. = 2.56 mi.	July 30, 1889
II. Podmaniczky	"	3.53 km. = 2.19 mi.	7.33 km. = 4.54 mi.	Sept. 10, 1889
III. Ring	"	3.70 km. = 2.30 mi.	7.50 km. = 4.65 mi.	Mar. 6, 1890 Aug. 7, 1890
IV. King	"	2.33 km. = 1.45 mi.	5.03 km. = 3.12 mi.	June 4, 1890 July 22, 1891

These lines have all a gage of 1.435 m. (4 ft. 8½ in.). The Stadtbahn Gesellschaft also equipped several lines with overhead conductors.

Roadbed.—The conduit conductors are of iron and form a complete metallic circuit. The yokes are of cast iron and are set 1.20 m (3 ft. 11 ins.) apart. The conduit, which is of concrete, has a maximum width of 28 cm. (11 ins.) and depth of 33 cm. (13 ins.) The slot in the earlier construction was 33 mm. (1.3 ins.), but in later construction the width of the slot was reduced to 25 mm. (1 in.). About 100 cars are in operation over this line.

Power Station.—The power station is located in Gärtnergasse and contains ten horizontal compound condensing engines having a total capacity of 2800 h. p. Each engine is direct coupled to a generator, the total generator capacity being 6200 amps. at from 300 to 320 volts, the potential used on the system.

Financial Results.—During the year 1895 the conduit line carried over 15,000,000 passengers with gross receipts of 1,091,972 fl. ($436,788) and the cars ran 2,884,435 car km. (1,788,350 car miles), earning 24.4 cents per car mile. During the same year the company carried on its Friedhofs line, which is equipped with overhead trolley wires and has a total length measured as single track of 10.12 km. (6.27 miles) 2,045,561 passengers.

THE BUDAPESTER STRASSENBAHN GESELLSCHAFT.

The Budapester Strassenbahn Gesellschaft, encouraged by the success of the electric railway system in Budapest, of the Stadtbahn Gesellschaft, decided to change the motive power on its line from horses to electricity, and

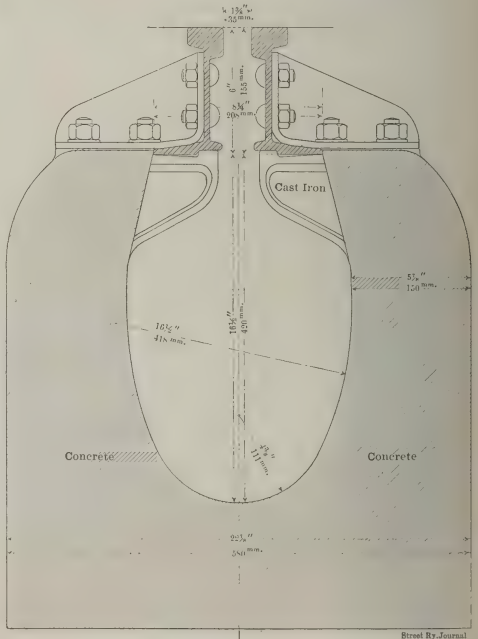


FIG. 1.—SECTION OF PRESENT STANDARD CONDUIT—BUDAPEST.

since May 30, 1896, when the first electric line was put in operation, has equipped 92 km. (57 miles) of track, of which 24 km. (14.9 miles) employs the conduit system, and 68 km. (42.1 miles) the overhead trolley system.

Roadbed.—In both roadbed and type of conduit the construction differs in a number of respects from that

1—Car house at Neupest.
2—View down Margarethenbrücke over the Danube.
3—Exterior of main car house and power station.
4—Street scene at Karlskaserne station.
5—Side view of the Margarethenbrücke.
6—Double bracket overhead construction.

VIEWS IN AND AROUND BUDAPEST.

first installed in Budapest, although in general character the yokes and conduit are similar. Four different kinds of track are used. For those sections on which the authorities have permitted the introduction of overhead lines, which lie mainly in the suburbs, a modified and novel type of Haarmann rail has been adopted. A section of this rail is shown in Fig. 2. Each rail consists of three members, two girders and one filler. The girders are 9 m. (29½ ft.) in length and are bolted together with two 15 mm. (⅝ in.) bolts every 600 mm. (23.6 ins.). This gives a substitute for a grooved rail with a groove 35 mm. (1.36 ins.) wide and 32 mm. (1.26 ins.) deep for the wheel flange. The weight of each outside member of the Haarmann rail is 21.03 kg. per meter (42.3 lbs. per yard). The outside members of each rail break joints a distance of 594 mm. (23.6 ins.) apart, where eight-bolt angle plates are used. The fillers are installed only at these joints, when they are the same length as the fishplates, and at the location of the tie rods. No ties are used with this construction, the tie rods being depended upon to keep the rails in alignment. The two rails are bonded together electrically on each side of each joint by a bolt threaded to fit an internally threaded chuck, screwed into each rail web (Fig. 4).

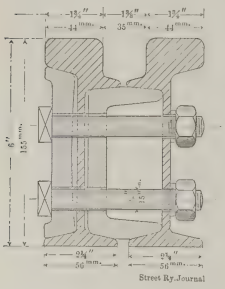


FIG. 2.—SECTION OF HAARMANN RAIL AT JOINT.

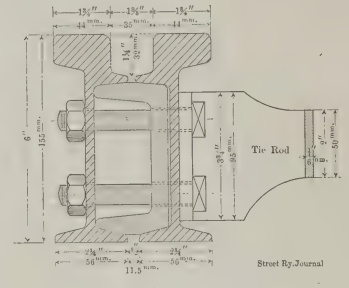


FIG. 3.—SECTION OF HAARMANN RAIL SHOWING TIE ROD.

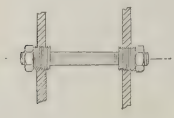


FIG. 4.—BONDING BOLT —HAARMANN RAIL.

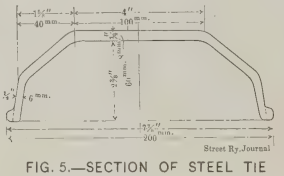


FIG. 5.—SECTION OF STEEL TIE USED WITH HAARMANN RAIL.

The rail used on suburban sections where the company owns its right of way is the Vignole rail which is quite similar to an American 4¼ in. T rail. The rail weighs 23.6 kg. per meter (42.9 lbs. per yard) and is mounted on beveled tie plates, as shown in Fig. 7. The tie plates are bolted to metal ties spaced 950 mm. (37.4 ins.) between centers, except at joints where the ties are spaced 510 mm. (20 ins.) between centers and the tie next to each joint tie, which is set 920 mm. (36 ins.) from the nearest joint tie. The joints are laid opposite each other with this construction.

FIG. 6.—PLAN OF HAARMANN RAIL JOINT. (Scale 1:20.)

Shortly before deciding to change the whole system to electric traction, a short section of street was equipped with Demerbe rails (Fig. 8) which were kept in use as they proved satisfactory. This rail weighs 41.18 kg. per meter (82.8 lbs. per yard) and, as will be seen from Fig. 8, is a double web or box rail mounted on a concrete base. The two webs are made flaring so as to compress the concrete when carrying a load and prevent the rail from depression. At the joints the rail is supported by a tie plate of similar form, connected to the rail by pins.

Such sections within the city on which the use of conduit was prescribed are equipped with a mixed system of track construction consisting of the Haarmann rails mentioned, and two "schlitz" rails, so called, which are mounted on the yokes and form the slot rails of the conduit as shown in Fig. 1. As will be seen from this, the conduit is not laid in the center of the track as in American practice, but at the side, the slot of the conduit forming the groove for the wheels on one side of the car. The "schlitz" rails, or slot rails weigh each 23.90 kg. per meter (48.1 lbs. per yard) and are 155 mm (6 ins.) in height. The joints are connected by 330 mm. (13 in.) eight-bolt angle plates, and the rails break joints, the joint centers being separated by a horizontal distance of 600 mm. (23.6 ins.).

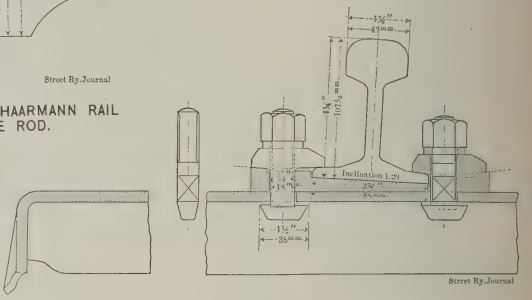


FIG. 7.—SECTION OF VIGNOLE RAIL.

The four systems of track construction described have been in use under electric cars since May 30, 1896, and during that time have shown themselves strong enough for the service. Over a part of the system, that within the city, there is a daily service of between 380 and 480 motor cars. As yet no signs of trouble with any of the types of rails have developed.

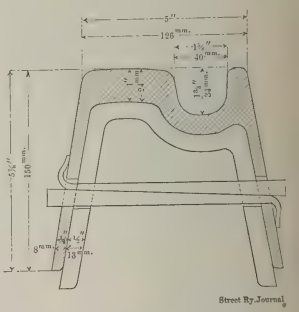


FIG. 8.—SECTION OF DEMERBE RAIL AT JOINT.

Conduit.—The yoke used is illustrated in Fig. 1 and is of cast iron. As will be noticed, the slot is 35 mm. (1⅜ ins.) wide. The depth of the conduit from the top of the yoke is 420 mm. (16.5 ins.) and from the top of the slot rails is 575 mm. (22.7 ins.). The conductors are iron T bars, with 70 mm. (2.76 ins.) head and 30 mm. (1.19 ins.) depth, the positive conductor being on one side, and the negative on the other, reinforced by feeders. These T channels are attached to the sides of the conduit at distances of 3.6 meters (11.8 ft.) apart by means of porcelain insulators. One of the chief claims for this form of conductor is that it can be easily reached without tearing up the street pavement.

The change from the overhead to the underground system can be made without stopping, the plow simply being lowered into the conduit. No stop is required either to

change from underground to overhead line. It might be also stated that of the two extensive bridges which connect the two cities, one is equipped with the overhead system, the other with the conduit system.

Overhead Construction.—On the suburban portions of the system, overhead wires, with Siemens & Halske sliding contact trolleys, are used. The span and bracket poles are exceedingly graceful and a good idea of them as well as of the character of the overhead line can be obtained from the several photo-engravings accompanying this article. One especially noticeable feature of the overhead line, due to the use of the sliding contact, is the entire absence of overhead frogs and crossings. This, as will be seen, gives a remarkably light appearance to the overhead line, and at the same time permits the least possible number of span wires and other supports. The trolley wire is of hard drawn copper, 8 mm. (.32 ins.) in diameter. The span wire is of galvanized steel, 6 mm. (.24 ins.) in diameter. The feeders in the business section of the city are all carried underground, while in the suburbs they are overhead. Return conductors are used to a considerable extent. According to municipal enactment, the potential on the overhead system is not allowed to exceed 400 volts, and that on the underground system, 350 volts, both measured on the voltmeter at the power station. The working conductors are divided into sections of from 1 to 2 km. (.62 to 1.24 miles) in length. The greatest distance to which power is carried from the central station is 15 km. (9.3 miles). The distant sections are fed at 100 volts additional potential.

Power Station.—For the operation of the company's lines it possesses two power stations, one at Pálffygasse, and one at Damjanichgasse, which was put in operation about a month ago. The first contains four tandem compound condensing Collmann engines of which two are of 700, and two of 400, effective h. p., giving a total output of about 1430 k. w. The boilers are six in number and of the Babcock & Wilcox type, each with 262 m^2 (2819 sq. ft.) heating surface. The generators are direct connected to the engines, and were built by Siemens & Halske.

The second power station is equipped at present with four tandem condensing engines of 850 effective h. p. each, power station is so arranged that its present capacity can be easily doubled should the needs of the service demand. The power station is equipped with a traveling crane running the entire length of the station.

DOUBLE BRACKET CONSTRUCTION—BUDAPEST.

Rolling Stock.—The company has 194 cars, of which 130 are motor cars, and sixty-four trail cars. The motor cars have a capacity of forty-eight persons, twenty-six

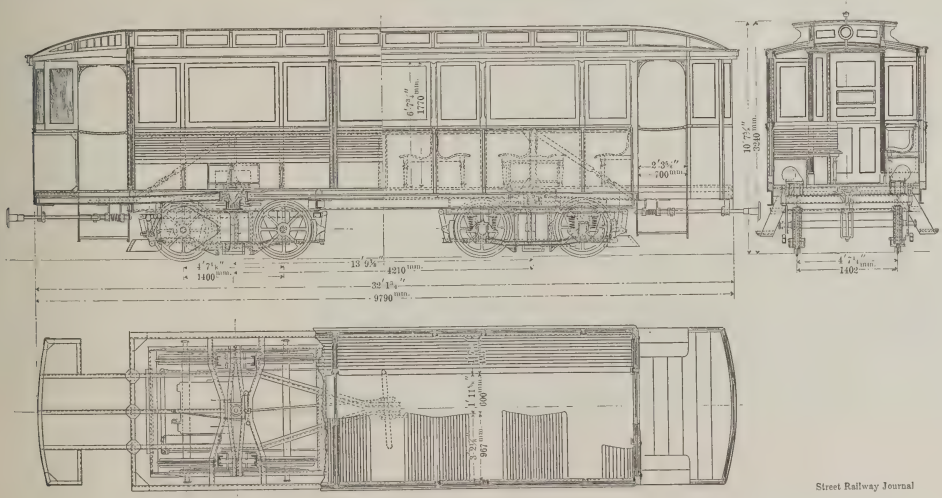


FIG. 9.—SECTIONS AND PLAN OF DOUBLE TRUCK CAR WITH LONGITUDINAL AND CROSS SEATS—BUDAPEST.

the total capacity of the station being about 2200 k. w. There are six Babcock & Wilcox boilers, each with a heating surface of 305 m^2 (3282 sq. ft.). The generators are of the direct connected Siemens & Halske type. The seated and twenty-eight standing, and are arranged with cross seats on one side of the aisle, and a longitudinal bench on the other side of the aisle. Seventy of the cars are equipped with two motors each, and sixty with one

motor. Both open and trail cars are used. Thirty are of the single truck type and have a capacity of forty-four passengers. Thirty-four cars are mounted on swivel trucks and have a capacity of fifty-six passengers. The cars are equipped with the Siemens & Halske type B 17-30 motors of 20 h. p. capacity each. The speed within the city is limited by the municipal authorities to 18 km. (11 miles) per hour and in the suburbs to 25 km. (15½ miles) per hour.

Car Houses.—The company has seven car houses, one of which is owned by a private corporation, but is occupied by the company. Small workshops for repairs are located in every car house and adjoining the Pálffyplatz house is an extensive repair shop.

Financial Results.—The results of the change to electric power on the lines now in operation have fully equaled the expectations of the managers of the company, as stated by them. The gross receipts during 1896 were 2,155,000 fl. ($862,000). The system is owned by a stock company having a paid up capital of 10,000,000 fl. ($4,000,000) and debt of 9,000,000 fl. ($3,600,000) in 4 per cent bonds. The company expects to build 60 km (37.2 miles) of new track within the next year. The active manager of the company is Heinrich Jellinek v. Haraszti, of whom a portrait appears elsewhere. The chief engineer of the company is Anton Steller.

BELGRADE.

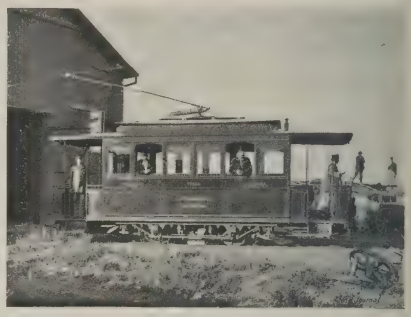
The historical city of Belgrade was long an object of fierce contention between the Austrians and Turks, and during the last 500 years has been captured by and belonged successively to each. From 1791 to 1877 it formed a part of the Ottoman empire, but when, in the latter year, Servia became an independent nation, Belgrade was made the capital of that country. It is situated on the Danube, is handsomely built, and has a number of important manufacturing industries. Its population in 1891 was 54,458.

The tramway system in Belgrade is owned by La Société Anonyme des Tramways de la Ville de Belgrade, a corporation whose headquarters are in Brussels. Part of

MOTOR CAR AND TRAILER—BELGRADE.

the company's system has been in operation by electric power since June 1, 1894, and it now comprises about 10 km. (6.2 miles) of track operated by electric power, and 7 km. (4.3 miles) by horses.

Roadbed.—The track is laid with Phœnix rail, weighing 40 kg. per meter (80.5 lbs. per yard), and mounted on a concrete base, which under the rails is 190 mm. (7.6 ins.) in thickness. The concrete bed is continuous, as shown in Fig. 10, between the rails, and rests upon a sub-foundation of broken stone, 120 mm. (4.7 ins.) in thickness, extending the entire width of the street. The gage is 1 m. (39.4 ins.). The track has stood up satisfactorily up to the present time under a service of 122 cars per day on certain sections, and its life is estimated at



STANDARD CAR—BELGRADE.

many years by the managers of the company. The road contains a number of sharp grades, some as high as 10 per cent.

Overhead Construction.—Cast steel poles are used to carry the overhead wire, and the generally tasteful character of the overhead construction is clearly shown in the accompanying engravings. Unlike the experience in many other European cities, this company had no prejudice to overcome on the part of the public against the overhead system, an assurance having been given to the municipal authorities that the greatest care would be taken to render the system unobjectionable from an æsthetic standpoint, and the company anticipates no trouble in securing further permission, if desired. The work of overhead construction was carried on by the French Thomson-Houston Company. The overhead wire has a diameter of 8.21 mm. (.31 in.), and the span wire of 7 mm. (.28 in.). For line insulators the company states that it is using an insulating material made of compressed paper pulp. The feeders are carried partly overhead and partly underground. The satisfaction given by the type of overhead construction adopted has been so great that the company would adopt the same system for any further extensions.

Power Station.—The current for the operation of the line is furnished by the Electric Illuminating Company of Belgrade upon a basis of the car kilometers run by the motor cars. It has therefore no power station of its own. The price paid is twelve centimes per motor car kilometer (3.9 cents per car mile). This price includes the furnishing to the railway company of all motors and other electrical apparatus for the cars, all electrical connections on the line, overhead system, direct and return feeders, etc.

Rolling Stock.—The character of cars employed is shown on this page. The cars are each equipped with two 25 h. p. Thomson-Houston motors. The speed is limited by municipal ordinance from 10 to 25 km. (6 to 15½ miles) per hour in different parts of the city. The average number of cars employed daily is eight motor cars and twelve horse cars.

Financial Results.—The equipment of the section of the line now operated by electricity has been very satisfactory from a financial standpoint, and the gross receipts have increased 35 per cent, while the operating expenses have increased only 9 per cent. The increase in receipts is stated to be sufficient to pay interest on the stock, and an additional increase in receipts is expected each year. The gross receipts the last fiscal year for the entire line amounted to about 420,000 fr. ($84,000).

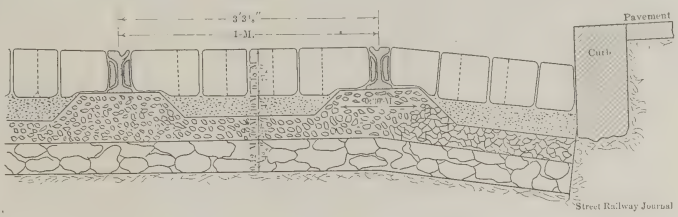


FIG. 10.—SECTION OF TRACK—BELGRADE.

VIENNA.

The first trolley line to be opened in Vienna was put in operation Jan. 28, 1897, by the Vienna Tramway Company. The success of this line has been so great that it is thought that other franchises will be granted for electric lines in the near future. The railway occupies a part of the well known Prater Strasse, and is a belt line surrounding half of the city. It does not, however, enter the main business district of the city, in which there is still a strong prejudice against the use of overhead wires. One terminal is near the Danube, and the line forms a connecting link between the principal steam railroad stations.

Roadbed.—The track is laid partly with heavy Phœnix rail, weighing about 43 kg. per meter (87 lbs. per yard) and partly with 155 mm. (6 in.) Haarmann compound rails connected with tie rods every 2.7 meters (8.9 ft.). The rail bonds are of copper and have a cross section of 107 mm² (No. 0000) and the rails are cross connected every 100 meters (328 ft.). The total length of line, which is double track throughout, is 9760 meters (6 miles), which is little more than one-tenth of the total street railway system of Vienna, which has a total length of line of 80.5 km. (50 miles) and 156.7 km. (97 miles) of track. The

CURVE AND SWITCH, SHOWING WIRING—BELGRADE

installation was made under the general direction of the Union Elektricitäts Gesellschaft, of Berlin.

Overhead Construction.—The trolley line is of the usual type and is supported by span wires which are supported in turn by poles and wall rosettes in about equal proportions, there being 310 poles and 366 rosettes. The poles, which are of the Mannesmann tubular type, are of ten different sizes, weighing 100 to 1000 kg. (220 lbs. to 2200 lbs.) each. Three feeders are used, one 4.2 km. (2.6 miles) in length, and 350 mm² (700,000 cm.) in section, placed underground in an iron armored cable; the second cable is similar in character to the first, is 1.45 km. (.9 mile) in length and 140 mm² (276,000 cm.) in section; the third cable is 1.75 km. (1.1 mile) in length and of the same size. Lightning arresters are located every 500 meters (1600 ft.). To guard against accidents caused by the possible fall of telephone wires upon the trolley wire, the trolley wire is fitted at the few places at which telephone wires are carried over it with a triangular wooden cover, the lower part of the trolley wire remaining free so that there is no interference with the trolley. Return feeders are used.

Power Station.—Current is taken from the central station of the Allgemeine Oesterreichische Elektricitäts Gesellschaft where two compound engines of 600 h. p. have been installed.

Rolling Stock.—There are thirty motor cars, of which twenty-five are in regular service. They are of the Hamburg type, mounted on four wheel trucks and are fitted with longitudinal seats. Each has a seating capacity of twenty passengers, and standing capacity on the front platform for four, and on the rear platform for seven passengers. Open cars are not used, as the windows are extra large, and it is thought that when these are lowered sufficient ventilation can be secured during the hot summer weather. An interesting feature of the line is that chilled cast iron wheels are used. These were supplied by Ganz & Company, who are making the Griffin wheels, well known in America. The adoption of this wheel was suggested by successful results secured in Leipsig and other cities. The motors are of the G. E. 800 type, and the cars operate at an average speed of 12 km. (7.6 miles) per hour. The controllers are fitted with special contacts, by which, in stopping, the motors are changed to generators, producing an electric braking effect. The trolley is of the General Electric type.

Financial Results.—The fares charged on the line are the same as those when horses were used and the gross receipts have increased rapidly, a good indication that the electric system satisfies the needs of the public. The line has not been in operation long enough yet for the economy to be known. For the particulars of this line the STREET RAILWAY JOURNAL is indebted to the "Mittheilungen des Vereines für die Förderung des Lokal und Strassenbahnwesens."

MUNICH, GERMANY.

Munich is the capital of Bavaria and is one of the largest cities in Germany, having in 1890 a population of about 350,000. It is situated on a plain, contains a large number of handsome public buildings, and is noted particularly for its art treasures and university.

The street railway system in Munich is owned partly

by the city and partly by the Münchener Trambahn Actien-Gesellschaft, of which George Hippe is manager. The system includes about 45½ km. (28 miles) of track, of which about 7 km. (4.2 miles) are operated by electricity.

Roadbed.—All the lines use exclusively Hartwich rails with a grooved lip bolted on, as shown in Fig. 11. This rail has proved quite satisfactory on the three systems of traction in use, horse, steam and electric. The rails are bedded in gravel and sand, and run partly through macadamized, partly through streets paved with granite or wood blocks. For the past half year or so the managers have been making some tests with stronger joints (Fig. 12) and expect good results from them.

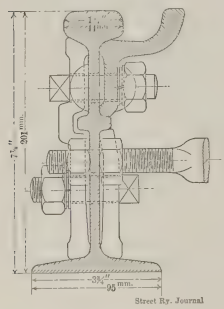


FIG. 11.—7⅞ IN. RAIL—MUNICH.

The company has had sections of rail in use since 1884, in Bayerstrasse where the heaviest traffic passes over it, and as yet no material wear of the rails is noticeable. The cars of four tramway lines are running over that section, making a total of 942 cars per day which pass a given point. The same rails have been used for the steam traction line partly since 1883, and here again after thirteen years of service there is no noticeable wear.

By keeping the track well aligned and in good repair the engineers estimate the life of the rail with horse traction at thirty years. In Munich they are compelled to use a 20 cm. (7.8 in.) rail on account of the paving, otherwise they would adopt the low Phœnix rail, which is regarded with great favor. For electric traction they would also recommend a heavier rail than for horse service.

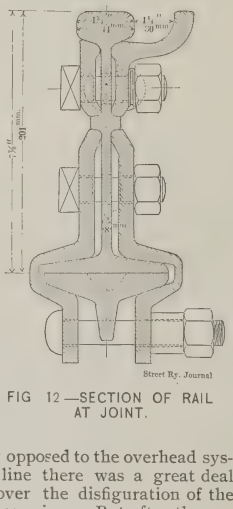


FIG 12.—SECTION OF RAIL AT JOINT.

Overhead Electric System.—The overhead system was erected by the Union Elektricitäts Gesellschaft and is of the usual span construction. Within the city steel poles are used and out of town wood poles. Wherever it was possible rosettes, similar to that shown in Fig. 13, and fastened to the houses are used instead of poles.

The public was generally opposed to the overhead system. At the opening of the line there was a great deal of dissatisfaction expressed over the disfiguration of the streets by the trolley and span wires. But after the eye grew accustomed to the overhead system, the public realized that the interests of traffic took precedence over æsthetic sentimentality, and gradually the dissatisfaction disappeared. If it should be proposed to extend the electric system within the city, however, it is possible that the plan would meet with opposition.

The trolley wire is of hard drawn copper 53 sq mm. (about 102,000 c. m.) in section. For the span wire galvanized steel of 5 mm. (.2 in.) 6 mm. (.24 in.) in diameter, according to the strain, is used. The trolley wire is carried at an average height above the rails of 5 meters (16 ft.) the rosettes as well as the poles are insulated from the span wire, and whenever necessary, a sound damper is fastened to the rosettes, in order to deaden the noise of the trolley. In future construction it is proposed to do away with wooden contact poles and replace them by steel poles.

Car Equipment.—Of the twenty-eight cars in use the Union Elektricitäts Gesellschaft furnished twenty, and Schuckert & Company the other eight. The cars of the former firm are equipped each with a G. E. 800 motor, form B 6, constructed by the Union Elektricitäts Gesellschaft, while the Schuckert cars have each a four pole Schuckert motor. The motors have a capacity of from 20 to 25 h. p. The speed is regulated by police ordinance and limited inside the city to 6 to 12 km. (3.7-7.6 miles) per hour and on suburban sections to 20 km. (12.4 miles) per hour. When the traffic is heavy trail cars are used. In future rolling stock somewhat stronger motors and larger platforms will be employed.

Power Station.—The current for the operation of the lines is obtained from the municipal lighting station as both electric lines are owned by the city. Here the generators are run by turbines during the day and by steam power at night.

Financial Results—The traffic has considerably increased on the two lines now using electric power since their equipment. The actual increase in gross receipts has been 36 per cent in one case and 67 per cent in the other in comparison with horse traction. During this time the actual operating expenses have decreased. After making the proper deduction for the sinking fund and renewal of machinery, however, the operating expenses are found to be no less than with horse traction.

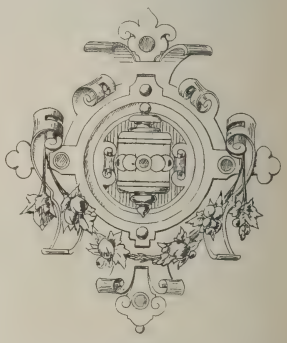


FIG. 13.—ROSETTE FOR SPAN WIRES—MUNICH.

From the net receipts 4 per cent is charged off for interest and 20 per cent for the sinking fund. The balance of the net receipts is applied to the redemption of the deficit on other sections of the horse railway line belonging to the city.

The gross receipts of the company for the last fiscal year were as follows:

103,384.05 marks ($25,846) for the steam lines belonging to the company.
2,122,165.45 marks ($530,541.25) for the horse lines belonging to the company.
165,831.95 marks ($41,458) for the horse lines belonging to the city.
363,684 marks ($90,921) for the electric lines belonging to the city.

On week days eighteen motor cars and trail cars, according to requirements, are run. On fair Sundays and holidays in summer twenty-two motor cars with a trailer each are required to carry the traffic.

Other Motive Powers.—At present there is in course of construction a section of track 600 m. (1950 ft.) in length, with a surface contact system built by the Schuckert Company. The contact plates are not continuously connected to the feeder, but are automatically put in and out of circuit by means of a special device operated from the car. All the connections are underground, nothing being visible on the street except rounded off square stones with the contact plates. The heads of the latter project about 2 cm. (.8 in.) above the pavement. The section distributing boxes are located under the sidewalk and are covered with iron manholes.

BELGIUM.

In no country in Europe has the development of light railways been carried to a greater extent, probably than in

the kingdom of Belgium. This has been mainly due to the density of the population, to the topography, which is favorable to railroad construction, and to the general prosperity of the inhabitants, which has been such as to support a large mileage per capita. The light railway system of Belgium is largely in the hands of the Société Nationale des Chemins de fer Vicinaux, which is under direct control of the Government and whose directors are nominated by the national legislature. The total number of lines owned and in operation by this company Jan. 1, 1897, was sixty-six, having a total length of 1343.53 km. (833 miles). At the same date the number of lines actually under construction was eleven, having a total length of 284 km. (176 miles.) Since Jan. 1, 1897, the company has been to construct eighty-seven other lines with a total length of 1452.8 km. (900 miles.) In addition there are seven light railways with a total length of 69.2 km. (43 miles) owned by outside corporations. The accompanying map shows the lines owned and projected by the Société Nationale des Chemins de fer Vicinaux and also those owned by other companies. The lines described, it will be understood, do not include the regular trunk steam lines which are also shown on the map.

The rolling stock to operate this vast system includes 280 locomotives, 722 cars, 2117 freight cars. Of the 280 locomotives, 214 are of a weight, ready for service, of 18½ tonnes (42,900 lbs.) or less.

Of the employment of electricity on the line between

granted additional rights for 53.2 km. (33 miles.) The lines had the following gages:

Gage of 1 meter (39 ins.)	67,	covering	1359.26 km.	(843 miles.)
Gage of 1.067 meters (42 ins.)	10,	"	295.03 "	(183 ")
Gage of 1.435 " (56½ ")	4,	"	26.04 "	(16 ")

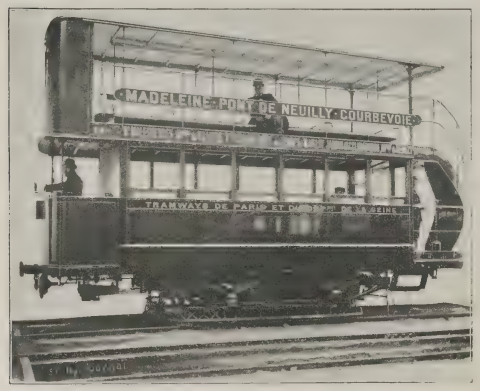
Of the sixty-six lines in operation, sixty-four, with a length of 1327.26 km. (823 miles), were operated by steam, one line of the length of 5.06 km. (3 miles) by horses, and one line, that between Brussels and Petite-Espinette, by electricity. The same power is being applied to two other lines, as will be described later.

As the total population of Belgium at the close of 1895 was 6,410,783, and as the area is 2,945,591 hectares (11,390 sq. miles) the number of lines of light railways in operation or under contract (1627.53 km. or 1009 miles) is an average of 2.54 km. (1.57 miles) per 10,000 inhabitants, and 5.53 km. per 10,000 hectares (88.6 miles per 1000 sq. miles.) In addition to the lines already mentioned, the company has already been awarded permission Brussels and Petite-Espinette, the directors of the company in their report issued this year state that the traffic has increased rapidly. The line has a total length of 9.72 km. (6 miles), of which over one-half is double track. An average of 1075 km. (666.5 miles) is run per day with eight trains in service. The number of train kilometers run during 1896 was 377,571,456 (394,000,000 train miles), and during the last year one new boiler, one 150 k. w. generator, a switchboard, feed pumps and condenser were added, together with several new cars. The total rolling stock on Dec. 31, 1896, included twenty-four motor cars and twenty-two trail cars.

The two new lines upon which electric cars will soon be in operation are the Lignes du Centre and the Charleroi lines. The contract for the first has been awarded to the Union Elektricitäts Gesellschaft. The system will be 19.95 km. (12.4 miles) in length and will be equipped with seventeen motor cars. The contract for the Charleroi lines has been awarded to the Société Anonyme Électricité

et Hydraulique, of Charleroi, and will have a length of 22.95 km. (14.2 miles), and will be equipped with twenty-two motor cars and twenty-two trail cars.

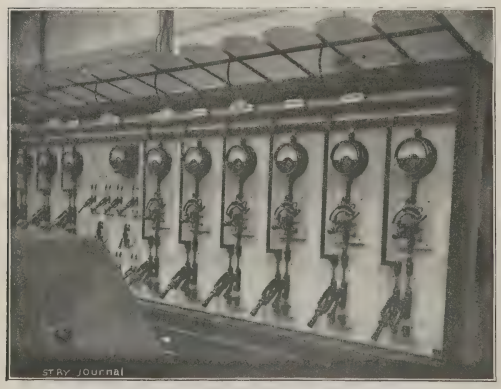
The outlook for electric traction on the light railways in Belgium is very bright, and it is safe to say that electric equipment will shortly be extended to a number of those now in operation by steam power.



ACCUMULATOR MOTOR CAR—PARIS.

PARIS.

The general condition of the tramways in Paris was described in the STREET RAILWAY JOURNAL for January, 1897, by M. Lavalard, manager of the Compagnie Générale des Omnibus de Paris. Since the issue of that number, the report of this company for the year 1896 has been published. It shows interesting statistics. The maximum number of horse cars in service in 1896 was 345. The average trip per car per day was 101.671 km. (63 miles). The average number of horses per car, including those disabled, was 14.49. The tramway cars carried 95,355,591 passengers during the year, or 260,534 per day. Of the total number, 52,757,153 were carried on the main platform, and 42,598,438 on the upper deck. The number of transfers given was 15,850,654. The average receipts per passenger were 17.4 centimes (3.48 cents), and per car km., 1.34 fr. (43.2 cents per car mile).



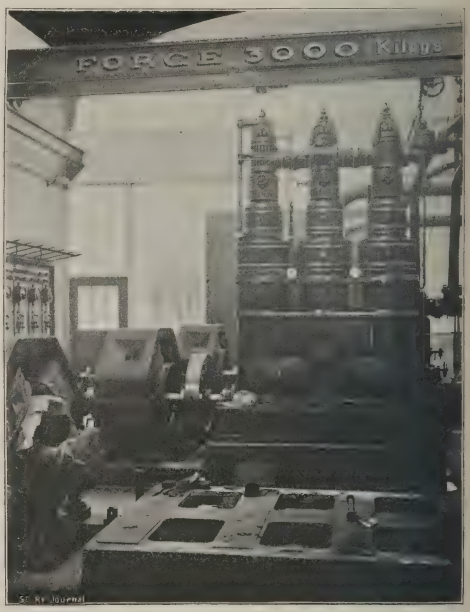
SWITCHBOARD AT PUTEAUX STATION—PARIS.

During the same time, the omnibuses of the company carried 135,379,665 passengers, with average receipts per passenger of 18.76 centimes (3.75 cents),

The steam motors of the company, during the same time, carried 15,305,635 passengers, and ran 1,551,296,574 train km. (961,803,876 miles). The average receipts per passenger were 15.97 centimes (3.19 cents). The total receipts of the company during the year amounted to 122,721,641 fr. ($24,544,328). The dividend declared last year was 55 fr. per share.

ACCUMULATOR TRACTION IN PARIS.

The tramway company of Paris and of the Department of the Seine recently put into operation a new system of accumulator cars on the lines of the La Madeleine-Courbevoie, Lavallois & Neuilly, which heretofore had been operated by animal power. The Hagen type of accumulator, built by the Tudor Company and similar to those employed in Dresden and Hanover, Germany, is used. A special feature of these accumulators is the short time in which they can be charged. In practice the car is charged at certain points along the line to which feeders from the power station are brought. The time of charging is said to be only twelve to fifteen minutes. The battery of the accumulator carried on each car consists of 200 elements located under the seats. They are, of course, stored without removing them from the car, the acidulous evaporations being removed by two small electrically operated ventilators. Each cell contains 15 kg. (33 lbs.) of plates, making the total weight of the battery 1600 kg. (3520 lbs.).



ENGINES AND GENERATORS—PARIS.

Each car is equipped with two motors of 25 h. p. each, and the speed is limited by municipal requirements to 16 km. (9.9 miles) per hour on suburban sections and 12 km. (7.44 miles) per hour in Paris, but on experimental trips considerably greater speeds have been made. The weight of a car with battery complete is 14 tonnes (30,800 lbs). Each motor car can draw a trail car of the same weight.

The power station is located at Puteaux, and adjoining it is the car house which has a capacity of fifty cars, a small workshop for repairs to electrical apparatus, and an office building. The power station is divided into two

sections, one for the engines and another for the boilers. The engine room contains three units of 120 k. w. each, consisting of a Willans triple expansion, condensing engine directly connected to a four pole Brown generator of 460 r. p. m., and 600 volts. The loss in the feeders is about 60 volts, making the potential at the distributing poles 540 volts. The boiler room contains three Babcock & Wilcox boilers. An economizer and feedwater heater is also used, the water from the Seine being employed for feed.

POWER STATION AT PUTEAUX—PARIS.

ODESSA.

Odessa is the principal seaport on the Black Sea, and is located on a fine bay on the northwest shore of that body of water, about 400 miles north of Constantinople. Being the terminus of an extensive railway system connecting it with the principal cities of Russia, it has a large trade, and is as well the site of a number of manufactories, the chief products being soap and candles, tallow, cordage, etc. The city was founded by Catharine II, in 1792, and in 1890 had a population of 313,687. The tramway system is owned by Les Tramways d'Odessa (Société Anonyme) a corporation having its headquarters at Brussels. The length of line in operation is about 64 km. (40 miles) or, measured as single track, the company has 89 km. (55 miles). Of this system, about 70 per cent is operated by horse power and 30 per cent by steam power.

The rolling stock of the company includes 84 closed cars, 144 open horse cars, 9 locomotives, 8 closed steam cars, and 45 combination open steam cars. The number of horses owned by the company, Dec. 31, 1896, was 733. The receipts of the line, which has been in operation since 1880, shows a regular increase, and in 1896 was 2,063,000 fr. ($412,600). The annual report of the company, issued Mar. 25, 1897, shows the following interesting statistics :

Horse lines:

Average receipts per car km. .662 fr. (21.3 cents per car mile).
Average number of cars in service per day 70.6.
Car kilometers, total, 2,650,000 (1,643,000 car miles).
Average kilometers per car per day 102.6 (63.6 car miles).
Total number of passengers transported, 12,835,000.
Cost of feeding and bedding per horse per day 1.18 fr. (23.6 cents.)
Average travel per horse per day 21.2 km. (13.1 miles).

Steam lines:

Average receipts per train km. 2.664 fr. (85.9 cents per train mile).
Total train km. 157,448 (97,618 train miles).
Average km. per train per day 125.2 (77.6 miles).
Total number of passengers transported 1,430,000.
Cost of coal and oil per train km. .182 fr. (5.8 cents per train mile).
Kilograms of coal per train km. 5.432 (19.2 lbs. per car mile).

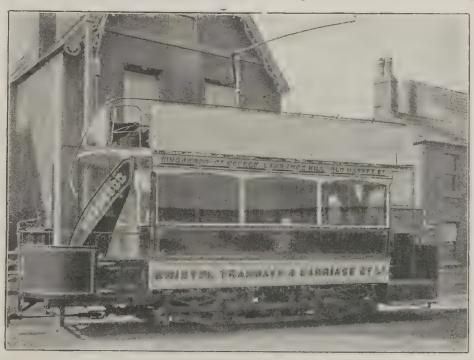
The officers of the company are: president, F. Baeyens; secretary, Paul Hammelrath; managers, V. Meer, H. Peemans, Ch. Pécher and A. Focquet.

BRISTOL, ENGLAND.

Bristol will always possess the distinction of being the first city in England in which direct coupled units were exclusively used for generating electric railway current. Although there are a few isolated direct coupled railway units in England, one of them being in the station of the City & South London Railway, there is no station which is entirely direct coupled except that at Bristol. The system is also noteworthy from the fact that it was the first to be installed under the existing rules and regulations of the Board of Trade. There were, up to the date of opening of the Bristol line, October, 1895, but two electric railways running in England, running through the streets of towns by overhead conductors—those in Leeds and in South Staffordshire. Both of these were undertaken before the adoption of the regulations of the Board of Trade by which a joint committee of Parliament has been granted important powers over electric lines with right to enforce rigorous rules relating to their equipment and operation.

Bristol is a prominent seaport of England and is located 118 miles by rail west of London. It is the seat of large and varied manufactures and is the fourth town of Great Britain in the amount of custom duties received. Its population in 1891 was 222,000.

Overhead Construction.—The trolley wires are supported entirely by the bracket poles, partly in the center and partly at the side of the street. These are exceedingly tasteful in construction and were supplied by Morris, Tasker & Company. They are spaced about 90 ft. apart and every other center pole on Old Market Street, a prominent thoroughfare, is utilized to carry arc lights for the street illumination. The trolley wires are carried over the side of the track instead of directly between the rails,



MOTOR CAR—BRISTOL.

according to the method employed on the South Staffordshire lines, described in the April issue of the STREET RAILWAY JOURNAL. Paper insulated feeders are used and are carried underground. Side by side with the feeders is laid a three stranded conductor. One strand is used for making the leakage tests required by the regulations of the Board of Trade under which the line leakage must not exceed .01 amp. per mile of track. The other two conductors are used as a telephone circuit. Telephone instru-

ments are located along the line from which the power station can be notified of any accident which would require the call of an emergency crew.

Roadbed.—The track is laid with 76 lb., 6 in. grooved rails laid on a bed of concrete 6 ins. thick, extending the full width of the roadbed. No ties are used, but the track is kept together by tie rods located every 7½ ft. The channel plate bolts are ¾ in. diameter, but are not fitted with nuts; the channel plates on one side are tapped and the bolts are screwed into them. Each joint is connected by two 30 in. Chicago bonds. The line is 10 miles in length and has a number of steep grades, the maximum being about 7 per cent.

Power Station.—The power station is on the Beacon Fields road and the general arrangement of it is shown in the plan (Fig. 14). The contractors for the engines, boilers, generators and electrical apparatus and machinery, as well as for the rolling stock and overhead equipment, were the British Thomson-Houston Company. The boilers are four in number, of the Lancashire type, made of Siemens-Martin steel and built by Adamson & Company. The inside diameter is 7 ft., 6 ins.; the length of three is 30 ft. and of one 28 ft. The boilers are fitted with Green economizers, and Vickars mechanical stokers. The same electric motor which drives the coal condenser and stokers also serves for the scraper of the economizer.

Two feed pumps, each operated by a separate electric motor, and capable of delivering 16,000 lbs. of water per hour, against a boiler pressure of 160 lbs. to the square inch, are used. The steam mains are 7 ins. in diameter; the pipes to the boilers are 6 ins., and to the engines 4 ins. in diameter. The ordinary working boiler pressure is 140 lbs. As will be noticed from the plan on this page, one of the features of the station is the entire absence of any engines but the main engines, all auxiliary work being done by means of electric motors.

The engines are of the McIntosh & Seymour horizontal, tandem compound type, with cylinder dimensions 13 ins. and 23 ins. × 17 ins. stroke, and are directly connected to M. P. 6 150-200 General Electric railway generators. This engine equipment has recently been installed, and replaces the rope driving vertical engines originally used by the company.

Besides the four main generators, there is a motor generator, which supplies current for lighting the station and also for storing a battery of accumulators. The latter are of the chloride type, and consist of fifty-five cells. The The motor generator is capable of generating on its secondary terminals an output of 230 amps. at 135 volts, and during the night hours, when the main current is off, it can be driven by the accumulators to produce a 500 volt circuit, by which the auxiliary electrical motors in the station are driven, if desired.

The company has also a well equipped repair shop and work shop, the motive power of which is supplied by an electric motor taking current from the railway circuit.

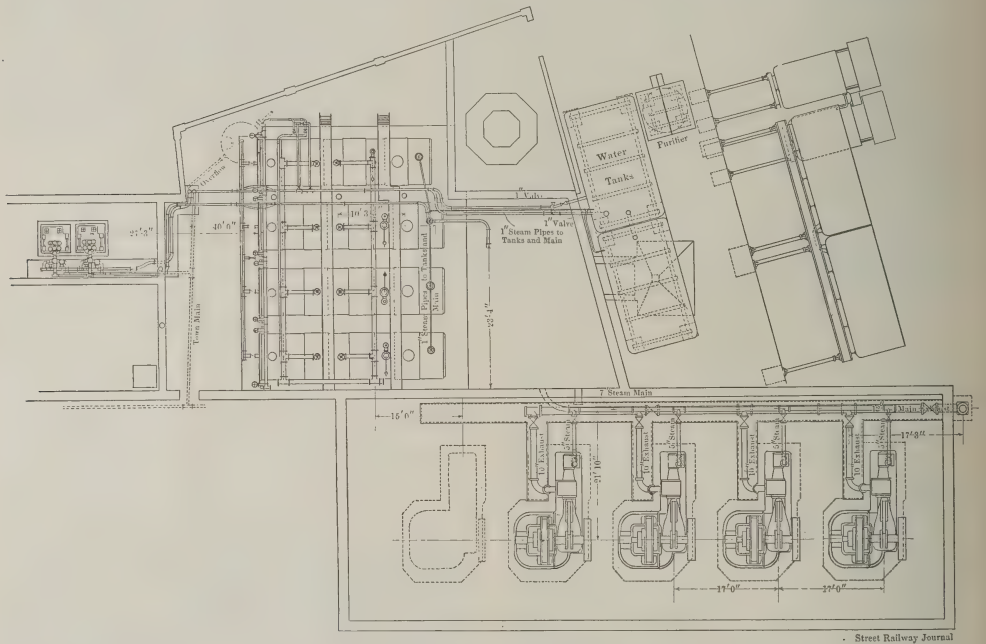


FIG. 14.—PLAN OF POWER STATION—BRISTOL.

Rolling Stock.—The company has eighteen motor cars, double decked and of English manufacture; twelve of these have a body length of 12 ft. 9 ins., length over platforms of 24 ft. and have a seating capacity of 44 passengers. The other six cars, which are the latest purchased, accommodate 24 passengers inside and 29 outside. They have a body length of 16 ft. 8 ins. and a length over platforms of 27 ft. 2 ins. The question of trucks was very carefully considered owing to the heavy weight carried and the high center of gravity of the load entailed by the use of the double deck. The Peckham Standard cantilever extension truck was finally selected, being considered best fitted to reduce oscillation under these conditions. The trucks are equipped with G. E. motors and controllers.

There are two separate systems of lighting the cars, which are employed simultaneously. One is from the main circuit, while in the other current is taken from a battery of accumulators carried on the cars. In the railway circuit there are five lamps, all 16 c. p.; one is on a standard on the roof and four are within the car. The accumulators supply current for one lamp on the roof, the col-

ored bullseye lamp at either end of the car and the head lamp over the motorman. The first three of these are 16 c. p. and the head lamp is 32 c. p. The batteries are of the chloride type, and there is space for five cells at either end of the car. They are pushed in from outside when the car is in the car house, and the connections are made by means of an automatic spring at the back of the battery tray.

VIEW SHOWING WIRING AT SWITCHES AND SIDE TROLLEY POLES—BRISTOL.

Financial Results.—The success of the line since its opening has been great, as is shown by the fact that the company has increased its rolling stock 50 per cent since the opening, October, 1895. The engineer in chief in the equipment of this line was R. W. Blackwell, and the work was carried on under the immediate supervision of Phillip Dawson. The engineer for the Bristol Tramway & Traffic Company was Joseph Kincaid, while the manager of the tramway company, J. Clifton Robinson, is well known on both sides of the Atlantic.

The Street Railway System of Buenos Ayres.

Buenos Ayres, the largest and most important city in South America, is the capital of the Argentine Republic, and is situated about 150 miles from the sea on the west bank of the La Plata estuary, here 30 miles wide. It stands upon a plain, is regularly laid out, and contains a large number of very fine buildings. The population of the city in 1890 was about 400,000.

The thickly populated portion of the city is literally covered with tramway lines, and there are very few streets indeed through which cars do not run. Most of the streets are very narrow, from 20 ft. to 22 ft. from curb to curb, and as a consequence, only one track is permitted by the municipality in each street. A few exceptions to this rule exist; one or two streets containing two and even three tracks. The entire system has until recently been operated by horses, which are very cheap in the Argentine, as compared with the United States or Europe. All tracks in narrow streets are laid close to the curb on the left hand side, and not on the right. Vehicles, cars and people pass each other on the left. The track is all standard gage —4 ft. 8½ ins. The rail is nearly all 6 ins. to 7 ins. in height, and of the grooved girder pattern. No ties whatever have been used in the old construction. The track is held in place simply by the tie rods and the pavement. Sometimes the rails rest on a concrete base, but more often on common earth or mud.

The horse cars are mostly of local make, although many Stephenson cars are to be seen. On approaching a crossing, the driver blows a warning by means of a horn, and many fantastic and weird sounds are the result of the efforts of some of the drivers, each having his own peculiar style. Bells are also used on approaching crossings. They are hung on the hood of the car, and are rung by the driver. The almost uniform fare is ten cents paper, which is equal to about three cents gold.

There are at present some eight distinct lines, with about 230 miles of track, and carrying some 85,000,000 people per year. Two of the roads alone carry over 28,000,000 each. English capital is interested in nearly all of the roads, and most of the roads have offices in London. The streets are all paved, and are in fairly good condition. Both wood and stone are used for paving.

Electric railroading is now making rapid strides in Buenos Ayres, and electric lines are now being constructed or operated in two different portions of the city. One of these, the first car on which was put in operation April 22, extends from the Plaza de Mayo, in the center of the city, to Belgrano, a pretty suburban town, 6 miles away. It was built by Charles Bright, of Buenos Ayres, who was the pioneer in electric lighting, and, in fact, in most of the improvements in the electrical line which the city now contains. This first line passes through some of the finest streets, through the beautiful Recoleta and Palermo, the city's pleasure grounds, by the National Hippodrome or race course, and along a beautiful wide *avenida* to Belgrano. There will be two or three branches also to this route, making in all some 20 miles of line. The most modern apparatus will be used throughout, and no pains or money spared necessary to make it in every sense "fin-de-siècle."

VIEW DURING FIRST OFFICIAL TEST OF ELECTRIC LINE AT BUENOS AYRES.

The second line is that of La Capital Tramways Company, a corporation with headquarters in London and New York. This company is engaged upon the construction of some 20 miles of track and its plans were given in the May issue of the STREET RAILWAY JOURNAL.

The Electric Tramway Company, the line first referred to, and a short section of whose line was put in operation Apr. 22, was installed under the direction of F. A. Wardlaw, a well known American electrical engineer, who has had charge of a number of prominent installations in the United States for the General Electric Company. The opening was made the occasion for a public celebration upon the completion of the first electric line in the city. Over 1500 invitations were issued for the opening which took place at nine o'clock in the evening. In front of the car house an immense arch of colored incandescent lamps was erected, while in the car house and on the street, ten Thomson '93 arc lamps, burning from the 500 volt circuit, were arranged to give the best effect and thoroughly illuminate the works and street. Just within the car house gate on the main line stood two cars, one blaze of light from roof to track. Eighty-five 16 c. p. lamps were used on each car, all of varying colors and so distributed as to leave no portion of the cars in darkness. In the interior of each car the pretty chandeliers were all equipped with shades of delicate and beautiful design containing the national colors, blue and white. The car house exterior and the pole line had also been attended to and looked remarkably tasteful.

TEMPORARY POWER STATION AND CAR HOUSE—BUENOS AYRES.

The official trial had taken place the afternoon of the day previous for the benefit of the municipal inspectors, and this was to be the formal opening of the road to the public. To the right of the cars, facing the street, was gathered the police band of forty pieces, one of the best in Buenos Ayres. They played exceedingly well and added additional life and vigor to the already animated scene. Every thing was in readiness when at nine o'clock to the minute, the time designated in the letters of invitation, the word to start was given. When the platform gong was sounded as a signal the controller handle was moved to the "first notch," and the car with its double load of passengers responded to the demand. Once on the main line, the controller was moved around until maximum speed was obtained, and the car sped over the kilometer of track at a 23 mile rate to the delight of all. When the Palermo Gates were reached the car was met by another appreciative audience, who made the air ring with cheers and hand clappings. The return trip was made without a hitch, as in fact was every trip during the evening. At eleven o'clock, the greater portion of the guests having departed, thoroughly well satisfied with their evening's entertainment, the cars were run into the car house.

Roadbed.—The line now built consists of a double track some 900 meters (½ mile) in length, 4 ft. 8½ ins. gage, and is laid partly with 7 ins. grooved girder, and partly with 55 lb. T rail. The T rail is only provisional and will be replaced by girder rail when the proper time arrives. This rail is only used on that portion of the route that has been filled in and is laid according to the usual steam railroad construction with ties exposed. The girder rail is employed on that portion of the street which is paved. The ties are of a native wood called *Quebracho*, which is as hard as iron, and will last a lifetime. They have been in use on Argentine railroads for thirty years or more and have shown no signs of depreciation. They are laid ten to the rail and double spiked.

The roadbed proper consists of 10 cm. (4 ins.) of concrete laid on the subgrade; on this concrete the ties are placed and floated under with good Portland cement. The space between the ties is then filled with concrete, and on this the sand and paving stones of granite are placed. The rails are tied every 6 ft. with strong steel tie bars. No other material being obtainable in time, the bonding was done with No. 0 tinned wire, and channel pins. Two wires were used to a joint on the T rail, and three to the girder rail. Cross bonds are used between rails every six rail lengths, and between tracks every twelve. No supplementary or ground return is used, it being deemed unnecessary for this short piece.

Overhead Construction.—The overhead construction is of the center pole type. Ornamental poles, made by Morris, Tasker & Company, are used. As the tracks are laid 11 ft. centers the employment of center poles is perfectly safe. The wire is No. 0 hard drawn copper and the insulating material is General Electric throughout. In the center of the line five spans of side pole construction have been erected simply to illustrate this manner of building a line. A good idea of the appearance of the center pole construction is given on page 395.

Power Station.—The power station and car house are combined in one building and are of a temporary character. The building is of wood, 20 meters × 17 meters × 8.7 meters in height, and has an extension of 4 meters on the side for the engine and dynamo. The building is covered entirely with corrugated iron galvanized.

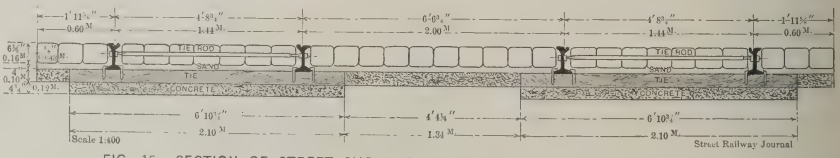


FIG. 15.—SECTION OF STREET SHOWING TRACK CONSTRUCTION—BUENOS AYRES

The engine is of the semi-portable type, compound, non-condensing, manufactured by Smith & Company, of Magdeburg, Germany. The boiler is a horizontal shell with removable furnace and fire tubes, and the engine is mounted on top of this shell. The engine cylinders are 11¼ ins. and 16⅝ ins. × 18 ins. and at 125 r. p. m. will indicate about 65 h. p. Belting is used to transmit the power to the generators. English coal is employed for fuel, and feedwater is taken from a well on the premises dug for the purpose. The generator is of the four pole, 40 k. w., slow speed type manufactured by the General Electric Company. The panel switchboard is of the "I" type and contains all the latest improvements.

Rolling Stock.—The cars were supplied by Stephenson and are 28 ft. over all and 6 ft. 10 ins. in width. They are open with reversible seats. The trucks are of the Standard extension cantilever type, made by the Peckham Motor Truck & Wheel Company, and are fitted with 30 in. wheels. The motors are G. E. 800, two on each car, nose suspension, and are fitted with electric brake attachments.

The controllers are of the "B A" General Electric type with controlling cylinder for electric brakes. These electric brakes are an important feature of the equipment and work admirably. They bring the car to a quick and easy stop, save the wear and tear on the wheels, and entirely dispense with the jolt incident to the use of hand brakes.

The Street Railway System of Dunedin, New Zealand.

As much interest is being taken in improved motive powers for tramway work in the various islands of the Australasian group as in Europe. New Zealand is one of the most prosperous of the British colonies in that group, and is well known for its valuable and extensive mineral products, principally coal and gold. The islands also contain large areas of forest land. The New Zealand group consists of one small and two large islands, besides others of lesser note. Of the cities on these islands the largest is Dunedin, the capital of the province of Otago, and at the head of a fine bay on the east side of Middle Island. It was founded in 1848, has a number of handsome buildings, university, etc., and had in 1891, with its suburbs, a population of 45,865. The city contains three tramway systems, the Dunedin City & Suburban Tramways, the Mornington Tramways and the Roslyn Tramways. The latter two are equipped with cable power, and the first, the most extensive, employs horses.

The Dunedin City & Suburban Tramway Company, has a length of 3 miles double track and 7 miles single track, and is laid with a 3 ft. 6 in. gage. About one-half the line is laid with 42½ lb. grooved rails, laid on stringers 6 ins. × 3 ins., which in turn rest on ties 6 ins. × 4 ins. × 6 ft. The remainder of the track is laid with T rails weighing from 30 lbs. to 40 lbs. per yard, placed directly on ties. As will be seen from the accompanying views, the city is located on a number of hills. The steepest grade on the line is 6 per cent.

The company has thirty-eight cars, supplied by the John Stephenson Company, J. G. Brill Company, and J. M. Jones' Sons. The largest cars have a body length of 16 ft., are double decked, and weigh 4800 lbs. The company owns about 285 horses. During 1896 415,780 car miles were run, and 2,890,621 passengers were carried. During the present year the traffic will be, it is expected, be considerably larger.

GENERAL VIEW OF DUNEDIN.

The question of motive power is being carefully considered by the company. During the latter part of last year and the early part of this year a project was being considered by a syndicate, of purchasing the entire system and equipping it with electric power. A proposition was made to the municipal authorities by Max Epstein, who represented the syndicate, to undertake this, provided the concession of the line should be extended from twenty-one years to forty-two years. As the City Council did not seem disposed to make the grant the project has been temporarily abandoned, and a plan to equip the lines with gas motors is now being considered, as less capital will be required for such a change.

The chairman of directors of the Dunedin City & Suburban Tramway Company is Geo. Fenwick, and the general manager, D. R. Eunson.

The Mornington Tramways Company owns a separate line extending into the suburbs to Mornington, Glen and Mary Hill. The line was equipped with cable power owing to the steep ascents on the line, the grades on the main line reaching as high as 16.6 per cent. The gage is 3 ft. 6 ins. On the extension line of the company to Mary Hill the grades run as high as 28.5 per cent.

CAR HOUSE AND CAR DECORATED FOR OPENING OF LINE—BUENOS AYRES.

The records of the cables on the extension line are as follows:

No.	Manufac'urer.	Installed.	Taken Out.
1.	Geo. Cradock & Co.	Mar. 10, 1885.	Nov. 28, 1887.
2.	Geo. Cradock & Co.	Nov. 28, 1887.	Feb. 8, 1894.
3.	T. &. W. Smith.	Feb. 8, 1894.	

1—Cable ar on 28½ per cent grade.
2—Mornington cable extension.
3—Grip cars and trail car, Mornington lin·.
4—Cargill monument and cars of City & Suburban Tramway Company.

VIEWS IN AND AROUND DUNEDIN—NEW ZEALAND.

The records of the cables installed on the main line are as follows:

No.	Manufacturer.	Installed.	Taken Out.
1.	Bullevant & Co.	Mar. 21, 1883.	Aug. 7, 1884.
2.	F. V. Scott	Aug. 7, 1884.	July 15, 1886.
3.	Geo. Cradock & Co.	July 15, 1886.	Dec. 8, 1889.
4.	Geo. Cradock & Co.	Dec. 8, 1889.	July 13, 1893.
5.	T. & W. Smith	July 13, 1893.	

On the main line the ordinary carrying pulleys, of which there are 273, are 9 ins. in diameter; the depression pulleys are 5 ins. in diameter; the crown pulleys and curve pulleys are 32 ins. and 40 ins. in diameter. The company has also two right angle curve pulleys, 7 ft. in diameter, with vertical axes; and one 10 ft. terminal pulley mounted on a self adjusting bogie, to which a tension gear with heavy weight is attached. This terminal pulley is located underground. The diameters of the pulleys and the general arrangement of the cable system on the extension line are similar to those on the main line. The cable in each is 3 ins. in circumference.

The power station is equipped with three high pressure horizontal engines, with cylinders 13 ins. × 27 ins. stroke, two being employed to drive the main line cable and one the extension line cable. Each is fitted with an automatic extension gear capable of allowing the engines to work up to a maximum of 71 h. p. The boilers are two in number, of the multitubular cylindrical type, and operate under a working pressure of 76 lbs. The water supply for the steam boiler is forced by a pump worked by a rope from two of the crown pulleys.

The electric railway system of Hobart, Tasmania, was described in the STREET RAILWAY JOURNAL for August, 1894.

The Street Railway System of New South Wales.

Sydney, the capital of New South Wales, is the oldest city in Australia, and had in 1881, with the suburbs, a population of 220,000. It is handsomely built, many of the public and private buildings being of fine sandstone.

An interesting feature of the tramway system of Sydney and the railway system of New South Wales is that they are owned and operated by the Government. The official report of the chief railroad commissioner, E. M. G. Eddy, under date of Apr. 26, 1897, shows the following interesting statistics.

Statistics of tramways for quarter ending Mar. 31, 1897.

Miles open	62½
Revenue	£78,060
Expenditure	£36,012
Tram miles run	779,129
Earnings per tram mile	2s.
Expenditure per tram mile	1s. 5¼d.
Percentage—Expenditure to earnings	71.75
Number of fares collected	18,459,834

Statistics of railways for quarter ending, Mar. 31, 1897.

Miles open	2,576½
Revenue . . Passenger	£285,903
" Merchandise	£406,115
Expenditure	£376,923
Train miles run	1,954,972
Earnings per train mile	7s. 1d.
Expenditure per train mile	3s. 10¼d.
Percentage—Expenditure to earnings	54 47
Number of passengers	5,614,666

The principal motive power used on the Sydney lines is steam. The standard cars have a length of 35 ft. over all and are run in trains of one, two, three or four cars to the motor. Of the motors about 80 per cent. have 11 in. × 16 in. cylinders, and the remainder have 10 in. × 16 in. cylinders. The motors were in most part supplied by the Baldwin Locomotive Works. The average speed is 9½ miles per hour.

Besides the steam trams Sydney contains one system of cable roads, but up to within recently no extensive application of electric power had been made, although an experimental electric line had been installed as early as November, 1890. At that time a short line 1½ miles in length was built. The Thomson-Houston system was employed and the power station contained one 50 k. w. Thomson-Houston generator and one Armington & Sims 100 h. p. engine. Although the results secured with this equipment were on the whole satisfactory, the financial depression which then existed in Australia and which continued for some time, prevented further equipment of the Government tramways with electric power.

Another short line, the Military Road Electric Tramway, was put into operation, however, a short time ago, and as a result of the operation of this line the Government Commissioners recently decided to install an extensive electric system. The contracts for the necessary apparatus were placed during June: four Allis cross compound condensing engines 26 ins. and 50 ins. × 48 ins. stroke, will be installed in the power station, each directly connected to a General Electric 850 k. w generator. The power station will also contain a standard panel switchboard of the General Electric type. For trucks, the Commissioners have adopted the Peckham standard cantilever, and for motors the G. E. 1000. About 100 cars will be put in operation soon as a result of this decision, a considerable proportion, however, of them being trail cars. Each car will be equipped with a Standard air brake (type Duplex B). About forty-five Standard brakes have been in operation for some time on the cable cars in Sydney and about five on the present electric cars with satisfactory results.

ELECTRIC CAR AT SYDNEY, NEW SOUTH WALES.

The accompanying engraving shows one of the cars on the Mosman's Bay extension of the Military Road Electric Railway, which was opened for traffic, Mar. 1, 1897. These cars show the type adopted by the Government Commissioners for future work.

THE Hartford (Conn.) Street Railway Company, on the occasion of the annual meeting of the Society of Mechanical Engineers in Hartford during May, presented to each attendant at that Convention an attractive little pamphlet descriptive of its system. The pamphlet is illustrated with a number of half-tone engravings and a map showing the system of the company and its connections.

Street and Other Railways in Siam.

By John Barrett.

The only street railway company in Siam is the Bangkok Tramways Company, Ltd., which has been organized several years and is doing a very successful business. It began with horse cars, but now has as good an electrical equipment as most lines in America. When the system was changed from horses to electricity, the contract for dynamos, rolling stock and work of alteration was given to an American firm who sent out a competent engineer to superintend it. From the very first day that the line was operated by electricity it has paid handsome dividends, never less than 8 or 10 per cent and running up one or two years to 15 or 18 per cent, per annum. The stockholders are chiefly Danes, Americans, Siamese and English. The president of the board of directors is an energetic American, Dr. T. H. Hays, while the manager, W. F. Jacobsen, and engineer, A. Hansen, are young Danes who thoroughly understand the work. Mr. Jacobsen is well known in street railway circles of America, because he has made several trips there on business. The company organized with a capital stock of about 300,000 ticals, or about $100,000 (gold), and has made one issue of debentures amounting to 100,000 ticals, or about $33,000 (gold), and may make another of about 100,000 ticals. The proceeds of these debentures are applied to improvements.

The Siamese Government has been favorably disposed to the company from its inception, and the king is a large stockholder under the name of some of his brothers and children. The Siamese people seem to have no prejudice whatever against this or other modern systems of rapid transit and crowd the cars at every trip. The line has been so prosperous that it is running all the cars possible without more trackage. It has a single track with switches about every quarter of a mile. The streets are too narrow for a double track. The road runs right away from the lower end of the city in the heart of the shipping interests to the Royal Palace, a distance of fully 6 miles, through the principal thoroughfare.

It is separated into divisions according to traffic, the fare averaging about four atts (two cents gold) for each division, or about sixteen atts or (eight cents gold) for the whole distance.

There are plans on foot for building branches and feeders on other streets, but these depend upon whether concessions will be granted by the Government. Nearly every possible route is covered by a concession granted or applied for by foreign residents here.

There are two regular steam railways now in operation in Siam, but one of them is being operated over only a part of its track, awaiting a completion of certain portions. The first and shorter of them is the Paknam Railway Company, Limited, running from Bangkok to Paknam, a small city near the mouth of the river Menam, and about 15 miles from Bangkok. It is a narrow gage road, using rather poor locomotives, brought out from England, The rolling stock is very ordinary, but answers the purpose—as do also, I suppose, the locomotives.

This company pays a fair dividend, but nothing like the street railway lines. It carries passengers only, and runs three trains a day each way. It has as managing director Capt. L. de Richelieu (Danish), and as operating and regular manager H. Fix (Danish).

The largest and most extensive railway undertaking in Siam is the Nagara Rajasima Railway, built and owned by the Government and running from Bangkok, a distance of nearly 150 miles, northeast to Korat. The whole distance however, is not covered by track, only about two-thirds being completed. Regular trains are already running from Bangkok to Anythia, the old capital, a distance of 50 miles. This is a broad gage road and should eventually be the connecting link in through lines to China and Burmah. This road has cost the Government over 12,000,000 ticals (approximately $4,000,000 gold). The contract was given to a well known English engineer, named G. Murray Campbell who, however, recently stopped work on account of troubles with the Government which are being settled by arbitration. The Royal Railway Department is conducting the work and hopes to have it done within another year.

This department is manned by a large force of Germans of which the head and director-general is K. Bethge, an able German engineer who had considerable experience in China, before coming here, in superintending Government contracts. It is possible that one of the causes of trouble between the engineer or contractor and the Siamese Government was the inability of himself and the director-general to agree. One of Mr. Campbell's most competent assistants was Lawrence E. Bennett, an American civil engineer, who before he came here had had charge of the construction of important railways in South America. All the rails, materials and original rolling stock were, of course, ordered in England by the British contractor, and the locomotives and carriages are of the English type. Now that a German is at the head of affairs the materials of all kinds naturally are ordered in Germany.

When this contract was originally let some six years ago, no American put in any bid, although the specifications were advertised in America.

Other lines being considered, but not yet started, include the following:

One from Bangkok southwest 100 miles to Petchaluree, through a very level, rich section of country.

One east about 40 miles to Petriew, through a similar kind of country.

One from Paknam southeast 30 miles to Anghin, along the seashore, Anghin being a port outside the bar of the river.

One north from Anythia to Cheng Mai, 400 miles, through level and rolling country.

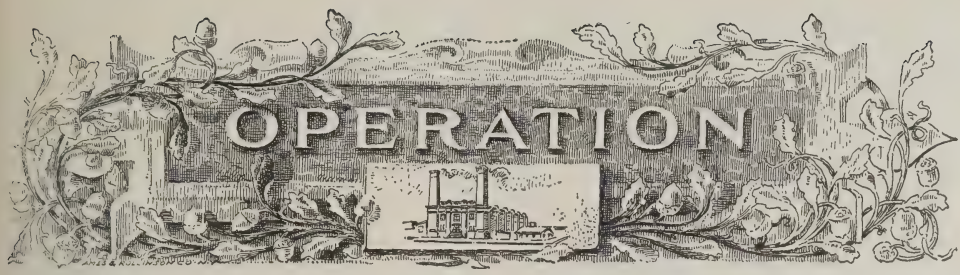
Concessions for all these lines have been applied for, but only one has been so far granted.

The language of business in Siam is English. The Government is not unfavorable to railway enterprises, but still is very slow to grant concessions. The duty upon all foreign imports averages 5 per cent, all according to treaty, but if these are to be used in enterprises where the Government is concerned, they are usually remitted.

The Electric Railways of Milan, Italy.

The Edison Electric Illuminating Company, of Milan, Italy, has increased its capital to £360,000 as a consequence of an arrangement made with the municipality for working the city tramways from the beginning of 1897. The conditions upon which the company has been awarded the contract, as stated by a foreign contemporary, are as follows: the company is to provide the cars and *personnel*, the motive power and its adjuncts at its own expense, the lines being provided and kept in order by the city. The company pays the city a rent of £180 a year for each mile of single line, and receives 3.8d. per car mile for each motor car, and 1.94d. per car mile for each trailer car. After deduction from the receipts of this and the amount for rent of the lines the remainder is to be divided between the company and the municipality in the proportion of 40 per cent to the former and 60 per cent to the latter. It is calculated that this arrangement will bring to the city a net yearly profit of at least £30,000. As yet only one line is being worked by electricity, the traction on the other lines being still by horses, but the new system is to be extended to them as rapidly as possible. There are in Milan 42 miles of single line, and in 1896 the tramway company carried over 35,000,000 passengers.

The Bergen County Traction Company, (Fort Lee, N. J.) has been granted a franchise through Palisade Avenue to the limits of Englewood City. It is thought the company will now try to get the right of way through Tea Neck to Cherry Hill.



The Repair Shops of the Brooklyn Heights Railroad Company.

The extent of the system of the Brooklyn Heights Railroad Company has compelled that company to pay special attention to its repair department, and, as a result, the shops of the company are well worthy of careful study. They are located at the corner of Fifty-second Street and Second Avenue, South Brooklyn, adjoining the Southern power station of the company, and occupy an area 100 ft. × 700 ft. The eastern or front end of the shops has been added within the past year, and is of brick, two stories in height, with high ceilings; here are located on one side the woodworking shops, while on the other side are car tracks leading to the truck repair department. The paint shop occupies all of the second story, except a small area partitioned off for offices, lavatories, etc. In the frame building in the rear, 100 ft. × 350 ft., are the electrical repair shop and blacksmith shop. The general arrangement of the different departments is shown in Figs. 3, 4 and 5. All work is in charge of D. S. Moffatt.

FIG. 1.—MACHINE SHOP.

FIG. 2.—ELECTRICAL REPAIR SHOP.

The course of a car through the shops and the general system of making repairs are as follows: the car is run into the shops at the Second Avenue entrance on tracks which pass under a set of Harrington hoists. The body is here lifted from the truck and is then transferred across to the next track and lowered to a temporary truck. The car body is then placed on an elevator connecting the ground floor with the second story and is taken to the carpentry and paint shop. Here is performed the necessary carpentry work, such as replacing broken panels, steps, dash, etc. After this the old paint is burnt off, when necessary, and the car repainted and varnished. Meanwhile the truck is pushed over the pits where the motors are taken off by means of chain hoists which run in overhead tracks along each of the pits. The motors are opened, armatures and fields taken out and replaced with new ones or repaired, new bearings put in and the motor painted inside and out. The truck is thoroughly overhauled, all large holes are plugged and rebored, new rivets are put in, brake shoes are renewed and the truck is scraped and painted. When necessary the wheels and axles are taken out and renewed. The motors are then replaced, and when the car body has been completed the truck is pushed back to the track underneath the overhead cranes and the body brought downstairs, hoisted from the temporary truck and replaced on its truck again.

Some of the details of the methods employed in each of the departments are given below:

ELECTRICAL DEPARTMENT.

The company owns 2200 cars, plows, sweepers and freight cars and a large variety of motors as follows:

W. P. 50, G. E. 800 with ring armature, G. E. 800 with drum armature, Curtis with ring armature, Curtis with drum armature, Westinghouse No. 3, Westinghouse No. 12 A, G. E. 1000 and Walker. For controllers the company uses the General Electric K and K2, and the Westinghouse No. 28 A. It has also a few rheostats. These are employed only to operate cars which are equipped with a single W. P. 50. A single motor of this type has been found large enough to operate a nine bench, 26 ft. open car, without a trailer.

The company not only rewinds armatures and fields in its repair shops and performs its new car wiring, but also makes nearly all of its commutators, repairs its controllers and does a large amount of other miscellaneous electrical repair work.

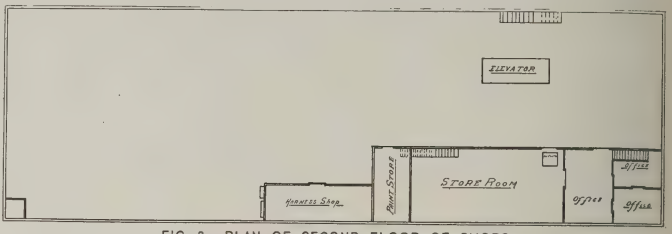
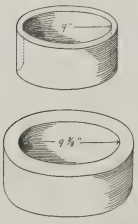


FIG. 3.—PLAN OF SECOND FLOOR OF SHOPS.

For its commutator segments the company uses almost exclusively hard drawn copper, which is bought in bars and sawed up. These commutators, it is thought, will wear longer than any other kind, and the company has some 2000, which it has manufactured, in use on the line. For commutator insulation amber mica is used between segments and micanite cones for end insulation. The thickness of the insulation between the bars is made .040 in. for all commutators except those for the Curtis motor, in which the distance is .038 in. These dimensions have been determined after many experiments, too much insulation having been found to result in rapid commutator wear, while too little is conducive to short circuits. All commutators have been increased in diameter from ⅜ in. to 1 in. In this way much longer life has been obtained from them. The commutator of the W. P. 50 has been increased more than any other, and is now made 1 in. greater in diameter than as originally received. The lug at the end of the segment has also been changed so as to form a solid bar and the leads are put in with screws. In all other commutators the leads are soldered in. In the Westinghouse No. 3 motor and in some of the other styles the form of commutators has also been changed somewhat to adapt them to the use of hard drawn bar. To accommodate the larger commutator in the W. P. 50 motor the wooden bar of the brush holder has been mortised to give a better adjustment to the brush holder, instead of making the adjustment of the brush holder depend upon the location of holes in the wooden bar.



FIGS. 6 AND 7.—RINGS FOR ASSEMBLING COMMUTATORS.

The method of assembling the controller segments is as follows: they are first laid up in a loose ring of steel: this for the G. E. 800 drum commutator is 9⅜ ins. in inside diameter (Fig. 7). A second ring of the same outside diameter, but of 9 ins. inside diameter and with beveled edges, as shown in Fig. 6, is then placed over the upper ends of the commutator bars and forced inside of the loose ring by 20 tons hydraulic pressure. This sets the commutator bars up tight to the proper position. While still held in the ring the ends are turned down to the proper shape. The commutator is then placed in the commutator shell, the ring removed and the commutator is finished up on the outside.

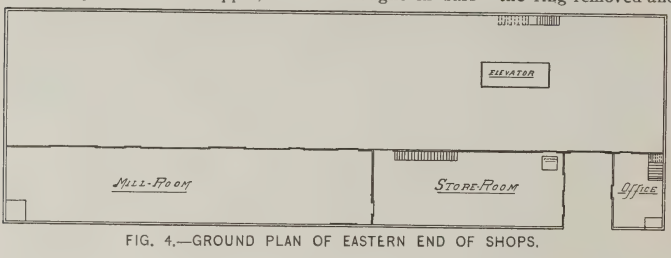


FIG. 4.—GROUND PLAN OF EASTERN END OF SHOPS.

For removing commutators from the armatures, the device shown in Fig. 8 is used. This consists of a screw passing through a bracket in which are several screw bolts. The screws which hold the commutator to the core are then removed and the rods on the brackets are screwed into these holes. When the bracket is thus firmly connected to the commutator the latter is pulled off by means of the screw, which bears against the end of the armature shaft. A small steel block is used to prevent the indentation of the shaft.

The winding of the armature coils and fields is all carried on in an upper gallery surrounding the machine shop. In drum armatures the coils are made up on frames, and the wires are insulated, first, by two cotton coverings next to the wire, next by two oiled linen wrappings, and next by two cotton coverings over the outside. In ring armatures the troughs on the outside and inside of the ring are composed of four layers of red fibre paper and four layers of mica laid alternately. The ends of the armatures are insulated, first by a layer of asbestos, then by four layers of paper and four layers of mica also alternated. For an insulating paint the company is using air drying japan. While the coils are being taped they are for convenience held in a frame shown in Fig. 10. This consists of wooden arms bolted to the bench and containing at their ends copper clips for holding the coil. The number of rewound armatures turned out during the week averages about seventeen.

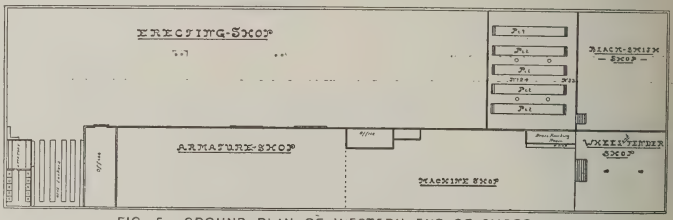


FIG. 5.—GROUND PLAN OF WESTERN END OF SHOPS.

For straightening those armature shafts which are not very much bent, the device shown in Fig. 9 is used. This is a frame in which the armature is placed, after the point at which the shaft has been bent has been determined, in the usual way by placing the armature in a lathe. A jack is then placed between the upper bar of the frame and the high part of the shaft, and pressure is applied until the shaft has been bent straight.

Hot pressed steel pinions, manufactured by the United States Projectile Company, are used exclusively. Nuttall steel gears are used exclusively and have been found to last about three years.

For transporting the motor parts from one part of the

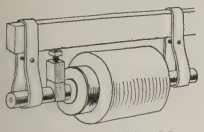


FIG 9.—FRAME FOR STRAIGHTENING SHAFTS.

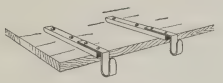


FIG. 10.—CLIPS FOR HOLDING COILS.

shops to another an overhead track with traveling hoist is used. This has a capacity of 3000 lbs. All completed work is transported to a platform which adjoins a track running the full length of the building. It is then transferred to an electric freight car which is run into the shops to receive the completed work and to deliver the parts to be repaired. The company has for this work three freight cars similar to that shown in Fig. 11. They are strongly built box cars with jib crane for hoisting in and out the heavy parts. Two are used to make daily trips between the repair shops and the different car depots. They start

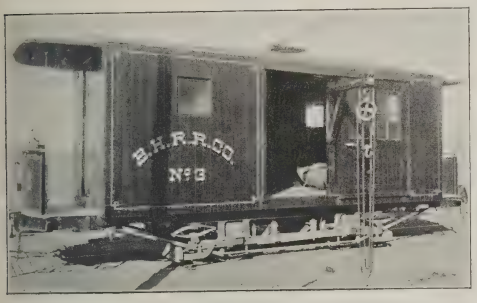


FIG. 11.—REPAIR FREIGHT CAR.

about nine o'clock in the morning and return about three o'clock in the afternoon, in time to be loaded for the next day. The third freight car is kept as an extra.

As stated, the company wires all of its new cars. A slight change, for simplicity, has been made in the wiring. Instead of carrying two cables under the car, one on each side, all the wires are placed in one cable. This is enclosed in a 2½ in. cotton hose and is held to the bottom of the car by cleats.

MACHINE SHOP.

The equipment of the machine shop includes the following:

14 lathes,
5 large drill presses,
3 bolt cutters,
2 shapers,
2 milling machines,
2 small sensitive drills,
1 boring machine,
1 universal milling machine,
1 large planer,
1 automatic grinding machine,
1 power press,
1 cutter grinder,
1 fender bending machine,
1 axle straightener machine.

The fender making department occupies the western end of the shops and all the work of making fenders is performed here. The company uses the Crawford type of fender, in which there is a pipe frame stranded with rope. The pipes for the frame, which are 1¼ ins. in diameter, are first heated red hot before bending. This is accomplished by placing them in a long furnace lined with fire brick and filled with short pieces of electric light carbons, about 1 in. in length. The fire brick is insulated from the iron shell of the box by layers of asbestos and mica. For convenience in heating, the furnace is divided electrically into four sections, of about 5 ft. in length. At the end of each section is a flat iron plate which is made one pole of the electric circuit. One hundred amperes are then sent through the box, 25 amps. for each section, the railway voltage being used. The current jumps from one piece of carbon to another, producing a very hot bed on which the fender pipe can be quickly brought to a white heat. The circuits are controlled by circuit breakers, and in each circuit are switches which can be opened and closed. This regulates the temperature so that all parts of the pipe can be heated equally.

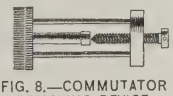


FIG. 8.—COMMUTATOR REMOVING DEVICE.

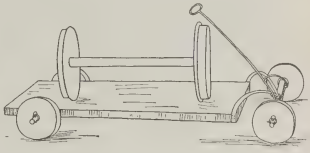


FIG. 13.—WHEEL TRUCK.

FIG. 12.—ELECTRIC FURNACE.

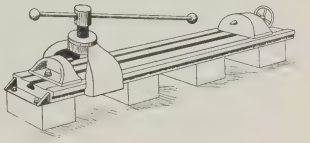


FIG. 14.—AXLE STRAIGHTENING MACHINE.

After the pipe has been heated red hot it is placed on the bending machine shown in Fig. 15. The middle of the pipe is then clamped to the back frame of the bending machine. Rollers are then placed over the projecting ends. These rollers are connected by chains to a countershaft driven by the power from the main shaft of the shop. When the countershaft is revolved the rollers are drawn by the chains over and around the frame of the machine, bending the fender rod into shape. Eighty fenders can be bent in a day. The top rod of the fender is then riveted on in the blacksmith's shop. The frames are then taken into the rope department where the ropes are strung in place. Manilla rope $\frac{5}{16}$ in. in diameter is used. To protect it from the weather the rope is boiled in a vat of P. & B. paint and then allowed to dry before being put on the frame.

Another heater, similar to that used in heating the fender pipe, is employed for the soldering pots and for soldering the brasses together. This is shown in Fig. 12.

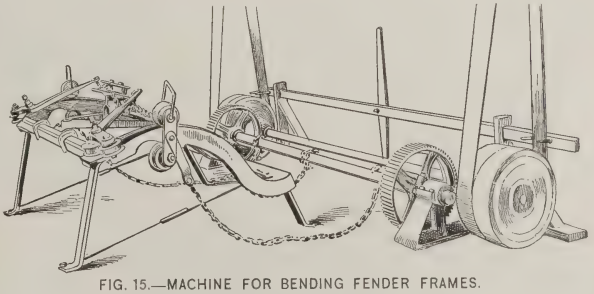


FIG. 15.—MACHINE FOR BENDING FENDER FRAMES.

In babbitting the bearings the attempt is made to cast the babbitt so as not to require any machining afterwards. The channels are cut by hand, however, after the work is done.

Close to the fender bending machine is the wheel department. The wheels are received at the side door of the shop from the company's freight car, and are unloaded on to the truck, shown in Fig. 13. The old wheels

are then hauled to the hydraulic wheel press, which is of 100 tons capacity, and are pressed off the axles. The new wheels are received roughly bored, and are then bored out and trued up by an outside borer. Thatcher wheels are employed, and seven pairs can be bored and the same number can be pressed off and pressed on in a day.

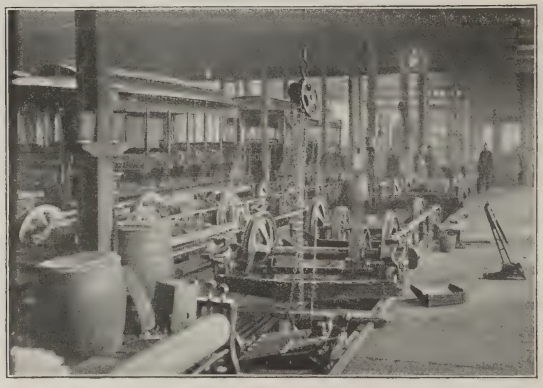


FIG. 16.—TRUCK DEPARTMENT.

The device for straightening bent axles is shown in Fig. 14. The high part of the axle is first located on a lathe. The axle is then centered on the machine shown, and two blocks are placed under it on each side of the high point. Pressure is then applied by means of the screw until the axle has been straightened.

All tools are kept in a special tool room and every machinist who wishes a tool must deliver a brass check to the man in charge of the tool room as a receipt for it. This check bears his number and is placed over a nail on the box in which the tool is kept.

Patterns for all parts of motors, generators and engines employed on the system are kept in a room over the machine shop. The possession of these patterns obviates the necessity of delay in the case of a broken part, as a part can be cast in Brooklyn from the pattern, sent to the machine shop and finished up in time for installation much more quickly than a duplicate can usually be obtained from the manufacturers if they are in a distant city. These patterns are all classified so that the pattern for any particular part can be readily found. Necessarily a large space is devoted to these patterns, as they include not only those for all motor parts, but all engine parts, grate bars for the boilers, etc.

Near the pattern room is the rattan and sweeper department of the company. For the track sweepers a ¼ in. rattan is used. This is cut up into the requisite length for the brushes, and is heated in a steam boiler before being placed in the frames. During the winter four men are kept constantly employed in this department.

The company has its own brass foundry, which is 15 ft. × 30 ft., and in which are three furnaces, 18 ins. square, four tubs and four core ovens for baking cores. Here are manufactured the car trimmings, foot gongs, etc., used on the system. The power for the machine shop is supplied by a 25 h. p. T-H. motor.

BLACKSMITH'S SHOP.

This adjoins the wheel shop and contains

9 forges,
1 steam hammer,
1 punching machine.

Here is performed, not only the blacksmith work required for repair parts, but also the manufacture of quite a number of tools used on the system, such as track sledges for the repair of joints, etc. An improvement has been introduced in the form of trolley fork by making it all of iron and then welding it on to a long shank. This shank fits into the trolley pole into which it is riveted, making a very strong pole. The class of work turned out from these shops will be understood when it is stated that some trucks which were bent out of shape during a recent fire were entirely reconstructed there.

The forge room is well lighted and ventilated by large windows on two sides.

WOOD WORKING SHOP.

This occupies the portion of the building to the right of the entrance on Second Avenue, a space of 210 ft. × 38 ft. being devoted to it. The work turned out here is mostly car repairs, but a few freight cars, as already stated, have being built during the past year. The company also makes here all its controller handles, the wooden parts of the brush holders, patterns, etc. The machinery here is as follows:

2 band saws,
1 circular saw,
1 planer,
1 lathe,
1 tenoning machine,
1 parallel borer,
1 mortising machine.

THE PAINT SHOP.

The paint shop occupies the second floor of the repair shops and is surrounded by windows on three sides. The cars to be repaired are lifted from the main floor of the building by means of an electric elevator. It is the company's practice to revarnish its cars every season and to repaint them as often as is needed, which is usually about once every two years. The summer cars are put in shape during the winter and the box cars during the summer. The standard main panel color is Quaker green, and this

FIG. 17.—WOOD WORKING SHOP.

certainly has a very rich and handsome effect, although it may not be as durable as yellow or some other colors. Straw color is employed for the roof, and the street signs are painted with Quaker green with aluminum letters.

The facilities of this shop are sufficient to permit the complete construction of cars if necessary. Last year a sample 25 ft. car was built on which bids were secured, and it was copied in every detail by the contractors who furnished the cars ordered. From twenty-five to fifty cars are overhauled, painted and varnished per week, and the trucks and electrical equipment are completely overhauled

if necessary. This work of putting cars through the shop is in addition to the regular constant repairs made on the smaller parts of the equipment, such as armatures, fields, controllers, brush holders, etc. The number of men employed in the shop at present is 256.

The harness department occupies a small room adjoining the paint shop. Here harness is not only repaired, but the curtains for open cars and the carpets for closed car seats are made ready for service. The company still owns about 120 horses used for repair, emergency wagons, etc., and two men are kept constantly employed in this department. For open car curtains blue striped duck is used and for car seats rich Wilton carpet of figured green on veneer is employed.

The Telephone Dispatching System of the Akron, Bedford & Cleveland Railroad.

By F. J. J. SLOAT.

The Akron, Bedford & Cleveland Railroad Company has been employing with great success, for a year or more, a telephone dispatching system in the operation of its cars. The system has been found so very advantageous under the conditions existing on this road that a description of it may prove of benefit to the managers of other lines similarly situated. The general principle upon which the system is based is the location, at each switch or passing point, of a telephone connected with a central switchboard at the office of the dispatcher, by whom the movement of all trains is directed. This system is supplemented by other telephone circuits connecting the ticket offices and the residences of some of the officials of the company, as will be described later.

The dispatcher's office, containing the switchboard and all electric appliances necessary to dispatch trains, is not unlike a small central telephone station either in appearance or equipment. It is located at Silver Lake Junction, near the Cuyahoga Falls power house and car house of the company. The office is in a separate building, 12 ft. × 12 ft. × 12 ft., built of seasoned pine with straight and cross paneling, and painted yellow and white to conform with the color of the depots and other buildings along the line. The interior is finished in Norway pine, varnished. On all four sides of the building are large windows through which the dispatcher has an unobstructed view in every side, as Silver Lake Junction is a point from which cars are operated in three directions.

The office contains a small switchboard for ten circuits with the necessary call plugs and switch plugs and is so arranged that three operators can use the board at one time. The current used to ring up with is generated at the power house by two small magneto-generators, belted directly to the engine shafts. A small hand generator is also located near the switchboard and can be used in case both engines are shut down at the power station. This occurs however only between the hours of 2 A. M. and 4 A. M., during which time the system is not in regular use, as the cars are not on the road.

From this office seven circuits are run; one of these is a private line which extends north a distance of 25 miles, tapping all ticket offices along the road and terminating at Miles Avenue Depot at Newburg. A second line is the dispatcher's line and extends north a distance of 24 miles paralleling the first line. This circuit is tapped at the different switches, which are nine in number, and are an average of 2½ miles apart. At each of these switches is located a neat little telephone house, also painted yellow and white, in which is a telephone connection with the dispatcher's line. Wires are also run from all telephone houses to the private line, so that telephones can be cut in on it in case the dispatch line fails to work.

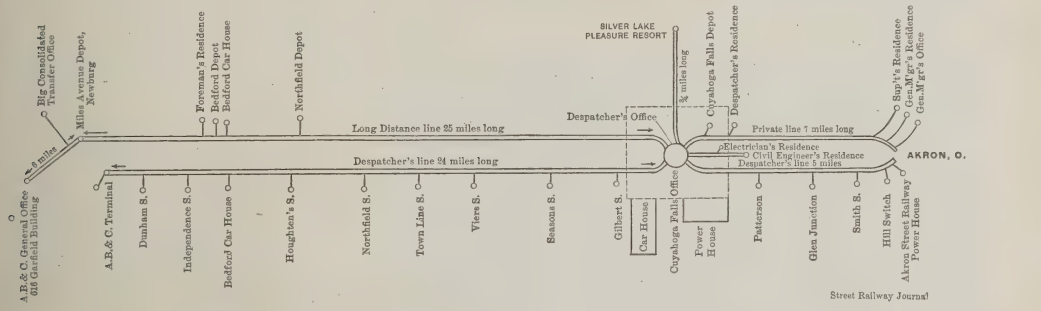


DIAGRAM OF TELEPHONE CIRCUITS—AKRON, BEDFORD & CLEVELAND RAILROAD.

Running east from the dispatcher's office is a line 1 mile long to Silver Lake pleasure resort, to which cars are operated during the summer months.

To the south of the dispatcher's office are three lines; one a private line tapping the depots at Cuyahoga Falls and Akron, the private office of the vice-president and the residences of the vice-president and superintendent; second, the dispatch line connecting the different switches and reaching as far as the Akron Street Railway power house, and, third, another line to Cuyahoga Falls tapping the residences of the dispatcher, civil engineer and electrician.

The overhead work was installed by the railway company. Each line is transposed every 2000 ft. and so arranged that the transpositions of one line lap at equidistant points the transpositions of the other, namely, at every

TRAIN DISPATCHER'S TRAIN SHEET.

NORTH BOUND. SOUTH BOUND.

Car No.	Train No.	Leave Akron	Due S. L. Junct.	Leave S. L. Junct.	AKRON DIVISION CREW	Akron Miles	MAIN LINE CREW	Leave Akron	Leave Twinsburg	Leave Hudson	Leave Boston	Arrive Peninsula	A. & C. Miles	C. E. CREW	Car No.	Train No.	C. E. Miles	MAIN LINE CREW	Due Peninsula	Leave Boston	Leave Hudson	Leave Twinsburg	Leave S. L. Junct.	Due Akron	A. & C. Miles	AKRON DIVISION CREW	Leave S. L. Junct.	Arrive Akron	Akron Miles	REMARKS.

BLANK USED BY TRAIN DISPATCHER FOR RECORDING RUNNING TIME OF CARS.

1000 ft. or one-half the distance of 2000 ft. Considerable trouble was experienced at first where the line runs through trees, but by the use of three wire cables, trouble at these places was avoided.

The total length of all the lines is 65 miles or 130 miles single wire. Since all this wire is on the main pole line and in close proximity to the heavy feed and trolley wire, the necessity for the transposition of the telephone wires is evident.

The switchboard and instruments were supplied by the Garl Electric Company, and the work required of these instruments is considerable as seventy trains are run daily between Akron and Cleveland, not including a work train and a number of specials. Two dispatchers easily take care of all these trains and a record of their running time is kept on a dispatcher's sheet. From this sheet is taken each morning the mileage run on the track of each of the three systems over which the cars run, the time of the crews, causes of delay, etc., in fact, the entire day's operation.

Conductors are not required to call up the dispatcher from any switch when both trains passing at that point are on time, except from Town Line Switch which is midway between Silver Lake Junction and Newburg. When the conductor reaches this point he must notify the dispatcher and he is then allowed, if on time, to proceed until his train reaches Newburg terminal when he again reports his train in on time or late as the case may be.

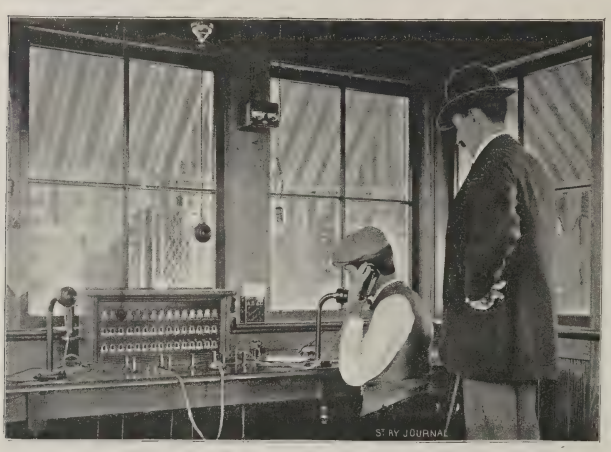


FIG. 3.—SUPT. SLOAT GIVING INSTRUCTIONS TO CHIEF DISPATCHER IN TELEPHONE DISPATCHING STATION.

The following rules and instructions are taken from the rule book given to all engineers and conductors employed by the Akron, Bedford & Cleveland Railroad Company, and give the procedure adopted in operating the system.

INSTRUCTIONS TO CONDUCTORS.

No. 1.—Conductors of all trains must call up dispatcher from Town Line Switch either going north or south, also report at Newburg Terminus. Each conductor must get his own orders.

No. 2.—When the conductor of a train arrives at any passing point and finds that the train he is to meet there has not yet arrived he must call up the dispatcher without delay, letting him know that the other car has not arrived. Same conductor will again call the dispatcher when said other car does arrive.

No. 3.—When the conductor of train is late in arriving at any passing point and finds there the train which he has orders to pass at that point, he must stop and call up the dispatcher for orders to proceed.

No. 4.—When any train overtakes another at a passing point *each* conductor must call up the dispatcher for orders to proceed.

No. 5.—After the conductor of any train has received his order from the dispatcher, he must communicate said order to his engineer at once.

No. 6.—Each conductor, who is on duty after sunset, must carry a lighted lantern and keep same in rear of train. This lantern must always be used in giving signals at night.

No. 7.—Conductors, who are on duty after sunset, must also see that a red light is kept lighted on the rear of the train.

With the above instructions every conductor is always in a position to know what to do in case of delay and can report any incident or acquire any information, regardless of where his train may be.

A system of this kind can be paid for in two or three years by the saving in cost of labor for delays caused by cars waiting on switches for want of instructions to proceed and in immunity from accidents, as it is safer to take the responsibility out of the hands of the many employes which the various roads employ, and place it in the hands of one or two good dispatchers.

From whatever standpoint we view the subject the conclusion forces itself upon us that dispatching trains by telephones will finally be decided on as the only quick and inexpensive way to operate a large number of suburban trains on electric roads.

Electric Railway Motors.

By George T. Hanchett.

I.—Forms of Field Magnets.

Direct current railway motors have two principal parts which are essential to their operation, namely the armature and the field magnets. The armature we may consider as a simple cylinder, upon the outer circumference of which are wires parallel to the axis and carrying electric current. As the current travels forward and back along the length of the armature it is evident that it must go in one direction on certain wires and in the reverse on others; in fact there are always two or more zones carrying currents in one or the other direction on every armature. To produce a continuous rotation of the armature we must present to each of these zones a magnetic pole which will repel the wires directly under it and attract those adjacent, and the problem of how these poles are constructed and placed about the armature is the object of discussion in this section.

It should not be difficult to comprehend that theoretically it makes no difference how the magnetism is obtained, providing it is strong enough to make the armature revolve with sufficient power; therefore in choosing a form of magnet for this service, practical considerations are the only ones that enter. Chief among these are the following:

1. The field magnet is the heaviest part of the motor at best, and hence it is easier to effect a reduction in the weight of the motor as a whole by a careful choice in the form of a field magnet at first and in its subsequent design.

2. The field excitation must take as little energy as possible, and therefore a form that has much magnetic leakage or that for other reasons requires excessive energy should be avoided.

3. The field magnet should be of such form that it can be easily modeled into an iron clad construction that will protect both armature and field coil.

4. It must be arranged so that the motor casing can be easily opened for inspection and repair.

5. The field must be both magnetically and mechanically balanced so as to evenly divide the work between the sections of the armature and avoid sparking, and also to distribute the strain equally on the bearings of the motor.

6. The diameter of the motor is usually limited by that of the car wheels, and if the motor is to be very powerful, this consideration will play a most important part in the selection of the form of field magnet.

It is now in order to discuss the types of field magnets that are used at present, and to show in what degree they fulfill the practical requirements just recited. The reader is referred to the diagrams, Figs. 1 to 7, inclusive. In these sketches are shown the exciting coils and the iron paths provided for the lines of force that are excited in the coils, and lastly the pole pieces that distribute the magnetism over the proper zones of the armature.

There are two types of poles that are utilized in railway motors. A pole that carries a coil is called a salient pole, and one which is formed by the return flux of a coil surrounding a salient pole is called a consequent pole. A machine may have its poles all salient or all consequent or a half of one kind and half of the other.

Fig. 1 shows the common horseshoe type of field

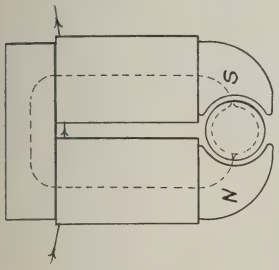


FIG. 1.

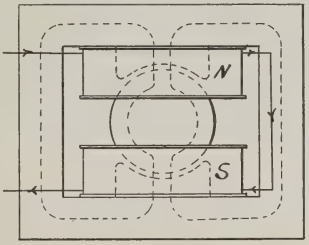


FIG. 3.

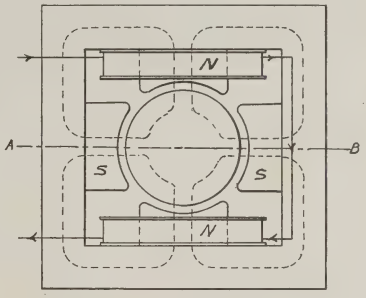


FIG. 5.

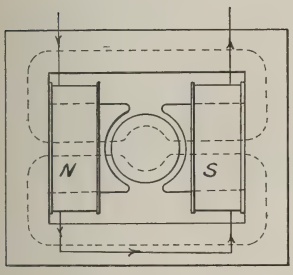


FIG. 2.

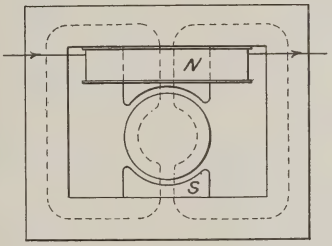


FIG. 4.

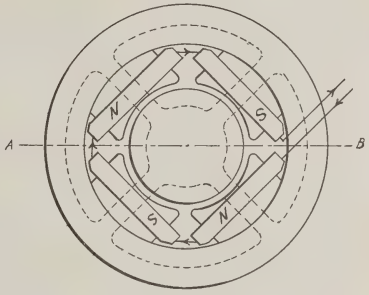


FIG. 6.

magnet in which both poles are salient; as this form is never used in present practice the only excuse for giving it a place in this treatise is that it was the first successful form used on a railway motor. It was employed both by Sprague and by the Thomson-Houston Company in its No. 6 and F 30 motors, now obsolete. Fig. 2 shows a form used in some experimental motors and to some extent abroad, but it has never been largely used in American practice. Being partially iron clad, this motor was quite successful. It has two salient poles and two magnetic circuits as shown by the dotted line, and the field is very symmetrical. This motor was inconvenient to open because the dividing line of the field magnets had to be vertical instead of horizontal. It would have been very easy to have spread out the return magnetic circuits and made a closed casing over the wire wound parts of the machine, but this was never done.

By turning on end the type shown in Fig. 2 and slightly modifying it, we have the motor shown in Fig. 3, which was first used on the S. R. G. (single reduction gear) motor of the Thomson-Houston Company. This motor was the first successful single reduction motor and was very much appreciated by railway men. As will be seen, the coils of the field partially protected the armature. Not a few roads are using S. R. G. motors to-day, and as these motors have not been manufactured for some years it can be seen that they have been wonderfully durable and efficient for a type that was so largely exposed. This machine has an exceptionally well balanced field and has a double return magnetic circuit. It can be divided horizontally and thus is exceptionally convenient as compared with the earlier types.

From the S. R. G. motor we pass to the form of field magnet which was used on the W. P. (water proof) 30 and 50. This machine (Fig. 4), had only one field coil which was in the upper part of the casing where dust and moisture would find it difficult to collect. It had one salient and one consequent pole. It was built iron clad, but not completely so, for little semicircular apertures were left in the upper half of the casing through which the commutator and brushes could be inspected. The simplicity which obtains in this type is at the expense of a balanced field, the salient pole is very much stronger than the consequent one and produces an upward pull on the armature which, it was intended, would be counterbalanced by the weight of the latter. This counterbalancing action is only partial, with the result that the armature was very hard on the bearings, and all of the trouble consequent upon uneven distribution of work in the armature was experienced. It remains to be said, however, that this type of field magnet was a great stride in advance of all practice up to that time and that the motor is famous even to-day for its tremendous hauling powers. A great many managers of railroads have said that it is the only motor that will run satisfactorily alone on a car equipment and that even the most modern types are deficient in torque when compared with the W. P. 50. The motor used considerable current and having a very large armature carrying many conductors, the reasons for its powerful torque are apparent.

The next form to be discussed is that of Fig. 5. When turned on its side it represents the type used on the old Edison General Electric motors. It has two salient and two consequent poles. The advantage of using the machine on its side was that the consequent poles could be made much shorter than the salient poles and therefore the distance from the center of the machine to the lowest part was so short that a very powerful motor could be

used and yet easily clear the ground. Owing, however, to the fact that the machine can be conveniently divided only along the line *A B*, it became difficult of inspection when used in such a position that this dividing line was vertical. For this reason the machine was turned so that the dividing line became horizontal, in spite of the fact that the inherently long dimension of the motor now became the vertical one. The field of this motor is in mechanical balance, but as the salient poles are always stronger than the consequent ones the magnetic balance is somewhat disturbed. Careful design has done much to make this difficulty practically *nil*. On these lines the well known G. E. 800 motor is built.

The type shown in Fig 6 is that adopted by the Westinghouse and Walker Companies, and as all the poles are salient it produces a remarkably symmetrical field. It can be divided along the line, *A B*, very conveniently, and is a very desirable construction. It has, however, the complication of four field coils, and so the choice between the types shown in Figs. 5 and 6 is practically an even thing, for each has advantages the other has not. It can

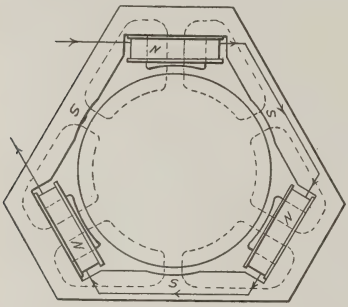


FIG. 7.

FIG. 8.

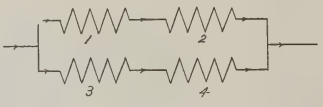


FIG. 9

FIG. 11.

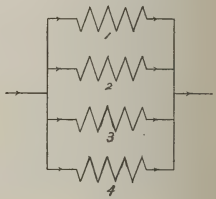


FIG. 10.

be easily seen that all of the types shown, except that shown in Fig. 1, can be made iron clad; the last two types were made completely so, access being obtained through suitable doors in the casings. Fig. 7 shows a type of motor which was first introduced in railroad work by Prof. S. H. Short. It has six poles, and as the lower one is consequent, an extremely powerful motor can be built in which the distance from center to base is a minimum. This was the final form of Professor Short's gearless motor, and was subsequently used with great success on the Baltimore & Ohio electric locomotives, whose fame is now world wide. The three field coils surround three salient poles, the rest being consequent ones, and it would be hard to make a construction any simpler. Each of the magnetic circuits is so short that it can be readily designed so that the difference in strength between the salient and consequent poles is very slight indeed, and as their distribution about the armature is symmetrical, perfect mechanical balance is obtained.

It is interesting to note that Figs. 4, 5 and 7 represent the same class of motor, that is, the class having alternate salient and consequent poles, and that, as the number of poles increases, the field becomes more symmetrical, and after the bipolar form has been passed, the trouble of mechanical unbalancing is done away with. Similarly Figs. 2, 3 and 6 belong to the same class, all of the poles being salient.

The various forms of field magnets that have been shown have from one to four coils which may be connected in different ways. The method which is now almost universally used is to connect them all in series as shown in Fig. 8. Then if each coil has the same number of turns, magnetic balance is assured, for the ampere turns of each coil is the same. Connecting two coils in multiple has been used, but is not so satisfactory, for the reason that even though the coils were of the same number of turns the conductivity of their copper might not be the same; the current would then divide unevenly between the two sets, thus producing an unbalanced field, where the form of field magnet gave no excuse for other than a balanced one. The only reason for using this connection is that smaller wire may be used on the coils, and this, in some cases, might make the winding easier. It would be possible to connect all of the coils in multiple as shown in Fig. 10. This would be liable to result in even more unbalancing than that of Fig. 9 and the wire of each coil would be so fine that it would actually be more expensive to wind than if it were coarser.

In some of the earlier types it was common to connect in one or more leads to an intermediate point on the winding of the field coil as shown in Fig. 11. Thus the current could be taken out of the coils from either *b* or *c*, and when the latter terminal was used the resulting field strength would be less, causing the motor to run at a higher speed. This effect is now obtained by connecting a resistance in shunt in the field coil and thus deflecting a portion of the current therefrom. More energy is wasted in the improved method than in the one just described, but trouble with arcing in the controller is less with the new method, although it would seem easy to devise an expedient to obviate this difficulty and still use the more economical device.

The Largest Trolley Party in the World.

During the convention of the Nobles of the Mystic Shrine held in Detroit, June 7–10, what was probably the largest trolley party in the world was given the visitors. Sixty-seven open cars were used and 3950 people took in the ride, the route being around the city and ending at the Water Works Park. The cars were gaily decorated with flags, and the conductors and motorman each wore a a boutonnière. Not a hitch marred the trip. The affair was managed by A. A. Schantz, G. P. A., of the Detroit & Cleveland Steam Navigation Company.

Eastern capitalists have recently purchased the rights and franchises of the Michigan Traction Company, and have been over the proposed road connecting Battle Creek (Mich.) and Kalamazoo. It is likely the road will be built by them this year. All the franchises and rights of way have been obtained and engineers are now making a survey. The Gull Lake resort, which will be an important feature of the new line, is already in the hands of parties identified with the proposed road.

The controlling interest in the Citizens' Street Railway Company, of Battle Creek, Mich., which has been held by E. E. Downs, a Kalamazoo capitalist, was sold recently to L. N. Downs and Dee Allen, of Battle Creek. F. J. Griswold becomes secretary and general manager of the company to succeed E. E. Downs.

Financial Results of Cable and Electric Railway Operation in the United States.

III.—Two Systems in Cities of 75,000 and 100,000 Inhabitants.

In the accompanying diagrams and tables are found the financial history of two street railway systems which are practically monopolies in their respective cities, although the latter are so close together that an interurban line belonging to one of the systems penetrates a short distance into the other city. The systems are under entirely different managements, but certain capitalists are directors in both companies, and there is, therefore, a common fund of experience to draw upon for the joint benefit of the two.

Case I serves a staid and quiet city of about 100,000 inhabitants, with an old aristocratic social life, but with comparatively small manufacturing interests. To make up for the lack of these, however, a large transient population is brought there on political business during six or seven months of the year, and as the city is extremely hilly there is more occasion for patronizing street cars than would otherwise be found. Case II serves a busy manufacturing city of about 75,000 inhabitants. There is little or no transient business throughout the year, except the ordinary pleasure riding in summer, which is cultivated as carefully as may be done in the absence of any unusual natural attractions.

ITEM.	Case I.			Case II.		
	1885.	1891.	1896.	1885.	1889.	1896.
Capital stock	$440,000	$1,040,000	$1,590,767	$384,700	$434,700	$2,090,000
Funded debt	236,400	1,029,000	1,030,000	297,555	334,155	2,380,300
Total capitalization	676,400	2,069,000	2,620,767	682,255	768,855	4,470,300
Cost of road and equipment	651,613	2,098,114	2,926,082	648,838	780,361	2,217,985
Miles of track	29.11	32.89	35.06	24.85	26.10	34.93
Total receipts	209,569	314,813	542,160	315,154	349,364	520,171
Operating expenses	168,956	279,770	354,490	254,560	271,943	276,414
Net earnings	40,612	35,043	187,669	60,594	77,420	243,757
Capitalization per mile track	23,236	62,906	74,751	27,445	29,458	127,979
Cost of road and equipment per mile track	22,385	63,792	83,459	26,110	29,899	79,874
Total receipts per mile track	7,199	9,572	15,463	12,682	13,386	14,892
Net earnings per mile track	1,395	1,065	5,352	2,438	2,966	6,978
P. c. operating expenses to total receipts	80.6	88.9	65.4	80.8	77.8	53.1
P. c. net earn'gs to cost of road and equip.	6.2	1.7	6.4	9.3	9.9	11.0

Both these systems are particularly valuable for study on account of the fact that the track mileage has not increased as rapidly, since their equipment by electricity, as has been the case with most American properties of their size, and it is possible, therefore, to see more clearly what has been the real effect of electricity alone in bringing about changes in their financial statements, than could be done were the causes of these changes complicated by the building of extensions. Case II was one of the first properties in the country to determine upon a change of motive power to electricity, and its equipment was completed before radical improvements in apparatus had been made. This property has always been somewhat handicapped, therefore, by its large proportion of partly antiquated apparatus, though much of it has been replaced by modern types within the last two or three years. Case I commenced equipment by electricity somewhat later than Case II, but still in the early days of electricity, and it, too, has suffered to some extent from the causes just described. Both roads to-day are in fairly good condition, however, but their operating expenses are considerably higher than they would be were the roads built according to the best present practice.

The capitalization curves naturally show a large and sudden increase, dating from the period when electrical equipment commenced. In Case I, there has probably been very little overcapitalization of costs, but the prices for apparatus and material of all kinds were much higher when bought than would be quoted at present, so that the tangible assets, exclusive of franchise, could doubtless be duplicated to-day for half the figure at which they stand on the company's books. In Case II there was little if any overcapitalization of costs up to 1893, but a new company was then formed which purchased for its treasury the stock of the old company and issued greatly increased capital stock and funded debt, the principal corresponding asset counterbalancing the increased capital liabilities, being "stock investments." The increase in these "cost of road and equipment" from year to year is not, however, excessive in view of added mileage and probable improvements.

The total receipts of Case I show little variation prior to 1890, when electrical equipment commenced, but thereafter moved rapidly upward to a point in 1896 double that of 1890. The operating expenses remained comparatively moderate until 1895, but in the last two years, owing partly to increasing business, and partly, without doubt, to replacements of worn out apparatus of the earlier types, they have increased quite materially. The net earnings, however, which were on a decreasing scale from 1885 to 1890, were somewhat larger in the next two years, and in 1892, when electrical equipment was well under way, jumped to three times the figures of the previous years, and since then have steadily increased to a result in 1896 nearly six times that of 1890.

The entire lesson is not taught, however, by the gross results of operation shown in Fig. 1, for the curves of Fig. 3, give an even clearer insight into the way in which electricity operates to change the financial characteristics of a street railway property. The most interesting curve perhaps is that of percentage of operating expenses to total receipts for the twelve year period of operation. For the first seven years covering the horse railway period the percentages ranged from 80.6 to 90.5, and during four of these seven years it was above 88 per cent. In 1892 it fell at one jump to 69.6 per cent, and since that time has ranged from 62.1 to 68.2 per cent. The old horse railway percentages were high on account of the heavy grades found on this system which made four-horse teams necessary on certain hills and were very hard on horseflesh everywhere. The electric power required for propelling cars at greater speeds up these hills is also very large, and the wear and tear on the motors must be considerable, so that the results for electric operation are certainly low and probably somewhat too low, if depreciation of roadbed and equipment be given proper consideration.

The curve showing the total receipts per mile of track is also an interesting one, and in this system we find something which is by no means always seen on American street railways, namely, largely increasing receipts per mile after electrical equipment. It is often the case that an increase of mileage is coincident with a change of motive power, and as this mileage is usually in outlying or suburban sections of the city not yet built up, the average per mile for the entire system is brought down to a figure lower than that before the change. Here, however, as before stated, there has been comparatively little increase of mileage, and the fact that we find so large an increase in receipts per mile is interesting as showing the possibilities of electricity in developing traffic solely, or almost so, because of improvements in speed, service and, of course, to some ex-

tent, increase of population, though in this case the resident population is probably little greater to-day than in 1890.

Net earnings per mile of track also show a most satisfactory increase, beginning with 1892, and are in 1896 more than seven times the low water mark in 1888-89, and about five times that of 1891, the last horse railway operating year.

Turning now to the curves of capitalization and return on investment, it is seen that the capitalization per mile of track is on a rapidly ascending scale. Nevertheless, the rate of increase has not kept pace with the increase in gross receipts per mile since 1889, as is shown by the curve of "percentage total receipts to stock and debt" (which curve gives a general idea of the way in which earning power has been capitalized.) It may be said in this connection that a curve showing cost of road and equipment per mile of track would follow quite closely the curve of total stock and debt per mile, though from 1892 to 1896 it would run higher than the latter by from $5000 to $9000 per mile.

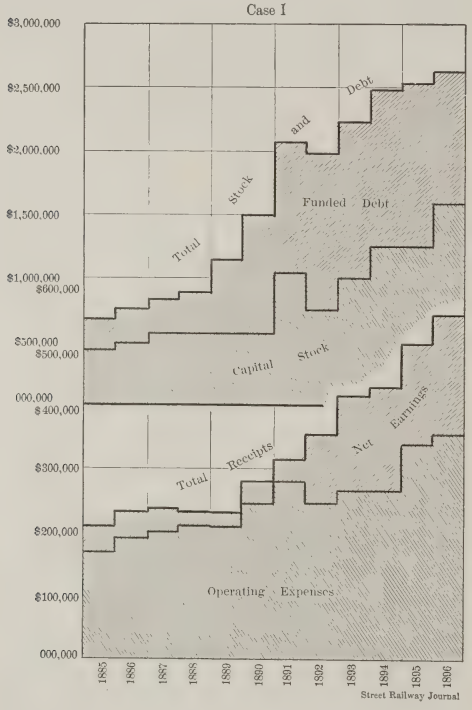


FIG. 1.

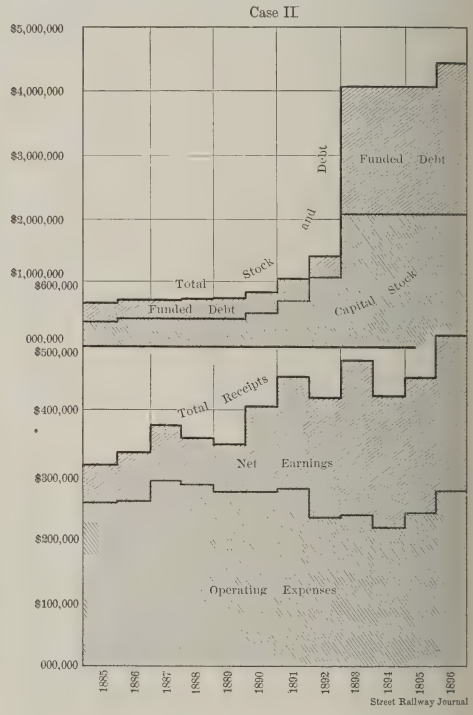


FIG. 2.

Finally, in the curve "per cent net earnings to cost of road and equipment," we see in a nutshell what electricity has done for this system. In 1885, its earnings from operation were 6.2 per cent on its total cost of road and equipment. This percentage fell rapidly to a low water mark in 1891 of 1.7 per cent. In the following year, when electricity was introduced over a part of the system, it rose to 4.8 per cent, and finally in 1896, to 6.4 per cent, the highest return of any in the twelve operating years. This is not a large return it is true, but it is one which, considering the physicial difficulties encountered by this system, is reasonably satisfactory, especially in view of the large percentage of what would be, in these days of low prices, unnecessary investment.

Turning now to Case II, we find again an interesting set of curves though different in many respects from those of Case I. As before stated, this system is now burdened with a much larger capitalization than is warranted by the actual cost of road and equipment, and this is quite clearly shown in the capitalization curves. The receipts have fluctuated a great deal during the twelve year operating period. This fluctuation is hard to explain, and the peculiar way in which it occurs, without any evident reason, is somewhat unusual among American street railways. The net earnings are more than three times as great in 1896 as in 1889, when the first beginnings of electric equipment were made. This system was more economically operated by horses than was that of Case I, on account of the fact that its roadbed is comparatively level, and it is seen by the curve that the percentage of operating expenses to total receipts varies from 1885 to 1889 from 76.9 to 80.8 per cent. The following year it was 67 per cent, and in 1891, 61.6 per cent, while in the five subsequent years it ranged from 49.5 to 55.2 per cent. These figures last named are extremely low and probably do not include sufficient charges for depreciation.

The total receipts per mile of track have been well maintained and in fact slightly increased since the adoption of electricity, and the net earnings per mile are very large as compared with those with horse equipment.

The "cost of road and equipment per mile" probably represents cash investment with little waste. A curve showing "total capitalization per mile" would be nearly coincident with the curve of "cost of road and equipment per mile" up to 1892, but would thereafter run far above the latter, the maximum being found in 1893 at $137,386. The heavy capitalization of earning power of these later years is shown by the curve "percentage total receipts to capitalization." These percentages are reasonably constant up to 1892 when they fall rapidly to a minimum of 8.9 per cent. What this means is, of course, that the property must be operated at less than 54 per cent of the gross receipts if a return of 5 per cent is made on both capital stock and funded debt. If, however, we consider the "cost of road and equipment" as the true investment figure for this property, we find a quite satisfactory result in the curve "percentage net earnings to total per-

manent investment." In the horse railway era it ranged from 9.3 to 11.7 per cent, in the two following years it was 14.4 and 14.9 respectively, and in the five subsequent years it ranged from 10.6 to 12.7 per cent.

In 1896 Case I earned .243 cent per car mile and operated its system at .159 cent. Case II earned .234 cent per car mile and operated at .124 cent.

City properties of about this magnitude have been greatly benefited almost, without exception, by the introduction of electricity, though in varying degree. It is in such cities that considerable increase of speed is possible and can be rightly allowed by municipal authorities, since the streets are rarely overcrowded. It is in such cities that suburbs can be built up to good advantage and that distances begin to be great enough to induce people to ride where the service is good and frequent. It is in such

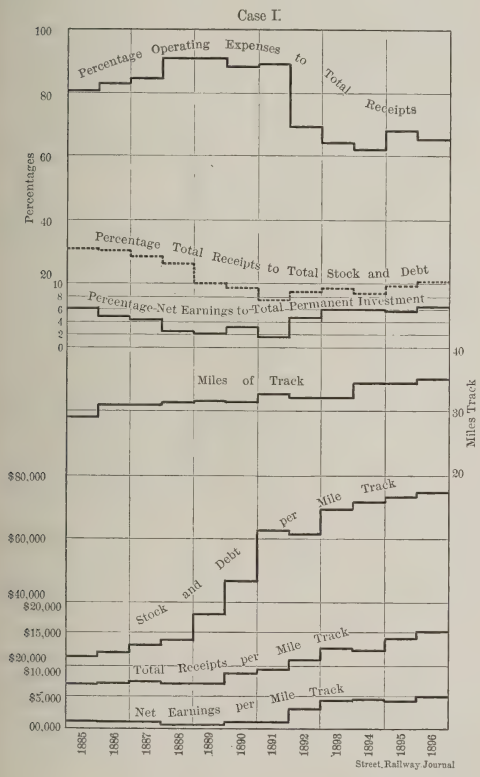

Case I.
Percentage Operating Expenses to Total Receipts
Percentage Total Receipts to Total Stock and Debt
Percentage Net Earnings to Total Permanent Investment
Miles of Track
Stock and Debt per Mile Track
Total Receipts per Mile Track
Net Earnings per Mile Track
Percentages
Miles Track
1885 1886 1887 1888 1889 1890 1891 1892 1893 1894 1895 1896
Street Railway Journal

FIG. 3.

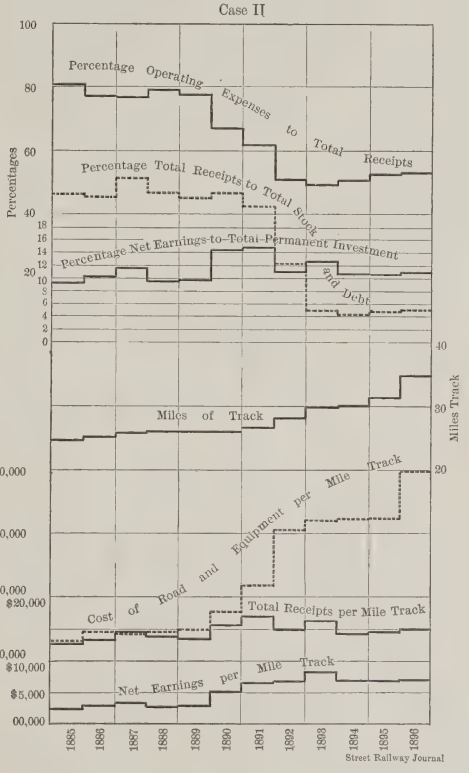

Case II
Percentage Operating Expenses to Total Receipts
Percentage Total Receipts to Total Stock
Percentage Net Earnings to Total Permanent Investment and Debt
Miles of Track
Equipment per Mile Track
Cost of Road and Total Receipts per Mile Track
Net Earnings per Mile Track
Percentages
Miles Track
1885 1886 1887 1888 1889 1890 1891 1892 1893 1894 1895 1896
Street Railway Journal

FIG. 4.

cities that labor can be obtained at prices lower than are paid in the larger cities and where other elements of expense are frequently reasonable. Finally, in cities of this class the areas covered are such as to make the copper investment problem possible to solve and this too without the heavy expense of putting feeders underground.

Raising the Metropolitan Elevated Railway in Chicago.

An interesting engineering work was undertaken last month by the managers of the Metropolitan West Side Elevated Railway Company, of Chicago, in raising nearly one-half mile of the Metropolitan elevated structure between Western and California Avenues. The tracks are to be carried up 6½ ft. above the present level, to permit the elevation of the Northwestern Company's tracks along Rockwell Street.

As the elevation has been extended over a distance of 2300 ft., the grade will be only .75 per cent, and the increase in the length of the road between the two points will be but little more than 1 in. The undertaking is being carried on so that traffic is not interrupted, the trains traveling over that part of the route at reduced speed.

The work has been divided into four sections, and the elevation of the two ends is being carried out first. Wooden towers are first built around each column as a temporary support for the structure. One span is raised at a time by installments of 2 ins. or less, by means of the hydraulic cylinders. The iron columns are left hanging in the air while the foundations are raised to a height varying from less than 1 in. to 6½ ft. at Rockwell Street. As soon as the extreme sections have ben elevated they will be made fast and the middle portion, including the Rockwell Street span, will be dealt with. This span is 160 ft. in length and the ironwork weighs more than 300 tons, and its elevation will be by far the most difficult part of the work.

At the street intersections the iron columns will be lengthened and at other points the additional elevation will be gained by adding a layer of cement to the foundations. It is thought that the work will be completed within three months. The contractors are Kelly & Atkinson, and Assisant Engineer Mendel is in charge of the work for the railway company.

IN the article "Cost of Electromotive Power in New York and Massachusetts" on page 344 of the STREET RAILWAY JOURNAL for June, a typographical error should be noted by reason of which the cost of power per car mile of the Buffalo Railway Company was stated to be $.0178 instead of $.0078, the latter being the correct figure. It should be added, that this figure shows that the Buffalo Railway Company has the lowest power cost per car mile, and per passenger carried, of the seventy-one companies represented in the table.

LETTERS AND HINTS FROM PRACTICAL MEN.

Tramways in Italy.

COMPAGNIE GÉNÉRALE DES OMNIBUS.

PARIS, Apr. 19, 1897.

EDITORS STREET RAILWAY JOURNAL:

On Feb. 15, 1882, I read before the Société des Ingénieurs Civils de France a paper discussing the general condition of tramways in Italy. I emphasized the fact that the creation of steam tramways on provincial roads aimed at the connection with the main railroad arteries of such towns as were not yet included in the railway system, the construction of other short interurban lines, and eventually the building of industrial railways connecting factory plants with large centers of population. As I pointed out at that time, it was not possible to reach these results by the creation of ordinary railways, on account of the large cost of construction and their expensive operation for such a small traffic. The towns of Northern Italy solved their traffic problem by the establishment of tramways along provincial roads. They thus created a considerable amount of new business which added materially to the passenger and freight traffic of the ordinary railway lines. At the same time I pointed out that the creation and operation of such "economical" roads was due solely and absolutely to private enterprise. No subsidy or security whatever was demanded from the Government. The people were quick to appreciate the advantage they would derive from "provincial roads," so-called, by the introduction of steam tramways, or to term them more correctly, "economical railways."

In this way by 1882 and 1883 Italy was well equipped with steam tramways, and by 1888, the mileage of steam tramways in operation amounted to 2262 km. (1402 miles) of which

140 km.	(89 miles)	were	on	national roads.
1572 "	(974 "	)	"	"	provincial roads.
269 "	(167 "	)	"	"	city roads.
281 "	(174 "	)	"	"	private rights of way.

The portion in which the development has been greatest is Lombardy, which alone includes 950 km. (589 miles), i. e., 40.5 per cent of the total mileage. The first steam tramway, from Cuneo to Borgo-San-Dalmazzo, was put in operation on May, 24.1878.

It can thus be seen that Italy was not slow in taking advantage of mechanical traction. Until 1890 steam traction was used almost exclusively on these lines, and it may be said that at that period the mileage of steam tramways in operation in the various provinces was at follows:

Lombardy	950 km.
Piedmont	774 "
Venetia	166 "
Emilia	134 "
Southern Provinces	112 "
Tuscany	82 "
Roman State	49 "
Romagna	40 "

One hundred and ten lines in operation were owned by forty-four companies. The speed was from 15 to 25 km. (9.3 to 15.5 miles) per hour, or an average speed of 18 km. (11.2 miles) per hour. In the meantime there had been opened a large number of lines of tramways with animal power. It is a matter of surprise that the Italian people should have taken so actively to street railroading, in view of the fact that they have the use of the old Roman roads, which are laid with flags, and afford very easy haulage. As a matter of fact, the sight of small horses drawing heavy loads is always a cause of astonishment to travelers in Italy. This, as stated, is possible on account of the flagging of the roads. It was, therefore, interesting to the writer, during a recent trip in Italy, to notice the changes that have taken place in that country since his last visit. It may be stated here that a considerable development of the tramway system was found, and that electricity is in use as a motive power in a considerable number of towns.

Genoa has, today, three lines of ordinary tramways—ordinary omnibuses, and three lines of electric tramways—altogether 18 km. (11.2 miles)—employing about 900 horses and forty tram cars. Electric traction will shortly be substituted for animal traction, and the trackage of electric lines will reach about 30 km. (18.2 miles). The same city will be also connected electrically with Nervi, Voltri, and Pontedecimo, which will increase the length of lines to 63 km. (39 miles).

Pisa still uses steam tramways. The writer was told that the use of electricity is being considered.

Florence has three lines of horse tramways, several lines of steam tramways and a line of horse omnibuses. There is also an electric line from Florence to Fiesole, 7½ km. (4.65 miles), with a grade of 8 per cent. It is equipped with the Sprague system.

At Rome there are fifteen omnibus lines, thirteen tramway lines, and every method of mechanical traction is used; steam in several streets, and electric traction upon the Cattori system, on certain sections with grades of 2 per cent. The Thomson-Houston system has been applied on other lines having 8.37 per cent gradients. Electric traction has also been introduced on the streets from Porta Pia to Saint-Agnes, and from the Piazza di Venezia to St. John Lateran. Changes to mechanical power are also being considered by other lines.

Naples has in service horse omnibuses, eight lines of tramways, one line of rack tramways on a certain steep grade, and six lines of suburban tramways, three of them steam roads. The substitution of electric traction for several of the systems is also being considered.

Milan has every method of traction—horse, steam and electric. This is certainly the city where the latter system has received its greatest development. A certain number of lines have already been changed to electric power, and in consequence of a contract, signed in 1895, with the Edison Company, all the lines of tramways in Milan will be equipped with electricity during the course of the present year. In Turin also the prospects for electric traction are good.

From what has been said it appears that electric traction is the rule in Italy. The impulse has been given, and from all sides, even from Cagliari and Sardinia, electric traction is clamored for, plans are being drawn up and companies are being organized. It does not seem that any system is wanted in Italy, except electricity by the overhead trolley.

E. LAVALARD.

Proper Handling of Controllers.

CHICAGO, ILL., June 7, 1897.

EDITORS STREET RAILWAY JOURNAL:

On page 332 of the last STREET RAILWAY JOURNAL I notice a statement by N. H. Heft, of the New York, New Haven & Hartford Railroad, in which he refers to some tests made on the motor cars on that road and says: "These two tests illustrate what we have found to be generally true, namely, that when the current is turned on quickly and used generously in moving the car the economy in power consumption is greater than when the rate of acceleration is less rapid. It is, of course, true, however, that power consumption alone is not a right test of commercial efficiency since repairs of apparatus due to overloads of current may wipe out any moderate savings

in fuel. As a matter of practice a medium course in the use of current has been found best by us, and motormen are instructed to wait until the power has responded to each service notch of the controller before passing to the next."

It seems to me that his conclusions as to power consumption are not warranted by the tests cited and published in the article; and that they are not the conclusions of others who have investigated the subject is too well known to be repeated. Of course, there is such a thing as advancing the controller handle so slowly in making a start that an undue amount of energy is wasted in the resistance after the car has gained speed on each point. But such slow starts are almost never made in practice, and there is no need to warn anyone against them, as the natural tendency of a motorman is to sin in the other direction, by turning on current faster than it will produce useful results in acceleration. Tests made two years ago by G. W. Knox, electrical engineer of the Chicago City Railway on various ways of handling the controller proved beyond the possibility of a doubt that there is an enormous waste of energy by too rapid advancement from one point to another of the controller with no corresponding returns in increased acceleration. A motorman putting his controller on the highest point in 4 seconds used an average of 43.3 h. p. in starting and car attained full speed in 9½ seconds, while when the controller was put at the top notch in 10 seconds an average of 24.7 h. p. was used in starting and the car attained full speed in 12 seconds. The horse power seconds used in the first case were 411.3 and in the second 296.4. This is the result of hours of testing on car acceleration alone.

Further than this, the two tests referred to by Mr. Heft were made, as he says, on a "motor car running without stop over the entire line." How can results be deduced as to the economy of different methods of controller handling and acceleration on a run where no stops are made and where the speed as shown by the curves given at no time even approaches a stop. The tests simply show that a given run was made with less power at a high speed than at a low, which it seems to me may be interpreted as meaning that the motors are designed to run more economically at a high speed and high voltage as when in parallel than at a low speed and low voltage as when in series.

J. R. CRAVATH.

The Tariff on Mica.

MICA INSULATOR COMPANY,
NEW YORK, June 18, 1897.

EDITORS STREET RAILWAY JOURNAL:

Reading over the discussion about the tariff on mica in a late number of the *Congressional Record*, amazement at the want of knowledge upon the subject as a whole on the part of our legislators is the feeling that dominates one who has happened to have a close connection with both the production and consumption of this remarkable article.

The general refrain is that mica is too cheap. If we could only increase the cost of mica three or even fivefold the country would be richer. That if we could stop the importations, profitable mines would be opened up in almost every state in the Union. Is this the truth? From my own experience it is not. The true cause of the low price of mica is the fact that the supply greatly exceeds the demand. And even at the present low rate of prices, the material is looked upon as a necessary evil, on account of its cost, by every consumer, and the tendency is to use pieces as small as possible. The smaller the piece used the greater the labor entailed, so in all cases an equilibrium has to be struck, which balances the price of the mica with the consequent labor. If the price is increased smaller sizes will be used and *vice versa*. If the price is reduced large sizes can be used, and, what is of greater importance, owing to the oversupply, larger quantities also.

Everyone knows that mica varies greatly in its properties, especially in hardness and transparency. North Carolina and Dakota mica and mica from other states stand at the head in combining these two properties—excessive hardness and perfect transparency—and this mica has nothing to fear from competition with that of other countries. It will always command a fair price, and, if the consumption is not interfered with, the mining industry in the states concerned will be in a healthy condition. The consumers of this quality of mica are the stove manufacturers, the makers of lamp chimneys, shades, etc., and, to a limited extent, the electrical manufacturers. Although the electrical manufacturers use this kind of mica where its qualities are required, the bulk of their supply happens to come both from Canada and India. Both countries possess mica of exceeding softness, the quality which is absolutely necessary for them, and Canada, with its high priced labor, successfully competes with India; and so would this country if it only had the proper quality. This soft mica has not been discovered in this country, and the electrical manufacturers must have it at any price, and no electrical engineer in his senses would think of using a hard mica where a soft one was essential. He would rather use a substitute, such as paper or fibre, which may be said to rank as the next best practical insulator. Paper at three cents, mica at nineteen cents—a pretty bedfellow to be sure. Any increase in the price of mica is certain to result in a decreased consumption, and it is to the interest of everyone in the mica business, whether he be a miner or importer, that the price of mica be as low as possible. The increased sales at a low price will more than offset the small sales with a large profit.

Whatever tax is put upon the mica imported from other countries will not increase the price of mica mined in this country. There is already an overproduction. It would increase the price of the soft mica imported from Canada and India and there would be a stronger tendency than there is now for the electrical manufacturers to use different substitutes.

It is the electrical manufacturer who has scoured the world over to find a suitable cheap mica for his purpose, and the present duty of 20 per cent is a severe tax upon his business, and the question of using mica is always before him. If from any cause the price is greatly increased a great blow will be struck at the mica business, and the miner, whether he be in Dakota or India will equally suffer. It will not only be the miner, however, but the electrical manufacturer also. There is no business in the country which has brighter prospects of sending its product abroad than the electrical manufacturer.

Only the other day one of them secured contracts in England and Australia entailing an outlay of over $1,000,000. In fact they are now looking forward to their export business as their chief outlet, and any tax upon them, when competing with England or Germany (and the one on mica is about the only one) might result in a loss of foreign business to the amount of millions of dollars. Mica, by the by, has played no unimportant part in securing these contracts. Owing to its large use American insulation stands very high abroad. This debate about mica in Congress shows a general pressure put upon the various representatives for a higher duty on mica. This pressure has come from those who own a bit of land with mica upon it. They are not in a position to know if a duty would help them or not. I most emphatically say that it would not. The remedy is a greater demand, not a higher price.

I may be like one crying aloud in the wilderness, but for the benefit of the miners, the thousands of men and women who are employed in working the mica after it has been mined and for the mica business generally, I trust these few words will have a hearing.

CHAS. W. JEFFERSON.
Manager.

Life of Wheels, Gears and Pinions.

Paterson Railway Company.
Paterson, N. J., June 11, 1897.

Editors Street Railway Journal:

The accompanying tables give some records as obtained by us of the life of car wheels, gears and pinions on our cars. The gear and pinion records are especially interesting as showing the relative effect on gears of soft and hard pinions. The manufacturers of the former have claimed that a pinion should be very soft to give a maximum life to a gear. If you will note, the maximum life of a pinion furnished by the General Electric Company is 32,925 miles running in car No. 162. The gear running with this pinion had a life of 38,527 miles, or 6000 miles more than the average life of the General Electric gears, whose average life is 6000 miles more than the average life of Nuttall gears, running with their soft pinions.

I am of the opinion, that a hard pinion cuts out a gear less than a soft one, as I find that the teeth in a hard pinion of a glazed face, does not cut so fast as a soft pinion. The best machinist in Paterson (the head of the largest firm of machinists in the city) states to me that he has found this to be true in practice.

CAR WHEEL RECORDS.

Lobdell 30 in. Wheels under Brill max. traction truck with G. E. 800 motors; mileage of each car made on same route and therefore same conditions to each wheel.

Car No	Miles.	Car No.	Miles.	Car No.	Miles.
156	40,080	160	45,146	163	44,537
156	40,080	160	45,146	164	41,344
159	35,756	162	45,275	166	46,026
159	47,174	162	42,685	166	41,030

Maximum . . . . . 47,174 miles.
Minimum . . . . . 35,756 "
Average . . . . . 42,856 "

Lobdell Pony Wheels under conditions same as above.

Car No.	Miles.	Car No.	Miles.	Car No.	Miles.
156	34,662	161	47,181	163	35,365
159	47,174	162	39,583	165	34,426
160	24,674	162	36,015	166	29,902
160	31,022	163	30,915	167	38,218

Maximum . . . . . 47,181 miles.
Minimum . . . . . 24,674 "
Average . . . . . 35,761 "

Rochester 33 inch Wheels.—Mileage over various routes, but all under single truck cars.

Car. No.	Miles.	Car No.	Miles.	Car No.	Miles.
24	17,272	150	40,597	153	38,787
25	24,680	150	16,981	153	27,498
27	7,364	150	16,605	154	28,442
31	3,735	151	26,111	154	22 546
110	30,816	151	30,296	155	29,869
116	17,420	152	33,341		

Maximum . . . . . 40.597 miles.
Minimum . . . . . 3,735 "
Average . . . . . 24,221 "

PINION RECORDS.

General Electric Pinions.—Maximum traction truck G. E. 800 motors; mileage over same route and conditions therefore the same.

Pinions General Electric make, composition steel, running against malleable iron gear of General Electric Company in gear casing with grease.

Car No.	Miles.	Car No.	Miles.	Car No.	Miles.
159	17,574	162	32,925	165	21,536
160	17,664	163	22,667	166	16,378
161	15,510	164	29,134	166	24,486
161	24,956	165	12,846	167	24,362
162	21,911				

Maximum . . . . . 32,925 miles.
Minimum . . . . . 12,846 "
Average . . . . . 21,688 "

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RECORD OF REPAIR PARTS AND MILEAGE OF SAME.

MOTOR No. 31777 BOX CAR No. 159
" No. 37736 TYPE G. E. 800 Bree May. Bartlett TRUCK. OPEN CAR No. 74
Gear 1897

Date In.	Motor No.	Armature No.	Kind of Material	Make of Same	Value	Date Out	Cause of Removal	Mileage	Weight In	Weight Out
y 15			Date in service							
"	37736		Axle Gear	G. E.		1/11/97		33857		
"			Arm Pinion	"						
"			M. M Bearings	"						
"			Arm "	"						
"	31777		Axle Gear	"		1/11/97		30788		
"	"		Arm Pinion	"		9/11/96		17074		
"	"		M. M Bearing	"						

General Electric Gears.—G. E. 800 motors, double truck cars; mileage made over same route; gears malleable iron running against G. E. steel pinions in gear casing with grease.

Car No.	Miles.	Car No.	Miles.	Car No.	Miles.
156	36,462	162	26,869	164	41,528
159	33,384	162	38,527	164	24,062
159	33 788	163	22,667	166	30,018
160	47,064	163	22,667		

Maximum . . . . . 47,064 miles.
Minimum . . . . . 24,062 "
Average . . . . . 32,458 "

Nuttall's Pinions.—G. E. 800 motors, single and double truck cars; mileage made over various routes; pinions Nuttall composition, steel, running against malleable iron in casing with grease.

Car No.	Miles.	Car No.	Miles.	Car No.	Miles.
103	9,962	110	22,883	156	5,942
106	11,432	112	9,950	159	8,636
106	7,752	112	5,316	160	7,076
106	14,569	115	5,111	162	8,512
106	4,200	116	6,806	162	8,512
107	16,198	116	19,295	166	10,886
108	4,284	116	11,489	167	14,600
109	14,544	119	3,228		

Maximum . . . . . 22.883 miles.
Minimum . . . . . 3,228 "
Average . . . . . 10.053 "

Nuttall's Gears.—G. E. 800 motors, single truck cars; mileage made over various routes; malleable iron gears running with steel pinions in gear casing with grease.

Car No	Miles.	Car No.	Miles.	Car No.	Miles.
103	29 472	113	9,647	119	5,035
109	21,000	115	42,351	153	44,775
112	32,144				

Maximum . . . . . 42,351 miles.
Minimum . . . . . 5,035 "
Average . . . . . 26,346 "

I also send a sample sheet taken from the book used for keeping record of repair parts. You will note that the system is such that the life of every part of the motor or truck is recorded immediately on its removal, make of same, etc. M. R. McAdoo, General Manager.

LEGAL NOTES AND COMMENTS.*

EDITED BY J. ASPINWALL HODGE, JR., AND GEORGE L. SHEARER,
OF THE NEW YORK BAR.

Two Recent Cases on the Power of Municipal Authorities to Grant Franchises to Street Car Companies.

The New York Court of Appeals and the Supreme Court of the United States have just rendered two opinions in which some general principles are enunciated with some emphasis and clearness, which are of more wide reaching interest than the particular and local issues involved in the decisions.

Both cases concern the rights of street railroad companies in the streets, and in both the claims made were based upon actions of municipal bodies. (*Beekman* v. *3rd Ave. R. R. Co. N. Y. Law Journal, June 14, 1897; City Railway Co.* v. *Citizens' Street R. R. Co., 166 U. S. 557.*) In the former case a valuable franchise in the city of New York had been sold to the Third Avenue Railroad, granting it the right to make certain extensions to its line. It appeared to the court that the authority vested in the Common Council to sell the franchises had been exceeded. Just in what particulars is of only local interest, but it will be interesting to some of our readers to learn the basic principles upon which the decision rested. The court says: "The authority to make use of the public streets in "a city for railroad purposes primarily resides in the State, "and is a part of the sovereign power, and the right or "privilege of constructing and operating railroads in the "streets, which for convenience is called a franchise, must "always proceed from that source, whatever may be the "agencies through which it is conferred. The use or occupation of the streets for such purposes, without the "grant or permission of the State through the Legislature, "constitutes a nuisance, which may be restrained by individuals injuriously affected thereby (*Fanning* v. *Osborne, 102 N. Y. 441.*) The city authorities have no "power to grant the right except in so far as they may be "authorized by the Legislature, and then only in the manner and upon the conditions prescribed by the statute. "(*Davis* v. *Mayor etc., 14 N. Y. 506; Milhau* v. *Sharp, "27 N. Y. 611; People* v. *Kerr, id. 188.*)"

The court goes on to note the restrictions placed by the constitution of New York upon the legislature, prohibiting it from granting any franchise except where the consents of owners of one-half in value of the property bounded on the road and the consent of the local authorities are obtained. (Article 3, Section 18.)

The statute in New York provided that "local authorities may in their discretion make their consent to depend "on any further conditions respecting other or further security or deposit suitable to secure the construction, "completion and operation of the railroad, etc." The Common Council had assumed under this provision of the statute to impose the condition that the road pay a lump sum in addition to percentage on gross receipts, which in another provision of the statute was provided for, but the Court of Appeals held that the Common Council was powerless to impose further "monetary conditions," on the ground that the expression "further conditions" related only to matters not fully covered in the other provisions of the statute; thus restricting the municipal authorities to a narrow rather than a broad construction of their powers.

Thus it will be seen that the power of the legislature to grant a franchise is limited in many cases by the constitutions of the several states. The power of the Common Council, who in a sense is the executive of the sovereign legislative body, is limited by the express instructions of that sovereign as embodied in the statutes. If it go beyond it its acts are invalid; and in the New York case a sale of a valuable franchise was declared abortive because the Common Council had assumed to do more than the legislature allowed, or, at least, to do it in a different way from that prescribed by the statute under which they assumed to act.

The decision of the Supreme Court of the United States, cited above, related to a controversy between two street railway companies in the city of Indianapolis. The Citizens' Railroad Company had an original franchise from the city which was for thirty years which would have terminated in 1894, but they had obtained from the municipal authorities an extension of the franchise to 1901. Notwithstanding the extension the city authorities passed a city ordinance granting to the City Railway Company, the defendant in the action, the right to lay tracks and run cars over many of the streets in Indianapolis, including a number occupied by the complainant's road. An injunction was obtained and was sustained by the Supreme Court.

The Federal Court was held to have jurisdiction, although both parties were corporations and citizens of Indiana, on the ground that the city ordinance constituting the grant to the Citizens' Railroad Company was a contract protected by the clause in the United States Constitution, which forbids states to make any law impairing the obligation of contracts; thus affirming the decision below reported in 56 Federal, 746, wherein the court held that an exercise of a power granted by the Legislature to the Board of Public Works, with the approval by ordinance of the Common Council, to grant franchises to street car companies was a law of the state within the meaning of the provision in the constitution referred to.

The claim that the extension of the franchise was without consideration and was void was held untenable by the Supreme Court, on the ground that the continued operation of the road was a sufficient consideration for the extension of the franchise, and so the Supreme Court comes to the conclusion that the company holding the original franchise had a valid contract with the city, which would not expire until 1901, and that the contract made with the other company was invalid.

The decree below provided for an injunction "without regard to any limitation of time mentioned in any "ordinance of the city," and contained also the word "forever," and Mr. Justice Shiras, of the Supreme Court, was of the opinion that the decree should be affirmed without modification, but all the other judges taking part in the decision held that they were "not called upon to express "an opinion whether the complainant was entitled to a "perpetual franchise from the city" and so decreed that the judgment below should be modified by striking from it the words which we have already quoted; thus leaving the question undecided as to whether the Citizens' Railroad Company's charter expired in 1901 or whether its charter is a perpetual one.

These two cases very clearly illustrate some of the principal limitations which surround the powers and acts of the legislature and municipal bodies and the granting of rights in the public streets, and enunciate principles of law often lost sight of by both state and city authorities. H.

*Communications relating to this department may be addressed to the editors, 32 Nassau Street, New York.

FRANCHISES, ORDINANCES, ETC.

U. S. SUPREME COURT.—A city ordinance granting a street railway franchise for a fixed period, with a provision that the city shall not, during that time , confer on any other parties any privileges which shall impair the rights and privileges thereby granted constitutes, when accepted, a contract between the railroad company and the city.

The Indiana act of 1891, granting a new charter to the city of Indianapolis, and giving to its board of public works, subject to the approval of the Common Council, power to authorize street railway companies to occupy the streets, alleys, etc., is not to be construed retrospectively, so as to authorize the granting of franchises which will impair the obligation of existing contracts, in the absence of language so clear as to admit of no other construction.

A city which extends the duration of a street railway franchise in order to enable the railway company to refund its bonded indebtedness at a lower rate of interest,is estopped, after the negotiation of the new bonds on the faith thereof, from attacking the validity of the extension for want of consideration.

The continued operation of a street railway is a sufficient consideration for an ordinance extending the date fixed in the original contract for the expiration of the franchise.

No formal resolution accepting an ordinance granting a street railway franchise is necessary if the facts show an actual practical acceptance by the railway company, or action by it which is only explicable on the theory of an acceptance.

An acceptance by a street railway company of an amendatory ordinance extending the period of its franchise may be presumed from the fact that the amendment was beneficial to it, and from the further fact that it issued bonds, as was contemplated when the ordinance was applied for, and made them fall due at the expiration of the extended franchise.

A city which, without express legislative power to do so, has authorized a street railway company to change from horse power to electricity, will be estopped from setting up a want of such power, after the company has incurred large expenditures in making the change, and after the legislature by a subsequent general law has conferred power on city councils to authorize such changes.—(City Ry. Co. v. Citizens' St. Ry. Co., 17 Sup. Ct. Rep. 653.)

MARYLAND.—Acts 1890, c. 271, amending the charter of the Baltimore City Passenger Railway Company, and authorizing it to use improved methods of traction, and any system of propulsion which the mayor and council may authorize other corporations to use within the city, when supplemented by Acts 1892, cc. 210, 232, authorizing other companies to use the trolley system, authorizes such company to erect trolley poles in streets, since they are a necessary part of such a system.

Acts 1890, c. 370, giving the Mayor and Council of Baltimore power to require all wires to be placed underground, does not authorize the Mayor to prevent a street railway company from erecting trolley poles in the streets under a charter power to use the trolley system, where the City Council has taken no action under such act as to trolley wires.—(Hooper v. Baltimore City Pass. Ry. Co., 37 At. Rep. 359.)

NEW YORK.—The franchise of a street railroad company becomes complete when the consents of the local authorities and of the abutting property owners are obtained.

A street railroad franchise, after it has become complete, cannot be destroyed by subsequent legislation, except by the exercise of the power of eminent domain.

Laws 1892, c. 676, § 99, as amended by Laws 1893, c. 434, making it a cause of forfeiture not to complete a road within three years after obtaining the necessary consents, does not ipso facto dissolve the corporation on non-compliance.

Laws 1892, c. 676, § 108, forbidding the construction of surface railroads in public parks, does not apply to a park laid out after a railroad franchise has been acquired.—(Coney Island etc. R. Co. v. Kennedy, 44 N. Y. Supp. 825.)

INDIANA.—A street railway, the right of which to cross a railroad has been determined, has the right, if it is not its duty, on the old crossing wearing out, to put in a more modern one, which is an improvement.—(C. & C. T. Ry. Co. v. Hammond etc., El. Ry., 46 N. E. Rep. 999.)

PENNSYLVANIA.—In a suit against a railway company for permanent injury to plaintiff's premises caused by raising the grade of a township road and maintaining a track thereon, without the consent of abutting owners, the measure of damages is the consequent depreciation in the value of plaintiff's property.—(Thompson v. Citizens' Traction Co., 37 At. Rep. 205.)

LIABILITY FOR NEGLIGENCE.

PENNSYLVANIA.—A trench, 18 ins. wide, which had been dug 21 ins. from a street car track, stopped 3 ft. from the crossing. In attempting to cross the street, and after crossing the track, plaintiff, who was pushing a baby carriage, stepped away from the cross walk, and, finding her course obstructed by dirt thrown from the trench, started back. As she was on the track, an approaching car, a half square away, rang its gong, and, instead either of continuing to go back, or of turning and taking an unobstructed part of the crossing forward, she took several steps backward to one side, and fell into the trench. The accident occurred in daylight. *Held*, that she was guilty of contributory negligence.—(Lumis v. Philadelphia Traction Co., 37 At. Rep. 414.)

CONNECTICUT.—A cause of action is stated by a complaint for injuries received in alighting from a street car at a transfer point, which alleges that by reason of the traffic at such point, the short time the car stops there and the large number of passengers who get on and off the car, it is necessary to have a conductor there to prevent injuries to passengers, all of which was well known to defendant; that plaintiff signified to the conductor her intention of getting off at such point, as did also other passengers carrying bundles; that on the stopping of the car the conductor abandoned it, and that plaintiff, in endeavoring to alight without assistance, was kicked in the back and pushed down by a passenger hurriedly alighting from the car.—(Baldwin v. Fair Haven & W. R. Co., 37 At. Rep. 418.)

NEW YORK.—Negligence and contributory negligence are questions for the jury, where plaintiff gave evidence that when deceased drove on defendant's street car track the car by which he was killed was 125 ft. distant, and that no bell was rung as it approached the wagon, while defendant gave evidence that decedent drove on the track about 10 ft. in front of the car.—(Schron v. Staten Island El. R. Co., 45 N. Y. Supp. 124.)

NEW YORK.—Plaintiff in an action for injuries received while alighting from defendant's street car as it approached a street crossing claimed that he asked the conductor to stop before crossing a certain street; that the conductor acquiesced, and the car slowed up, but suddenly started up again before plaintiff got off. Defendant claimed that plaintiff attempted to get off before the crossing was reached, and that he gave no notice of his intention. *Held*, that it was competent to prove an order of the superintendent of police that the cars should stop only on the far side of a crossing, and that as a matter of fact they did stop only at the far side of the crossing where the accident occurred.

The arrest of the driver immediately after the accident is not admissible to prove that he was negligent.—(Maisels v. Dry Dock, E. B. & B. R. Co., 45 N. Y. Supp. 4.)

NEW YORK.—In an action by an administrator to recover damages for causing the death of his intestate, it appeared that the deceased was run over by an electric car, which after running over him, backed and ran over him again. There was a conflict of evidence as to whether the backing was the result of an effort to stop the car, and occurred within a few feet, or whether it did not begin until the car had run some distance. *Held*, that the defendant street car company was entitled to have the jury explicitly instructed that it was not responsible for any error of judgment of the motorman in managing the car after it first struck the deceased.—(Bittner v. Crosstown St. Ry., 46 N. E. Rep. 1044.)

LOUISIANA.—Riding outside of the car on a running step is unusual, and dangerous.

There were others on the step, near the plaintiff. They all passed a pole equally as near as the one by which a moment after the plaintiff was knocked off and severely injured. Taking into consideration the width of the step and the distance from the step to the pole, the rock and sway of the car in motion could not account for the contact of the plaintiff with the pole. The plaintiff must have leaned back into the darkness to such an extent that his head came in contact with the pole.—(Gilly v. N. O. City & L. R. Co., 21 South Rep. 850.)

NORTH CAROLINA.—In an action for injuries caused by the derailing of a street car because of excessive speed in going down a hill, statements made by the motorman to plaintiff prior to the accident as to the condition of the track, the want of sand, the overloaded condition of the car, and the excessive speed, were admissible as part of the res gestæ.

Such statements were also competent to charge the company with notice of facts requiring more than ordinary care.

A charge that a street car company must provide "all known and approved machinery necessary to protect its passengers" is too exacting, the correct rule being that it is negligence not to adopt all approved appliances which are in general use and necessary for the safety of passengers.—(Witsell v. West Asheville & S. S. R.Co., 27 S. E. Rep. 125.)

MICHIGAN.—It is negligence for the driver of a fire department truck, in going to a fire, to approach a street traversed by streetcars, without having his horses under such control as to permit his stopping them, though he has the right of way by ordinance.

Deceased drove a truck of the fire department, in going to a fire, at such rate that he could not stop the horses as they approached a crossing of defendant's tracks, and a car collided with the truck, and killed him. *Held*, that where there was evidence that the car was at a distance within which a jury might find that it could have been stopped, and that deceased might have driven across in the expectation that it would be stopped in view of his having the right of way, the question as to whether he was guilty of contributory negligence was for the jury.—(Garrity v. Detroit Citizens' St. Ry. Co., 70 N. W. Rep. 1018.)

PENNSYLVANIA.—Plaintiff, in crossing a street traversed by street cars on double tracks, did not look for cars after starting to cross, and went on the second track, six or seven feet in front of a slowly moving car, which it was impossible for the motorman to stop in time to avoid an accident, and which plaintiff would have seen had he looked. *Held*, that he could not recover for injuries caused by being struck by such car.—(Nugent v. Philadelphia Traction Co., 37 At. Rep. 206.)

U. S. SUPREME COURT.—If a horse car driver was negligent in attempting to cross a steam railroad in front of an approaching train, rssulting in injury to a passenger who jumped from the car in

a reasonable effort to avoid injury from the expected collision, the fact that the negligence of the gateman in lowering the gate between the horses and the car united in producing the result does not absolve the horse car company from liability.—(Wash. & G. R. Co. v. Hickey, 17 Sup. Ct. Rep. 661.)

NEW JERSEY.—The occurrence of a "lurch" or "jerk" of a street car, of sufficient violence to throw off the car a passenger who had notified the conductor of her desire to get off at Fifth Street, and who, after the conductor had called out "Fifth Street," had arisen, and gone to the rear door, in preparation for alighting, justifies an inference of some breach of the duty owed to her by the carrier, and falls within the maxim, "res ipsa loquitur."

A passenger on a street car who, on being notified that the car is approaching the point where he desires to leave it, gets up and goes to the door of the car, while it is in motion, for the purpose of being ready to alight, is not necessarily guilty of negligence. Such conduct is not per se negligent.—(Con. Tr. Co. v. Thalheimer, 37 At. Rep. 132.)

KANSAS.—The court will not declare, as a matter of law, that a motorman in charge of a car on an electric street railway, who propels it at the rate of about 12 miles an hour over a street crossing adjacent to a large public school building, when the street is filled with children just leaving school, who fails to ring the bell nearer to the crossing than 150 ft., and who neglects to keep watch of the track ahead of him, is not guilty of gross and wanton negligence.

Nor will the court declare, as a matter of law, that a boy, ten years old, who crosses a street car track in a crowd of school children just released from school, is culpably negligent because he fails to see a street car coming towards him, at a high rate of speed, without the ringing of any bell or other warning.—(Con. City & C. P. Ry. v. Carlson, 48 Pac. Rep. 635.)

NEW JERSEY.—The plaintiff, a girl of nineteen, was sleeping at night upon a bed made of boards and blankets upon a market wagon driven along a public highway by her father, who walked by the side of his horse. While crossing the tracks of a street railway, a nut came off one of the axles, to seek which the father left the wagon standing with a rear corner projecting over the rail of the car track. An electric car coming from the opposite direction struck this corner and knocked the wagon some distance, throwing plaintiff to the ground. *Held*, that the question whether the motorman exercised reasonable care to foresee and avoid the collision was properly left to the jury.—(Con. Traction Co. v. Behr, 37 At. Rep. 142.)

NEW JERSEY.—In the case of a trolley car overtaking another vehicle directly in a line with its progress, and a possible obstacle in its way, a proper regard for the rights of others requires that the car be reduced to such control that it may be brought to a standstill, if necessary, before reaching the obstructing vehicle.

Such timely warning of the approach of a trolley car must be given as will enable others to avoid any danger from it.

It is the duty of others not to obstruct the track, but a violation of such duty does not necessarily constitute such contributory negligence as will relieve the trolley company from responsibility for an accident which might have been avoided by the exercise of proper care.—(Con. Traction Co. v. Haight, 37 At. Rep. 135.)

LOUISIANA.—If, with due attention, the motorman of a street car could and should have perceived a child of tender age on or straying near the tracks under circumstances indicating the great danger of the child, the motorman should seasonably use the preventative means to avert the accident; and his failure in that respect, resulting in injury to the child, will make the railroad company liable for the injury.—(Nelson v. Crescent City R. Co., 21 South Rep. 635.)

PENNSYLVANIA.—Whether injuries to deceased, caused by a sudden starting of a street car, were the proximate cause of her death, was a question for the jury, she having at once felt the physical effects of her injury, followed the next day by symptoms of premature childbirth, which occurred a few days later, and was followed by lockjaw, which caused her death; the medical testimony being that, while tetanus resulting from childbirth is comparatively rare, there is a distinct relation between it and miscarriage, and that it is one of the natural consequences to be apprehended; there being no evidence to justify the court in saying that there was an intervening independent cause, though it was shown that the disease was caused by specific infection, it being also shown that the miscarriage made deceased especially liable to infection.—(Brashear v. Phila. Tr. Co., 36 At. Rep. 914.)

PENNSYLVANIA.—Plaintiff was riding on defendant's street car. She stood, holding an overhead strap, all the seats being taken; and a sudden movement of the car threw her forward, injuring her spine. She testified that the car ran roughly, and seemed to jump and run across the track; that she would have fallen if she had not held the strap; that she could not say that the car left the track, but she believed it did; that it seemed to leave the track, and be pulled back by the forward car. *Held* to raise a fair presumption of negligence, sufficient to take the case to the jury.—(Dixey v. Phila. Tr. Co., 36 At. Rep. 924.)

WASHINGTON.—Where a complaint in an action against a railroad company and a receiver alleges injuries by the negligence of a motorman who was the agent of the company, it states no cause of action against the receiver.

Where a motorman stops and keeps a car at a place where it is dangerous for an intending passenger to go to it, of which danger the motorman knew, it constitutes negligence for which the street car company is liable.—(Vasele v. Grant St. El. Ry. Co., 48 Pac. Rep. 249.)

MAINE.—Electric street cars have, in a qualified way at least, the right of way, as against persons traveling on foot or with teams and carriages, in the same manner as ordinary steam railroads have; and all such persons should carefully observe the movements of street cars, when likely to meet them, and leave them an unobstructed passage, as well as they reasonably can.

Great care must also be exercised by motormen and conductors on the street cars to see that no injury be caused by themselves to either persons or property. Street cars are granted very great privileges out of the public right, and their treatment of the public must be reasonable in return; so that when a person or a team, through accident or misjudgment, or for any cause, be caught in any position of peril by coming in close contact with a car, it is the duty of those managing the car to use all possible effort to avoid collision or injury.—(Flewelling v. Lewiston & C. H. R. Co., 36 At. Rep. 1056.)

NEW YORK.—Contributory negligence is a question for the jury where plaintiff, a boy 9½ years old, started to cross the street when the car by which he was struck was at a sufficient distance for him to cross safely under ordinary circumstances, though when he reached the track he saw the driver increase the speed of the car, and notwithstanding attempted to cross.—(Elleck v. Met. St. Ry. Co., 44 N. Y. Supp. 523).

NEW JERSEY.—The case was properly submitted to the jury, where the evidence was conflicting as to whether plaintiff, without looking behind him, suddenly drove across defendant's track when the trolley car was at a distance of only 35 ft., or whether he saw the car from 200 to 400 ft. away, when he attempted to cross, and would have succeeded but for its great rapidity.—(Con. Tr. Co. v. Knoth, 36 At. Rep. 1086.)

ILLINOIS.—An instruction that "the plaintiff, as a passenger, was not required by law to exercise extraordinary care, or manifest the highest degree of prudence to avoid danger. All the law required of him while traveling as a passenger was that he should exercise ordinary care and prudence for safety, such as ordinarily careful persons would exercise under the same circumstances as those shown in evidence,"—is not open to the objection that the two sentences are in conflict, or that they invade the province of the jury in drawing a conclusion from the evidence.—(West Chicago St. Ry. Co. v. McNulty, 46 N. E. Rep. 784.)

TEXAS.—Plaintiff, under an allegation of negligence in that the car was suddenly started as he was attempting to get on, cannot recover because of any negligence in not stopping it thereafter.—(Christie v. Galveston City R. Co., 39 S. W. Rep. 638.)

COLORADO.—The car repairer of an electric railway is not a fellow servant of a conductor whose death was caused by inadequacy of repairs.

Deceased, conductor of an electric street car, stood on the track, at the end of his car, adjusting the trolley. Another car stood about 8 ft. from deceased, and headed away from him. The electric reverse switch on such car was out of repair, by reason of which, instead of moving forward, the car came suddenly back, killing deceased. A witness testified that the car was moving back slowly, by the force of gravity, while deceased was adjusting his trolley. He could have adjusted the trolley from the platform of his car next the other car, by leaning over the railing. *Held*, in an action for death by wrongful act, that it was not error not to instruct as to contributory negligence, no instruction thereon being requested.

Evidence of the defective condition of a car on the day preceding an accident caused by such condition is admissible to show notice thereof to the railway company.—(Denver Tramway Co. v. Crumbaugh, 48 Pac. Rep. 503.)

PENNSYLVANIA.—A street car company cannot be held liable for injury to one riding on a wagon which is negligently turned to cross the track when the car is but a short distance from it; the speed of the car at the time being moderate, there being no negligence in its management, and everything being done to stop it as soon as possible.—(Kane v. People's Pass. Ry. Co., 37 At. Rep. 110.)

PENNSYLVANIA.—Statements of one riding with the motorman on a street car, made immediately after a person was run over, and before he was removed from the track, that he had run ahead of the car to pull him of the track, and did not have time to do so, is admissible as part of the res gestæ, though he was not in the company's employ.

Declarations of a motorman two minutes after he ran over a man, and while he and others were in charge of the body of the man, that he could have stopped the car in time, but supposed a person who had run ahead would have the man removed from the track before the car reached him, is not too remote from the occurrence to be admissible as res gestæ.—(Coll. v. Easton Transit Co., 37 At. Rep. 89.)

DELAWARE.—A street car company, which has a right to use a street for its cars, is not guilty of negligently obstructing the street by allowing one of its cars to remain on a spur track on the street for a reasonable time for the purpose of allowing another car to pass.

Plaintiff, employed to clean street cars, was standing near a car on a spur track, while another car was passing, and was injured by a wagon driven by defendant's servant in such a way that when he was attempting to pass the car the rear wheels of the wagon slid along the tracks, and crushed plaintiff against the car. *Held* that, though plaintiff was guilty of some negligence in standing on the street without looking about him, it would not prevent a recovery if defendant's servant did not exercise due care in attempting to pass the car.—(Ford v. Charles Warner Co., 37 At. Rep. 39.)

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Special effort will be made to answer promptly, and without charge, any reasonable request for information which may be received from our readers and advertisers, answers being given through the columns of the JOURNAL *when of general interest, otherwise by letter.*

Street railway news and all information regarding changes of officers, new equipment, extensions, financial changes, etc., will be greatly appreciated for use in our Directory, our Financial Supplement, or our news columns.

All matters intended for publication in the current issues must be received at our office not later than the twenty-second of each month.

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WE desire to call special attention to a circular letter found in another column, issued by the committee appointed at Cleveland by the Street Railway Accountants' Association of America, to consider the question of a standard system of street railway accounting covering the classification of operating expense accounts, construction and equipment accounts, and a form of annual report. Few things are more urgently needed in the street railway industry to-day than an authoritative recommendation looking to the standardization of accounting methods. We earnestly hope that no company will refuse to further the efforts of this committee, which has cheerfully, and in a public spirited way, taken upon itself the great burden of standardizing and comparing the immense mass of information which they have asked to have sent to them.

WE issue this month our Financial Supplement, "American Street Railway Investments," and it is with some satisfaction, too, at the exceptionally complete returns which we have received from our friends, the street railway companies of the United States and Canada. Over 1000 companies have sent in direct information for our use, and of this number nearly 900 have revised and "approved" final proofs sent to them on the eve of publication. Less than 250 companies, or 20 per cent of the entire number in existence in this country, have failed to furnish us with information direct, and of this number, the reports of more than 100 companies have been brought up to date from official sources and are entirely authoritative, while many of the remainder are new corporations whose roads are building, but which have not yet commenced operations. Of the 1262 reports included in the "Red Book," 919 bear a date of information in April or May, 1897, 139 are dated in the first quarter of 1897, and 204 only bear date prior to Jan. 1, 1897. We feel that our thanks are due to the street railway companies who have so cordially co-operated with us during the last three years in our plans for issuing a financial manual which shall properly represent the great street railway industry.

IT is difficult to see how the recently given decision of the Supreme Court of Indiana to the effect that the Indianapolis three cent fare bill is constitutional, can possibly be correct. According to the Indiana law, special or local legislation is admittedly unconstitutional. Nevertheless, the Indiana Legislature passed a law relating to "street railways in cities in the state of more than 100-000 inhabitants by the census of 1890"—a nomenclature which just as clearly said "Indianapolis" as if that name itself had been used, since there was but one, and could possibly be but one city of that size, *by that census*, in the state. If the law had omitted "by the census of 1890" there would have been no question about its constitutionality, we presume, at least as regards this particular point, and this is the usual way in which our honorable legislators at Albany assume the municipal government of New York City, but with these words in, it does not seem possible, we repeat, that any court, uninfluenced by public opinion, could fail to hold that this is "special legislation." The United States Supreme Court will be called upon to settle the conflict between the courts of the state and of the United States, the latter holding the law unconstitutional, and we have no doubt that its decision will be emphatically against the constitutionality of the three cent fare law.

IN another column we present an interesting comparison of the gross receipts of our principal street railway companies for their respective financial years ending in 1895 and 1896, together with the percentage increase or decrease in these receipts in each case. These tables, and the more complete ones found in our Financial Supplement, are well worth study by managers as a means of determining whether the results obtained with individual systems are in line with others of the same class or are affected by local conditions not generally found. It is quite satisfactory on the whole to note that there has been an increase in gross receipts of 7.39 per cent in 1896 over 1895 for the 195 companies given in the tables, the total receipts for 1896 being $116,389,320, as against $108,377,662, in 1895. Thirty-seven companies only out of the entire number report decreased receipts, and these are usually

by very small percentages, only thirteen, of which three were found on elevated railways, showing decreases above five per cent. The largest percentage increase has taken place among roads having gross receipts of from $25,000 to $50,000, next to which come those having receipts of from $100,000 to $500,000, while the increase in receipts of the largest properties averages but about 6.5 per cent. The great bulk of the receipts is found, of course, in these larger properties, the 49 systems earning over $500,000 reporting nearly 85 per cent of the total in 1896. From reports coming in to us from many street railway companies since Jan. 1, 1897, we are inclined to fear that bicycle riding is cutting more of a figure in reducing street railway receipts this year than has ever before been the case, and we should not be surprised to see some diminution in the percentage increase in gross receipts of 1897 over 1896 as compared with the increase in 1896 over 1895.

THE important work of preparing a standard set of rules for safe electrical construction and wiring, which has engaged for a year or more the National Conference on Standard Electrical Rules, has now been completed. The status of the rules for electric wiring was in an extremely chaotic condition before the undertaking of this work by the body which has had it in charge. Not only was there a pronounced difference of opinion on vital points between the electrical men and the representatives of the insurance interests as to what constituted proper wiring, but there was also a marked divergence upon the same points between the different insurance organizations themselves. The friendly spirit with which the introduction into buildings of electric light and power circuits was first received by the insurance organizations gradually changed to one of a more and more hostile character as the losses through defective wiring accumulated. The rules adopted by the different insurance bodies became finally so divergent as to be in some points contradictory to each other, and some action toward a standard was sought by the electrical and insurance interests alike. As a result, the National Electric Light Association at its convention held in New York, May, 1896, appointed a committee, with W. J. Hammer as chairman, and extended invitations to the various organizations interested in settling upon some standard code. The outcome of this action was the organization of the National Conference on Standard Electrical Rules composed of representatives of insurance, electrical and kindred interests and consisting of the following organizations: National Electric Light Association, American Institute of Electrical Engineers, American Street Railway Association, National Board of Fire Underwriters, American Institute of Architects, International Association of Fire Engineers, Underwriters' National Electric Association, Factory Mutual Insurance Association, American Society of Mechanical Engineers, Western Union Telegraph Company, Postal Telegraph Company, American Bell Telephone Company, General Electric Company, Westinghouse Electric & Manufacturing Company. This list was increased later by including several other representative bodies. The actual compilation of the rules was delegated by the National Conference to a committee of eight, including the president, whose work the members of the Conference have unanimously voted to recommend to their respective organizations for approval. At the Niagara Falls meeting of the National Electric Light Association, the rules with the title "The National Electrical Code" were adopted by that body unanimously, and, as the other principal organizations adopt them, their official approval will be printed upon the flyleaf of the book of rules. As the code has already received the unanimous endorsement of the Code Committee of the National Conference and of the Codification Committee of the Underwriters' National Electric Association, it is thought that there will be no doubt as to its adoption by each of the organizations interested. We wish to congratulate the members of the National Conference and of the Code Committee upon the success with which their efforts have been followed and believe that their work will have a most important effect on the development of electrical interests.

A SLIGHT but perceptible improvement in business is evident as the country approaches nearer to a settlement of the tariff questions, and there is a distinctly more cheerful tone in the commercial and financial world. As far as surface railway equipment sales are concerned, the summer solstice is upon us, and it is hardly likely that there will be material improvement before the early fall. Large contracts for the equipment of elevated lines have just been placed, however, and some extremely large business in this field and that of heavy electric railroading is fairly in sight with the prospects good for its being brought to an issue before Jan. 1. On the other side of the water, the greatest activity in electric railway matters continues. The closing of the contract for the Central London Underground Railway announced last month has given a fillip to electrical enterprises in the principal capitals of Europe, and advertisements for bids and announcements of contracts placed are coming into manufacturing centers from every quarter of the globe. Constantly lowering prices in the United States during the last three years have taught our manufacturers economies which they might not otherwise have learned in a decade of good times, and these economies, together with the superiority of our goods, have enabled American makers to build up an export trade far larger than we have ever known before, in spite of our preconceived ideas as to the way in which we are handicapped in international markets by comparatively high prices for labor. American street railway manufacturers, who have made agency arrangements abroad, report to us, almost without exception, that they are doing a surprisingly good business and at satisfactory prices and terms of payment. Many are holding back with the idea that "the game is not worth the candle," but to such we say emphatically that we believe they are mistaken, and that there is no reason why American goods should not go to nearly or quite all the great consuming countries of the world. What we need more than anything else to-day is an international banking system established by Americans for the benefit of Americans. Such a system has been one of the great forces which has brought Great Britain success in foreign trade, and the Germans, who have become their principal competitors in international markets, are wise enough to see this, and are creating a German international banking system which will, some of these days, surprise the world when its extent and completeness is fully realized. There are many branches in which American manufactur-

ers are now prominent—in none more entirely so than in electric railway equipment. If our manufacturers grasp the situation promptly, we can, to a great extent, prevent the successful competition of foreign makers of apparatus simply by the entirely legitimate process of perfecting our product and lowering its cost of production.

Electric Railway Power Station Design.

AN interesting difference of opinion between well known Chicago engineers regarding types of railway power station design and equipment, has been reflected in our columns of the last two months, and is well worth the attention of engineers. The power station which gave rise to this discussion has just been completed, and is equipped with forty-eight horizontal return tubular boilers, smokeless furnaces, economizers, six single cylinder, double engines of 2000 h. p. each, connected by rope transmission systems to twelve 800 k. w. generators—forming a non-condensing generating plant of approximately 12,000 h. p. capacity contained in a building which covers an area of 57,780 sq. ft. equivalent to 4.8 sq. ft. per horse power capacity. The plant is located at about the center of the power load and at considerable distance from condensing water.

Disregarding minor points of criticism made against the design of this station, the principal ones are, first, that its efficiency in coal consumption would be from 25 to 50 per cent more were a compound condensing steam plant installed instead of a simple non-condensing plant; second, that direct connected units are preferable to rope or belt driven units for railway service; third, that the furnaces should have been so designed as to make economizers unnecessary; and fourth, that water tube boilers would have been preferable to return tubular in this particular instance.

The reply by Mr. Hill, the designer of the station, to the first criticism is that the interest upon the additional cost of a compound condensing plant, plus the additional cost of repairs and depreciation on its more complicated apparatus would more than counterbalance any probable saving in fuel. He also makes a strong point, and one which is too often overlooked by engineers, in saying that, other things being equal or nearly so, it is better to lock up the smallest possible investment money in a plant operating under changing conditions, and where "improvements in the art" may at any time make radical changes necessary. Mr. Hill is undoubtedly right in considering all sides of the question of commercial efficiency rather than fuel efficiency only, and if it is true in this particular case that the saving in fuel would be no greater than the sum of additional interest and depreciation, his argument is unanswerable. We think, however, that he has overestimated the difference between the cost, in these days of low prices, of a compound condensing plant and simple non-condensing plant even if the former includes the cost of an air condenser to be used in the present location of the station where ordinary condensing water is not available. The item of repairs and depreciation is a difficult one to estimate, but while there is no question that there will be some saving from both these elements of operating cost to be credited to the simple plant, it is certainly significant that the study by many engineers of the special conditions under which our large railway power stations are operated, has led them to recommend, with few exceptions, compound condensing plants.

Mr. Hill's answer to the second criticism is that, by means of the rope drive, greater flexibility between engines and generators is secured, together with better insulation, better distribution of weight, less frictional load in the engine generator unit, and increase in life of apparatus. These are the engineering advantages claimed for the rope drive units, in addition to which is the important one of a saving in interest on the additional investment required for a direct connected plant. Mr. Hill's critics claim, however, and with some reason, we think, that the engineering advantages urged by Mr. Hill are unimportant if not negative, while the saving in interest on additional investment in direct connected units would be, in almost every case, offset by the saving in that on extra investment in high priced land for the power station where the more compact plant is installed. It certainly does not seem that anything could be more flexible than the steam in an engine cylinder, and we think that the old idea that direct connected units are unsafe because of the sudden shocks put upon them in service is an exploded one. Insulation of generator units in any desired way is not a difficult thing to accomplish, and as to frictional load, we doubt if there is any essential difference between that of two heavily loaded bearings and eight lightly loaded ones. It is impossible, however, to generalize on problems of this character which are properly a subject for special investigation in particular cases.

We believe very firmly in the more general use of economizers in railway plants, particularly where coal is expensive, for we doubt if theoretical efficiencies in furnaces can be often so closely reached, even in regular service, as to avoid the loss of considerable heat in the stack gases more than is necessary for maintaining draft, while it is true also that boilers often have to be forced in this character of service. This is, like many other engineering problems, dependent not a little upon special conditions, but the increasing use of economizers in this country and abroad would certainly indicate that they have been found valuable as fuel savers in a great many classes of service. One decided element of safety in their use is found in the fact that they can be instantly cut out of service if the temperature of the gases at the base of the stack proves temporarily too low for proper draft.

The question of water tube versus return tubular boilers for electric railway service has been pretty thoroughly thrashed out among engineers and railway managers during the last few years, and certainly, as gaged by the number of engineering decisions in favor of each, water tube boilers have easily won the day. We imagine that this result has been brought about not carelessly or by reason of "engineering fads," but because of definitely more favorable results in most cases from the use of water tube boilers, in fuel economy, in flexibility under heavily varying loads, and in comparative freedom from accidents.

It is through public discussions of problems of this general character that progress is made, and it is to be earnestly hoped that honest differences of opinion among engineers may not be stifled or given limited publicity. More is often learned by mistakes than by successes, and the engineer whose opinion is most sought after is he whose experience, both of failure and success, is wide and far reaching.

The Erection of Power Station Switchboards.

By George Moffat.

While the mission of switchboards in power stations is to concentrate all energy at one point, from which it may be measured, distributed and controlled, the number of different designs which have been tried is only equalled by the number of makers of electrical apparatus with ideas of their own—modified and changed by almost every constructing engineer.

In the old style of switchboard, with but two or three feeders, the construction was very rude and simple, and consisted only of the necessary number of switches with fuses and meters mounted on wooden panels. The latter were sometimes vertical and sometimes horizontal, with an occasional one lying at an angle of 45 degs.

It is on the proper construction and operation of the board that successful and economical service of the plant depends to a great extent. An accident may temporarily embarrass any other part of the system without serious consequences, but here it will be keenly felt. The board does not always receive the recognition it deserves, as a buyer will be particular about generators, boilers and engines, while knowing little or nothing of the board and its instruments. It is the fascinating mystery associated with this part of the system which does the mischief.

Of the more important attributes essential to fully meet the requirements of the service, that of convenience is paramount. Switches and circuit breakers must be easily reached, as should be the rheostats; the board should be located near the machines and not with 95 ft. of empty floor space between them, as I have seen in one of our large cities; the machine panels should be grouped together that the machines may be manipulated with most freedom and flexibility; there should be points where station voltmeters or boosters can be switched in if necessary,

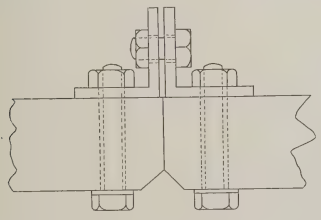
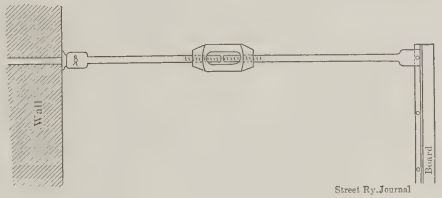


FIG. 1.—METHOD OF BOLTING PANELS TOGETHER.

and every part of the back of the board should be readily accessible in case of repairs. By conveniences I do not mean automatic devices, for they are not always conveniences by any manner of means, nor is every novelty an improvement. All of these are dependent, of course, on room available, which is equivalent, in power station work, with room which cannot otherwise be used.

If possible to avoid it, do not locate the board over steam piping, as the ascending heat has an injurious effect; Nor should it shut out light by being built in front of windows, for aside from the point of view of health, artificial lighting will be necessary throughout the day if this precaution is not taken. The best plan is to have the machines and the board facing each other, as the man in charge of the engine can then act more intelligently than if he cannot see the board without running around the end of the engine.

Compactness is almost synonymous with convenience in this connection, for the more condensed and compact —within reasonable limits—we have the various parts the more easily can they be reached by the attendant. There is no doubt but that in the desire to secure compactness some designers go to the other extreme until parts of the



Street Ry. Journal

FIG 2.—METHOD OF BRACING SWITCHBOARD FROM WALL.

construction are really dangerous to the employes. Sometimes bus bars are placed so close to the ironwork of the board that with the jarring of the building they will touch, making the iron frame alive and liable to shock any person coming in contact with it. One maker has the circuit breaker so close above the switch, on the feeder panels, that if the switch be thrown in while trouble is on line the breaker will blow directly in the operator's face. These are the *little things* about which the owners may know nothing, still they have a decided effect on the efficiency of the system.

As all circuits are opened at the switchboard it is imperative that it should be fireproof, otherwise the flashes incident to opening the breakers will soon char it. Of course this non-combustible material must also be a good insulator; hence the employment of slate and marble, which also gives an opportunity for the artistic manager to display his skill in a neat appearing board, and as the board is the index and controlling point of the system it is but just that it should receive extra attention and be kept neat.

The necessity of using finely finished instruments facilitates this. Moreover, owing to the cost of first class instruments—such as the Weston—and other apparatus, the board to be efficient will cost money, and the endeavor of some engineers to save money on the back of board, in labor and material, to put fine finish on the front is fatal to the very object they seek—economy.

Being built in sections, the necessity becomes apparent of having some good, strong, quick method of construction, one in which the board can be added to at any time and still preserve its symmetry. The attachment on the back of the board, at the sides, of angle iron which can be readily bolted together, as shown in Fig. 1, is the most satisfactory of any method. When it becomes desirable to add to this board new panels can be added, or any panel can be taken down to be replaced in case of accident. The advantage of this arrangement is obvious when it is stated

that two men can replace one of these panels in less than half an hour, while I have seen five men almost an entire day doing the same thing on a board constructed by one of the two largest manufacturers of electrical machinery in the country.

The board should be supported by fitting an eye expansion bolt into the wall, and by using a turnbuckle in

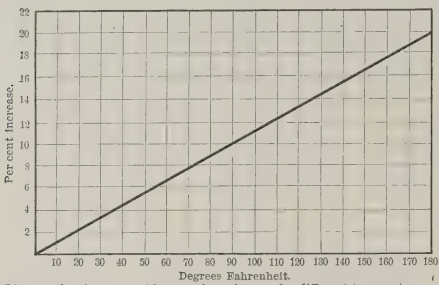


Diagram showing per cent increase in resistance for different temperatures.

FIG. 3.—DIAGRAM SHOWING RELATION BETWEEN TEMPERATURE AND RESISTANCE.

the tie rod, perfect adjustment can be secured. This is plainly shown in Fig. 2 in which it may be seen that the upper bolts in the angle irons are used to hold the rod. The manner of fastening to the floor may be either that of using an angle iron laid horizontally or with a 2 in. × 4 in. wooden piece.

While this gives a very strong, substantial board it must be borne in mind that its function is not to support large bus bars, massive shunts, cables and connections, which are a necessity in large stations, but these should be supported from proper independent supports and not from the slate. One able manager, with whom I am acquainted, made this mistake and marveled that the slate broke. Thorough ventilation is also essential, for, as all leads will heat somewhat, it will be necessary to carry off this heat.

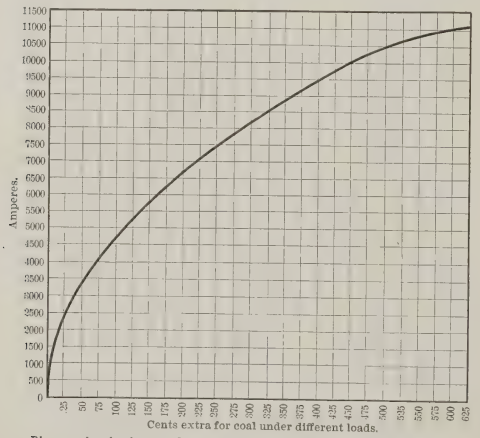


Diagram showing increased cost of operating when there is a temp. rise of 45° F. Coal costing $2.80 per ton: 4 lbs. allowed to K.W. hour: resistance 1/10 ohm.

FIG. 4.—DIAGRAM SHOWING RELATION BETWEEN TEMPERATURE AND COST OF OPERATION.

Aside from the slight element of risk attending this heating there is also a waste of power, because, with the increase of temperature, there is also an increase in resistance. The resistance at the back of the board sometimes becomes quite a factor, owing to the number of connections. The percentage of increase of resistance owing to increase of temperature is shown in the diagram in Fig. 3.

With insufficient ventilation and when in close proximity to steam piping there is much wasted power. With coal at $2.80 per ton and allowing 4 lbs. per k. w. hour, Fig. 4 shows the increased cost in cents for different amperages at an increase in temperature of 45 degs. F. This is taking the resistance cold at $\frac{1}{10}$ ohm. If a station manager know his multiplier (resistance of back of board) and is troubled with heat he will be astounded if he should calculate the loss.

The best and most convenient way of securing proper ventilation—provided the board is located properly—is simply to leave the top and sides of the board open that there may be free circulation. This system of ventilating will also have a tendency to keep all parts neat and clean; it is not needful to enter into a discussion to prove that this is desirable. The mischief that can be accomplished by this agency—dirt—is surprising; the finer instruments, if not protected, are rendered entirely worthless. Dirt, if allowed to lodge and accumulate in rheostat segments, will detract from their efficiency, while that which finds a resting place on switch blades and jaws will prevent them from making perfect contact, and promote heating. One 1000 amp. switch, which came under my notice, was allowed to get very dirty, and when the machine had worked near full load it required the united strength of three men to open the switch.

When any attempt is made to clean the back of the board, it is usual to send someone with a dust brush and order to "clean up." This cleaning up process means

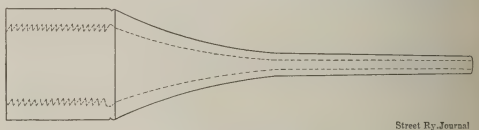


FIG. 5.—RUBBER NOZZLE.

work, and as it is impracticable to get at all parts needing it, the improvement is but slight.

Some of our large stations have installed air pumps to blow out armatures (and those which have not should do so, as it is the only perfect way of accomplishing this), and when available this method should be used on the switchboard. A pressure of about 25 lbs. will be found ample. It is not all advisable to use the ordinary brass nozzle, for it is not policy to invite accidents, and the nozzle cannot be used in close quarters on account of its blunt shape.

In Fig. 5 is shown a nozzle for this purpose. It is made of hard rubber, that it may be used in any place with impunity, and its peculiar shape will permit it to enter any place where dust or dirt is liable to lodge. With this device there is no excuse whatever for dirt or filth, as it will vanish as if by magic. It is this class of tools which the operating engineer will appreciate; tools, not to do the men's work, but those which compel him and assist him in its performance. Complication on the switchboard —or, for that matter, in any part of the station—is to be religiously shunned.

The less number of instruments we have which are essential to proper working the less liability is there of men becoming entangled in case of accident. A multiplicity of devices is sometimes confusing to the engineer himself as well as to the novice. On some switchboards bells are arranged to ring when some certain action takes place when there is no need whatever for such a signal. This is a practice which should be condemned. One genius had seven bells on the board, but why there I do not know although some of them were necessary. With his two telephone extension bells (local and Bell), fire alarm, door bell, circuit breaker bell and two signal bells for stopping and starting machines, the effect at times was rather deafening and should have made its designer happy —but I doubt it. The proper idea to follow is to have a board which makes serious mistakes impossible. This does not mean that there must be an elaborate system of

self-locking switches and circuit breakers, but that the switches be so placed that if thrown in accidentally the result would not be to shut down the station or burn out a machine. But singularly enough, just such complex systems exist on most boards.

When one switch can be made to do the work of two or more, and at the same time do away with an element of risk—as replacing the positive, negative and equalizing switches with a three pole switch—it has a double claim on our attention, or should have.

Simple, safe and efficient control is the end at which to aim. The place for a switchboard instrument is on the board and not on the machine, which may be a considerable distance away, but we find it the practice of two of our large makers to commit this very fault; they place their negative switch on the machine. A prominent Chicago firm outdoes even this by placing a switch in the pit beneath the machine.

Pleasure Traffic in Cincinnati.

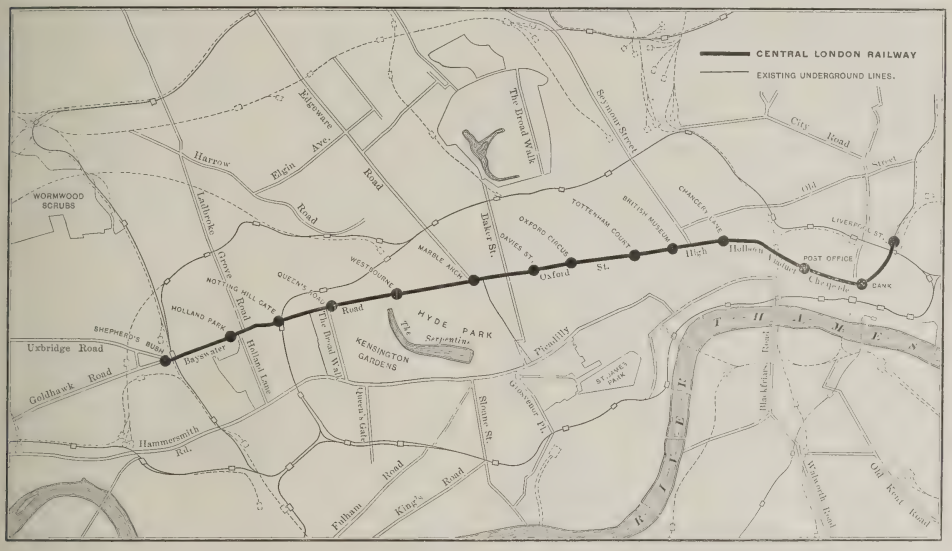
Superintendent T. M. Jenkins, of the Cincinnati, Newport & Covington Railway Company, is a great believer in park resorts when properly managed. The original outlay on the Ludlow-lagoon, reached by that company's lines, was very large, and it has been operated on a broad and generous plan ever since its opening two years ago. The first year's business far exceeded all expectations, but many were the predictions that the novelty would quickly wear off and the original investors would never begin to get their money back. Instead of the interest dying out, however, it continued to increase and the business this season is larger and more satisfactory than ever. On Sunday, June 13, the road carried 15,420 passengers to the lagoon, this being the largest Sunday business in its history. On holidays these figures have, of course, been exceeded considerably. Elaborate spectacular productions have been a feature at the lagoon ever since its opening. Almost every manner of amusement feature known to pleasure resorts can be found within the grounds, and besides the usual devices are numerous aquatic attractions of a high order. There is a regular admittance of twenty-five cents to the enclosure and two performances are given daily.

The Central London Underground Railway.

The most recent addition to the system of underground railways with which London is provided, and the most important of all the present undertakings of a similar character in the world—the Central London Railway (underground)—has an especial interest for Americans. This is due to the fact that the entire system and electrical equipment will be of American manufacture. With the exception of the elevators, the entire electrical contract has been assumed by the British Thomson-Houston Company, Limited, representing in Great Britain the General Electric Company, while the elevator contract has been secured by Frank J. Sprague, of New York.

The road, which is laid in two deep subway tunnels, driven by the Greathead shield method, stretches from Liverpool Street, beneath the station of the Great Eastern Railway Company, near Broad Street, the city terminus of the North London Railway, and the Bishopgate Street station of the Metropolitan Underground Railway, through the very center of the great commercial district of the city, and runs due west under Holborn, High Holborn, Oxford Street and past Hyde Park as far as the generating station, located at the terminus at Shepard's Bush. It follows the line of greatest traffic in London. The road will receive passengers from the great underground central depot, now in course of construction by the Central Railway Company, between the Bank of England and the Royal Exchange, and passengers brought in by the main lines of the London & Northwestern, Midland and London & Southwestern Railroads. It is especially at this point in the city that crossing is a perilous task, and the railroad company is now engaged in constructing a series of subways immediately below the surface for the convenience of pedestrians and as approaches to its own station below. From this central depot will radiate not less than five underground tunnels, some 85 ft. below the surface, each feeding a separate and equally populous district of the great agglomeration known as London.

The construction of the road itself has been carried out by the Electric Traction Company which has also fitnanced it. It is this company that has made the contracswith the British Thomson-Houston Company and F. J. Sprague, and which will turn over the road fully equipped



MAP SHOWING ROUTE OF THE CENTRAL LONDON UNDERGROUND RAILWAY.

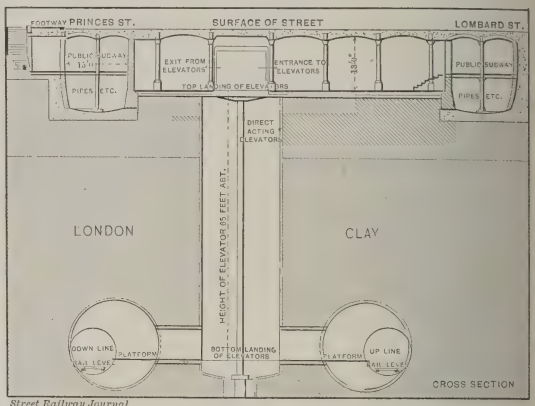
and in working order for the Central London Underground Railway ready for operation.

It was not until three years after the necessary Parliamentary act was passed in 1893, that the actual work of building this road could be undertaken. Vertical shafts were driven at six different points to a depth of between 60 ft. and 70 ft. and the tunneling was begun in four tunnels at once, two running in each direction from the shaft. At each of the stations were driven two shafts 23 ft. in diameter and 87 ft. deep and one 18 ft. in diameter and 76 ft. deep—the two former containing two ingress and two exit elevators and the smaller two spiral stairways, one for ascending, the other for descending passengers. The shafts are built up of cast iron plates 1⅛ ins. thick and 4½ ins. in the flanges. All crevices in the back of the plates are filled with hydraulic lime grout injected under pressure.

The glazed white brick passages leading from the bottom of the shafts to the stations are 8 ft. 3 ins. wide on the entrance side. On the exit side where crowds might collect in front of the elevators, they are 13 ft. wide.

At the stations the widened tunnel is 21 ft. in diameter, and 375 ft. long. The main tunnels are each 11 ft. 6 ins. in diameter, and are practically steel tubes driven forward through the clay. The plates used to line these tunnels are ⅞ in. thick with flanges 4 ins. deep. The shield for driving the small tunnels was 12 ft. 8 ins. in diamater and was pushed forward by six hydraulic rams giving a pressure of 230 tons. For driving the station tunnels the shield was 23 ft. 8 ins. in diameter and was pushed forward by 22 rams giving a pressure of 840 tons. Each tunnel will contain one track, one tunnel carrying the east bound trains, the other, the west bound trains.

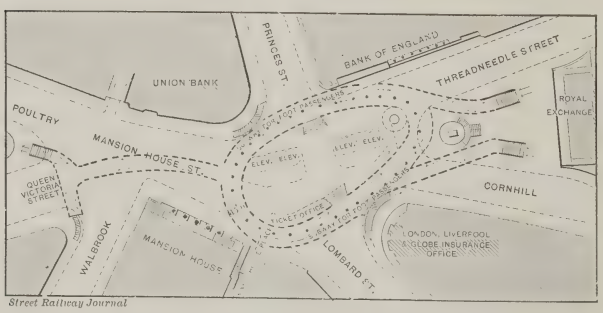
In laying the roadbed, the best modern steam railway practice has been followed. The steel rails weigh 100 lbs. to the yard and are laid upon heavy cross ties. The system of contact will be the third rail, with the contact rail placed between the service rails of the track and insulated. The conductors will be fed at intervals from a copper feeder cable. This feeding will be controlled from the signal boxes and the operator will be able to cut out any section of the line when necessary. This method of contact is similar to that employed so successfully by the General Electric Company in the installations on the East Weymouth, Nantasket Beach and Berlin-Hartford branches of the New York, New Haven & Hartford Railroad. The method of traction, however, will differ radically from that used on the branches above mentioned. Instead of passengers carrying motor cars, with the motors mounted on the forward axle, locomotives similar in appearance to those used on the belt line tunnel service of the Baltimore & Ohio R. R. will be used to haul the trains. The reason for this lies in the fact that the tunnel is only 11½ ft. in diameter and that the bottom of the tunnel must accommodate the roadbed. This materially reduces the clearance. The motors require to be suspended between 30 in. wheels, at least, to give the necessary clearance between them and the ground, and this fact has brought about the locomotive in place of the passenger motor car.



Street Railway Journal

SECTION OF STATION IN FRONT OF BANK OF ENGLAND.

The total length of the road is 6½ miles, from the station at Shepard's Bush to the Mansion House, or 13 miles of single track. There will be fourteen stations including the termini, located at the following points running east from Shepard's Bush: Holland Park, Notting Hill Gate, Queens Road, Westbourne, Marble Arch, Davies Street, Oxford Circus, Tottenham Court Road, the British Museum, Chancery Lane, Holborn Viaduct, the Mansion House and Liverpool Street. In designing the line a decided departure has been made in the arrangement of the station approaches. As the railway company is not embarrassed by any considerations of grade, as in the case of surface railroads, the plan is adopted of making the road act as an auxiliary to the operation of the trains as well as merely to carry them. On each side of each station is a 3 per cent gradient rising on the approaching side and falling again to the level of the road on the departing side. This unique method gives a retarding effect to all trains approaching the stations, equivalent to the application of considerable braking power, while materially aiding in the acceleration of all trains as they leave the platforms. Furthermore, the saving in power necessary to secure the requisite rapid acceleration is by the adoption of this plan, calculated to amount to about 33 per cent.



Street Railway Journal

PLAN OF STATION IN FRONT OF BANK OF ENGLAND.

The schedule speed of the trains will be 14½ miles an hour, with stops at each station of twenty seconds. The trains will be run at first under a headway of 2½ minutes, which will be reduced, as soon as the traffic demands, to a headway of two minutes.

The generating station will be located in the open air, at the extreme western end of the line near Shepard's Bush station. In building this the most modern methods will be followed. The steam will be supplied from Babcock & Wilcox boilers and the engines, of which there will be six, will be Allis machines each of 1300 h. p.

The electrical system adopted is the three-phase alternating, high voltage primary with reducing transformers and rotary converters, similar in general principle to that installed successfully by the General Electric Company for the roads between Lowell, Mass., and Nashua, N. H.,

and at Portland, Ore., between Niagara Falls and Buffalo, and on the line between Dublin and Dalkey in Ireland.

The dynamos, of which there will be six, will each be directly driven by its own engine. These dynamos are of the newly developed rotating field and stationary armature type. Each will have a capacity of 850 k. w. The speed of revolution will be 94, the frequency 25 cycles, and the initial voltage 5000 volts. The total capacity of the power station will be 5100 k. w. or 6800 h. p.

From the switchboard the current is carried to the converter substations, of which there are four. Two of these will contain seven step-down static transformers, six for service and one in reserve, each of 300 k. w. capacity, and two rotary converters, each of 900 k. w. capacity. The other two stations will contain four 300 k. w. static transformers and one 900 k. w. rotary converter. In the transformers the voltage of the current will be reduced from 5000 volts to 330 volts alternating, at which pressure it will enter the alternating side of the rotary converters, issuing from the commutator side direct railway current at 500 volts. The spare transformers mentioned above will be put into service when the headway of the trains is reduced. The static transformers are of the air blast type, the windings being cooled by air forced through them by a blower. The rotary converters will be similar in construction to those used at Niagara, Buffalo and Nashua.

The use of the sub-station method of electrical distribution insures a uniform pressure throughout the entire length of the line. Fluctuation, therefore, which would materially interfere with the lighting of the station and trains, is reduced to a minimum. The limit of variation fixed by the Board of Trade, to the rules of which department all electrical installations in Great Britain must accord, is 10 volts. With the method adopted in this installation, the variation in pressure will not exceed 3 volts.

The locomotives will number thirty-five. Each will consist of a sheet iron cab containing the controller, indicating instruments, air brake, pump and controller, and boxes, etc., mounted upon a locomotive truck. The motors have been especially designed for this work. They are of the gearless type and according to the new system of motor nomenclature adopted by the General Electric Company, are known as the G. E. 56. Four of these motors will be mounted on each locomotive, one to each axle, the total drawbar pull being 14,000 lbs. The controllers will be of series-parallel type arranged for four motors. Each controller will embody the magnetic blowout principle.

The weight of each locomotive complete will be 35 tons of 2240 lbs. The trains will be made up of seven cars weighing when loaded 105 tons additional, giving a total train weight of 140 long tons. The seating capacity is calculated at 336 persons.

Access to and exit from the stations will be effected by means of powerful high speed elevators. These will also be of American manufacture and will be built by the Sprague Electric Elevator Company. The elevators will number forty-nine, each with a capacity of 15,000 lbs. or about 100 passengers per trip. The speed of elevation will be about 150 ft. per minute. These elevators will be of the double drum type, similar to those built for the War Department at Washington, but of much higher carrying capacity.

It is estimated that the number of passengers which this road will carry per annum is 48,000,000, which at an average fare of four cents, will give an ample return to ensure dividends upon the capital stock.

Transportation of Bicycles.

The Second Avenue Traction Company, of Pittsburgh, Pa., has put into service a number of bicycle cars. The furore for bicycling is very pronounced in Pittsburgh, and the railway company properly thought it a good plan to cater to the wheelmen and thus recover part of the income which has been lost to street railway companies through the use of bicycles. Pittsburgh is surrounded by many hills beyond which are excellent roads for bicycle riding, and the object sought by the company was to transport the wheelmen and wheels between the city and the good roads in the suburbs.

The bicycle cars have been transformed from the ordinary closed trail cars of the company by removing the seats from one side and putting in racks for holding the bicycles. The charge for carrying a bicycle and its owner is fifteen cents. J. M. Tate, Jr., assistant to the president of the Second Avenue Traction Company, through whose kindness the above particulars were obtained, states that the cars have not yet been in operation long enough to give any data as to the amount of traffic which may be expected. Four cars are at present in use.

The Electric Power Transmission Line between Niagara Falls and Buffalo.*

BY J. G. WHITE.

My first personal knowledge as to the then proposed transmission line between Niagara Falls and Buffalo dates from the autumn of 1894 when the White-Crosby Company was asked to prepare and submit detailed plans, specifications and proposals for its construction. It was then found that the engineers of the Westinghouse and General Electric Companies had both recommended the construction of circuits of three wires, adapted to the three phase system, each wire having an area of about 330,000 c. m. Beyond this no definite plans had then been determined on. The engineers of the Cataract Construction Company at that time considered it advisable to have the line built entirely of iron poles, and accordingly detailed drawings and specifications were prepared and submitted, showing alternative plans. The first included two entirely independent lines of iron poles not less than 40 ft. long, weighing something over 2000 lbs each. The second consisted of lines of poles of about the same height, weighing about 1000 lbs. each, set in pairs and tied together by deep trusses, which served both as braces against the terrific wind storms which sometimes sweep across Lake Erie, and as a means of carrying part of the wires. A steel truss, fulfilling admirably this double function, was designed, which weighed about 600 lbs., the company's right of way being 30 ft. wide, and the lines of poles located 15 ft. between centers.

In determining the details for these alternative plans it was assumed that poles would be set in concrete and spaced 100 ft. apart; that each wire would weigh 1 lb. per lineal foot; that the three wires composing each circuit were to be placed at the corners of an equilateral triangle having sides at least 3 ft. long; and that the lateral strength of the line was to be not less than three times the force produced by wind acting with a pressure at right angles with the direction of the lines, equal to 30 lbs. per square foot on the projected surface of the poles, arms, insulators and wires, when the latter were covered with a coating of ice ½ in. thick.

As a matter of fact the heat generated by the current passing through the wires, together with the static effect tending to repel all particles of moisture coming in contact with the wires, this effect being quite noticeable on a 10,000 volt line, would combine to prevent the formation of any such coat of ice unless at a time when current was off the line. Any error thus introduced was on the safe side and consequently not objectionable.

Full proposals with detailed plans and specifications for the construction above outlined were submitted Oct. 11, 1894, and an amended proposition for carrying out the construction on the same general lines was submitted Mar. 13, 1895. Nothing further developed in the matter until June, 1896, when new proposals were asked for the construction of the line on the assumption that white cedar instead of iron poles would be used throughout. Such proposal was submitted June 13, and accepted some days later. In working out the details of the line as built, the same general assumed data above given were used.

When the route for the line was finally determined on, its length was found to exceed 27 miles instead of being 25 miles, as previously assumed and consequently the area of the wire was increased from 330,000 to 350,000 c. m. The wire actually erected is composed of nineteen strands, having a combined area of full 350,000 c. m., and weighs nearly 6000 lbs. per mile.

In designing a transmission line the three most important factors probably are:

1. Its ability to carry its full load continuously and without interruption.
2. Cost.
3. Efficiency.

The first cost of power used to develop current for a transmission line is usually low, wherefore the efficiency of the line is not of primary, although of great importance.

Entering into the problem of sure and continuous operation we have the same two factors which usually confront us in connection with any electrical installation, namely, insulation and mechanical strength. In low tension plants of all kinds the insulation is usu-

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ally accomplished with ease, and any probable defects are likely to be of minor importance, but on such a line as that under discussion the importance of these two factors is practically equal and they are mutually interdependent. This has been practically illustrated by the experience afforded by the present line. With units of an ordinary size a short circuit on a line carrying 10,000 volts, even if through a defective insulator, a wooden crossarm and a wooden pole, would make itself manifest at the power station by the opening of a circuit breaker, the blowing of a fuse, or some similar method. With the huge generators which furnish power for this line the effects are different. Of what importance to a 5000 h. p. dynamo is the current which will leak down a wood pole even when wet? Nevertheless this same current is sufficient to char or burn the pin under a defective insulator. During one night last fall while an attempt was being made to operate the line on temporary insulators, the best obtainable at the time, the ends of no less than five of the large crossarms used on this line were burned entirely off; and this too without any manifestation having been made at the station that anything unusual had occurred. This naturally raises the question whether it is possible to procure insulators which can be depended on to maintain the insulation on a circuit carrying 10,000 volts or over, and whether it is not good practice to have fewer poles, and consequently less weak spots in the form of insulators. There are two sides to this question and both deserve serious consideration in designing any transmission line. Let us assume that poles are set 100 ft. apart and allow a sag in wires between supports of 20 ins., or one-sixteenth of the length of the span. We find that the area of the wire in use on this line is .267 sq. in., and that its tensile strength, even assuming high value for soft copper, is about 10,000 lbs. Allowing the same deflection, one-sixteenth of the length of the span, this determines the maximum safe distance between poles as 178 ft., allowing a factor of safety of 4 and shows that the cables might be expected to break if the span were lengthened to 712 ft., not allowing for wind pressure or extra load due to ice.

Assuming a tensile strength of 8000 lbs. per square inch for yellow pine, we find that the larger crossarms used on the line, which are 12 ft. long and nearly 5 ins. wide by 6 ins. high, would support a load of 270 lbs. on each end without bracing, and of 360 lbs. on each end with the steel angle braces used, and this, too, with a factor of safety of 10, an unnecessary margin when we consider that the arms are all specially selected heart, long leaf Georgia pine. Similarly these crossarms would have the same factor of safety carrying three power cables on each side, with spans 177 ft. long if without braces, and 266 ft. long with braces. Besides giving this added strength, the braces used on this line prevent such vibration and oscillation as usually take place with the ordinary strap iron braces, such oscillation being the cause of many of the petty troubles on ordinary lines. These braces were each made from a single piece of steel angle, 2½ ins. × 2 ins. × ¼ in., bent to shape and forming, when finished, a truss, 18 ins. deep and 5 ft. in extreme length, their weight being a little over 20 lbs. each. Assuming again that poles are set 100 ft. apart, we find that twelve wires, with crossarms, insulators, etc., would present an area to the wind aggregating about 67 sq. ft., and that consequently each pole would be subjected to a side strain, when wind pressure was 30 lbs. per square foot, of about 2010 lbs. A sound 50 ft. cedar pole, 8 ins. in diameter at the top and 18 ins. in diameter at the butt, 8 ft. being held rigidly in the ground, would be capable of withstanding before breaking a side pressure near its top of only about 4900 lbs., and of only about 3400 lbs. when a layer, 2 ins. thick, had decayed around its circumference.

With spans of 100 ft., the pole would, therefore, have a factor of safety of only about 2½ when new, while the wires would have a factor of safety of about 7, and the crossarms, of about 26. The advantages of having crossarms amply strong are so evident, and the possible reduction in cost such an insignificant part of any ordinary line carrying much copper, that it would seem foolish to reduce the size of these in order to bring their strength down to correspond with other parts of the line.

It is evident from the above that the weakest point of this line mechanically is the pole, in spite of the fact that final decision was made in favor of spacing the poles 75 ft. apart on straight, and proportionately closer on curved, parts of the route. The only reasonably safe and practicable method of decreasing the number of weak spots furnished by the insulators would be to use poles larger than 8 in. tops, or to brace the poles to withstand this wind strain. Fifty foot poles having tops greater than 8 ins. are now hard to find, and although 35 ft. poles were used on a part of the company's private right of way, nevertheless many 50 ft., and even a few 65 ft., poles were required to avoid obstructions and for crossing railroads and highways. The only feasible plan, therefore, would seem to be to brace the poles laterally, which can readily be done if set in pairs, but which would be very difficult to accomplish in a satisfactory manner with a single line. This naturally brings us back to the question, "Are insulators such insurmountably weak links in such a chain, and is it not possible to get insulators which can be depended on, even when supporting wires under a pressure of 10,000 volts?" This can be most satisfactorily answered by again narrating the experience with this line. During the past eight months insulators have been sent to Niagara Falls by four of the works which are among the first six in this country in the production of porcelain for electrical use. Of a sample lot of ten, received a few days ago for test from one of these factories, one had broken in transit, eight broke under the strain of electrical pressure varying from 16,000 volts to 36,000 volts, and the last broke under 40,000 volts strain. This latter would seem to be a minimum safe test limit for any insulator expected to sustain a regular strain of 10,000 volts, and is a test which any mechanically good, well vitrified insulator of ordinary design will pass. As several previous lots from the same factory showed even poorer results, the manager of that company states that he hopes within a few weeks to be able to furnish insulators which will stand a 40,000 volt test. It is only fair to state that these insulators were of a smaller type than, and different design from, those in use in the Niagara line. Several lots of somewhat similar insulators from another factory gave about the same results.

Several thousand insulators of a diameter almost equal to the round type now on the line, but of a design somewhat different in details, were furnished by a third porcelain works. These were all supposed to have been tested and to have successfully withstood a pressure of 40,000 volts at the factory before shipment. When, however, these were tested at Niagara Falls by Mr. Lincoln, the electrical superintendent of the Cataract Construction Company, it was found that a large majority of them broke down under a 40,000 volt test, illustrating that a dry test such as had previously been made is useless for practical purposes. The method of test used at Niagara Falls was as follows: the insulators were set inverted in a shallow iron pan in lots of about twenty, the bottom of the pan being covered with an inch or two of water containing a little salt. A little of the same brine was poured into the pin hole of each insulator and into this was thrust a small piece of metal such as an ordinary iron spike or the small round zinc rod from an ordinary sal-ammoniac battery, this being connected to the side of the testing circuit, the other being connected to the pan containing the insulators. After the metal rod had been placed in the brine in the pin hole of an insulator the primary circuit of the testing transformers, specially built for the purpose, was closed; and if the insulator was weak, this was quickly manifested by a series of sparks through the punctured porcelain. Experiments made with pure water and with brine showed that there was no difference in the results; but that any weakness was manifested a little more quickly with brine, besides which the salt imparted the characteristic bright sodium color to sparks otherwise almost colorless and difficult to detect.

As it was important that the line should be ready to deliver current by a specified date, the test was reduced on these insulators to 20,000 volts, and all of which withstood this pressure were passed for temporary use. These insulators were later replaced by some of those now on the line, all of which successfully passed a 40,000 volt test made as above described.

A lot of the temporary insulators illustrated the old saying that every rule has its exception for when after removal from the line they were tested under 40,000 volts pressure, a solitary insulator from a total of 1150 was able to pass muster.

Of the insulators shipped by the fourth factory and of the two types now on the line, about 25 to 40 per cent were usually found to be defective, breaking down under 40,000 volts, this percentage decreasing in the last shipments received. It is, however, worthy of special note that since the last of the temporary insulators were removed from the line, there has not been one minute's suspension of current supply due to defective insulators. During this time, some three or four months, three insulators have been replaced, none of these being of the oval type. Two of these three had been broken while being put in place and the third was broken by a stone or other missile. In all three cases only the outer petticoat was broken and the insulator continued to do satisfactory service until such time as it could be replaced without affecting the operation of the line. Apparently, therefore, it has been demonstrated that it is possible to secure insulators which are reliable. That there have been no greater troubles in the past from defective insulators is probably due to the fact that most of the large transmission plants in operation under high voltage, up to within a few months, have been in the Far West where a climate prevails very different from that natural to this immediate region.

In the above and other experiments with insulators some interesting facts have developed and are worthy of note. The insulating strength of porcelain depends almost entirely on the thoroughness of its vitrification and very little on its thickness, a thin china teacup having successfully withstood a pressure of 60,000 volts, while a porous piece of porcelain 2 ins. thick was readily pierced by 20 000 volts. It is therefore practically unnecessary to test electrically any insulator which when broken will not pass a good absorption test, using red ink or other fluid.

It is quite, if not entirely, impossible to puncture a glass insulator, even an ordinary pony telegraph insulator withstanding any pressure which can be applied, the last being determined by the pressure which will send an arc around the insulator. The objection to using glass insulators in the past has been due to the difficulty in getting a well annealed and mechanically strong insulator of such massive design as is needed for this work and to the hydroscopic property of glass, which is not shared by porcelain. The first can unquestionably be overcome by care in manufacture. The importance of the second has probably been exaggerated in most calculations made in the past, due to an inadequate appreciation of the static effects of 10,000 volts in warding off snow flakes and drops of rain, and to a less extent, of the rapidity with which water falling on such insulators is evaporated by the heat of the current leaking over the surface.

It is consequently reasonable to expect that the use of glass insulators for high voltage lines will greatly increase with improved manufacture. Meantime any lines erected should have the best obtainable porcelain, and every insulator should be subjected to test.

Before closing it is natural to ask "Is the line as built a genuine success? Can it be depended on and is it effective?"

In answering let me give briefly some of the facts. The line now in operation is over 25 miles long, of which the last 4000 ft. is underground, the current being carried in lead covered cables with rubber insulation, these having been drawn into terra cotta duct conduit built specially as part of this line. These cables successfully withstood a test of 40,000 volts, are guaranteed for five years under working pressure up to 25,000 volts, and were punctured during test only by a pressure estimated by Mr. Lincoln as about 80 000 volts. They have given no trouble since current was first turned on the line, Nov. 15 last, except at two joints imperfectly made. Except for the short time needed to repair one of these joints, there has not been a single shut-down chargeable to the transmission line itself since the last temporary insulators were removed some three or four months ago. A number of interruptions to service have occurred during that time, due to derricks used on the work now being done on the Erie Canal hitting wires, undermining of poles and conduit by this work and to allow new lightning arresters to be put in circuit at transformer houses. Except for these extraneous and unusual causes, the service has been perfect, with the one slight exception above noted. One short interruption last winter was due to the dead limb of a tree blowing across the wires, illustrating the fact that all trees should be cut down for some considerable distance on both sides of any high voltage line. The line shows an insulation resistance of some 250,000 to 300,000 ohms on wet and about 1,000,000 ohms on dry days, this being between any one of the three wires and the ground, the insulation therefore varying from 6,000,000 to 25,000,000 ohms per mile of wire.

The actual working efficiency as shown by the wattmeters in the low tension alternating circuits at Niagara and the direct current, 500 volt circuit at Buffalo was 79.6 per cent, this being for a considerable period and a fluctuating load. This efficiency included loss in step-up transformers, line, step-down and rotary transformers. It is probable that any decrease in this due to greater line loss with larger load would, to a considerable extent at least, be offset by increased efficiency of transformers. In view of these figures we hope you will feel warranted in endorsing the opinion that Niagara power *is now* being satisfactorily delivered in Buffalo.

One of the questions often asked is why this entire line was not placed underground. One of the principal reasons was that the line of twelve wires, having a capacity of 20,000 h. p. would cost, irrespective of right of way, fully $1,250,000 if underground, and only about one-third that amount overhead, making a serious difference in interest charge. Of such total costs about 20 per cent would cover cost of conduit complete, including manholes, the remaining 80 per cent being lead covered cables. Of the overhead construction cost, slightly over 80 per cent is bare copper wire, less than 10 per cent covers poles set in place, and about 3 per cent covers insulators. It is probable moreover that the depreciation of the lead covered cables would greatly exceed that on pole line, the first cost being some thirty times as great, and the depreciation of the bare copper being negligible. Aside from this, experience to date has not demonstrated that the underground line would be more reliable, which alone could justify the increased depreciation and interest charge.

As a final deduction it seems reasonably certain that it is now possible to build either overhead or underground transmission lines, even in regions subject to much cold, damp weather, capable of carrying current at 10,000 volts or higher pressure, which can be operated with efficiency and every assurance of uninterrupted service.

The Application of Electricity to Steam Railroads.*

BY P. H. BRANGS.

The recent developments in the application of electricity to the present existing steam railroads, is a question that is of great interest to the practical railroad men of the present day. The many advantages to be gained by the partial substitution of electricity for steam in conjunction with the steam locomotive, must be apparent to all wideawake railroad managers. The tremendous inroads that have been made in the receipts of local passenger traffic, on the majority of steam railroads to day, by the electric trolley roads, make it manifest that something must be done to check these inroads.

The demands of the traveling public, living in suburban towns have become very fastidious of late, and justly so, from the adequate facilities afforded by the electric lines.

They have paralleled our railroads, in many cases to such an extent that it has put the railrord manager to severe perplexity as to the best method of meeting this great competitor. Many railroads running from large cities into the suburbs, which have large suburban traffic, are at a loss to know how they can accommodate the demands of the public for more frequent trains, without very materially increasing their operating expenses. This, of course, is a very grave matter, as short and frequent trains, with locomotive traction, are expensive, in view of the fact that each train must be fully equipped with locomotive engineer and fireman, and a full crew, whether there be three cars or ten cars.

The running of short and frequent trains by locomotive traction, would not be so extravagant if the motive power department had at all times such sizes and weights of locomotives as were best suited for the purposes required. The tendency of late years has been towards heavier and more powerful locomotives, so that when called upon they can haul the heaviest and largest trains; but it is only during certain hours of the morning and evening when traffic is heavy that they are required to haul such heavy trains, consequently at other hours one can see these same powerful and heavy locomotives hauling trains of one-quarter or one-third their actual capacity.

A locomotive, weighing, say, 50 tons, will have about 40 tons on the drivers, possibly more. The tender will weigh about 25 tons, and the coal and water 10 tons more. Th refore, out of 85 tons of engine, tender, coal and water, only about 40 tons rests on the drivers, or about 50 per cent. At slow speed the capacity of the locomotive depends not on the amount of work the steam in the cylinders can do, but upon the adhesion of the wheels to the track, or in other words, upon the weight on the drivers. Now, as only one-half the weight rests on the drivers, the other half is useless, and is just so much dead weight that has to be hauled over the road for nothing. It can thus be readily seen that an electric motor under average speed, with half the total weight of the steam locomotive, would do just as much useful work, with less wear and tear on the roadbed and track.

By the partial substitution of electrical traction for the exclusive locomotive traction, this could be vastly and economically improved. The heavy locomotives could be still used for drawing heavy through express and freight trains, while the short and local trains could be run by electricity.

Most of the railroads running into large cities, which have a large commutation or suburban traffic, have four tracks running for some distance from such cities. In that event I would advocate your equipping two tracks with electricity, and running two or three car trains at short intervals, thereby making it a rapid transit system.

Almost every one of the trunk lines running into New York City has a more or less number of leased lines and branches, which are used as feeders for the trunk lines. These lines, also, are particularly favorable as regards grades and locations for the trolley lines, which are great competitors, in many cases paralleling them for miles, and, unfortunately for the railroad companies, carrying passengers in many cases for less than one-half the fares that were charged by the steam railroad companies. In one case particularly, Philadelphia, I believe, one of the large steam lines lost so much traffic that it has attempted to regain it by reducing prices and increasing the number of trains. In this it has partially succeeded, but at greater expense and decreased receipts. There are certain kinds of local traffic which the steam railroads, must, to a large extent, lose, and which, in the nature of things, they cannot regain. In large cities having considerable suburban traffic, the trolley roads, forming, as they do, a network of lines in the city and extending in every direction into the suburbs, offer advantages with which the steam railroad cannot compete. As far as these branch lines go, whether it would pay to partially or wholly substitute electricity for steam depends upon the local conditions prevailing.

I would advocate as far as possible the equipping of these small branches electrically, and as the gage of roadbed and other things would be the same, this would greatly facilitate the matter while change of construction was going on. I fully believe that if many of the small branches of the various railroads centered around New York City were equipped electrically, so that short and frequent trains could be run at a profit, it would add very materially to the advantages of the trunk line.

Objection will be made that the trolley, or the third rail, as the case may be, would inte fere with the operation of the steam railroad, but I see no reason why they could not be run jointly. During such hours of the day when traffic might be light, freight might be drawn by electric motors to the various small towns along the line, which rarely have more than one or two cars. This in itself would be a very great saving, as now special freight trains have to be made up. The consumer is now often put to great inconvenience by only getting one freight train a day, whereas, by the partial substitution of electricity, these cars could be drawn with the same electric motors or motor cars used for the passenger traffic. Another important adjunct to this would be the quick delivery of express matter, which is, of course, a source of great revenue to the railroad companies.

As to the nature of the equipment that will be required, it would depend upon the work to be done and the branch to be equipped. In some cases it might be well to use single electric cars, while in other cases two or three car trains could be used.

In a very able article, written some years ago by O. T. Crosby, on "The Limitations of Steam and Electricity in Transportation," he made very thorough researches into the subject of the costs of repairs to steam locomotives versus the electric motor, and from deductions arrived at, he reasoned that the cost of repairs to motors would not be more than 30 per cent of the amount expended on steam locomotives. At the time this article was written, however, it is doubtful whether these claims could have been substantiated. It is a well known fact that the construction and efficiency of electric motors have been vastly improved, and I venture to say that if he was correct then in allowing that the cost of repairs would not be more than 30 per cent that of steam locomotives, it can reasonably be supposed to be very much less to-day.

It is conceded by all well informed engineers that the locomo-

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tive is an unbalanced machine, and cannot be made otherwise. The moving parts of a steam engine can be balanced either in a vertical or horizontal direction, but not in both. A locomotive can be balanced vertically by placing a counterbalance weight in the driving wheel, opposite the crank, about equal to the crankpin and half the connecting rod. To balance it horizontally, it is necessary to make this weight equal all the moving parts—that is to say, the piston, piston rod, crosshead, connecting rod and crankpin. If the latter weight is used, the machine will be more out of balance vertically than if no weight at all were used, therefore, the best result is obtained by taking a weight that overbalances vertically and underbalances horizontally. As the engine is out of balance vertically, the result is that the track is subjected to a series of shocks, being detrimental to the roadbed and bridges.

Wm. Baxter, Jr., in an able article recently published in the *Electrical Engineer*, in comparing the efficiency of the tests obtained from the engine drawing the Empire State Express on the New York Central Railroad, states, "they have shown results as high as 3¼ lbs. of coal per horse power per hour, but the conditions under which such tests have to be made are such that it is very difficult, if not actually impossible, to obtain exact results. The power developed by locomotives, as shown by the indicator cards, can be considerably out of the way. This fact is recognized by steam railroad engineers, and few, if any, of them would undertake to claim that the results of these tests represent the average working efficiency of locomotives in high speed service. It is very doubtful whether the average everyday work of high speed passenger locomotives can show a result much below 4 lbs. per horse power hour. Assuming that the coal consumption of a locomotive will average in actual service about 4 lbs. per horse power hour for express engines, 5 lbs. for local passenger and 6 lbs. for freight. There is another class of work for which locomotives are used, in which the coal consumption per horse power of useful work performed is very great, just how much it is impossible to say, but in all probability it is in the neighborhood of 20 lbs. per horse power hour, and in some cases may go even higher. The work referred to is that of drill engines. Of course, these engines cannot be taken into consideration in an estimate of the relative efficiency of locomotives and electric motors, because their wastefulness is due to the fact that while they are burning coal all the time, they are only developing horse power for short periods at a time.

"The average efficiency of large stationary engines is conceded to be about 2 lbs. of coal per horse power hour. The data presented in the foregoing sustain the claim that the substitution of electricity for steam would effect a saving of about 55 per cent of the coal bill. The saving of coal alone, however, is not the all-important factor upon which hangs the future destiny of electricity in the steam railway field. In the first place, we have the very important fact that the electric motor does not depend upon the skill of the man who handles it for its efficiency, while the locomotive does. No matter what the intelligence of the motorman may be, the energy absorbed in doing a given amount of work with the same motor will always be the same. This is by no means the case with the locomotive. There are two ways by which the speed of a locomotive can be regulated. One by the movement of the link motion lever, the other by opening and closing the throttle. If the link motion lever is used, the steam will be expanded in the cylinders and the highest efficiency obtained. By using the link motion, the throw of the valve is shortened in precisely the same way as it is in the various types of high speed engines that have a single valve, the motion of which is regulated by the governor. Under these conditions the locomotive becomes a variable c. t-off engine, and works at a high rate of efficiency; but when the throttle is used to regulate the speed, it becomes simply a slide valve engine, and uses a much greater amount of steam to do the same work.

"The amount of coal used to generate steam will further depend upon the skill and care of the fireman. This is one point in which steam is at a decided disadvantage when compared with electricity. It may be said that what is true of the locomotive is true of the engine at the power station of an electric system, but such is not the case. The engines regulate themselves by the action of the governor.

"And so far as the efficient use of steam is concerned, they are no more dependent upon the skill of the engineer than the motor is. As to the wastefulness of the engineer and fireman, it is not at all likely to be as great at a central station as on a locomotive."

Many of the large railroad companies introduced into their motive departments a system of rewards for the economical use of coal and engine supplies, but I understand that that system proved a failure from the fact that the engineers and firemen in their zeal to get the coveted rewards frequently preyed upon one another, and often were so economical as not to use sufficient fuel to enable them to make their running time. Now, in a central station, where everything is under the watchful eye of a capable and efficient engineer, and with the automatic mechanical stoking apparatus now at hand and adequate facilities for handling coal, and all other conveniences which go to make up a well equipped central station, unnecessary leakages cannot long exist.

The interest that manifested itself in the railroad world within the last few months in regard to electric traction is remarkable. The successful operation of the electric locomotive by the Baltimore & Ohio Railroad Company, with which you are familiar, and the more recent operation of the electric traction by the New York & New Haven Railroad Company at Nantasket Beach, and the most recent installation of the third rail system between Hartford and Berlin, Conn., is an evidence of the rapid advance of this unseen power. The managers of the New York & New Haven Railroad Company are to be commended on the adoption of electricity for steam, from the fact that there have been numerous obstacles and difficulties to overcome. To design and construct motors for new conditions has always been a very expensive matter, and the New York & New Haven Railroad may be congratulated upon having installed at a remarkably short notice a successful and efficient electric railway system.

As regards the advisability of using either the third rail or the trolley, there has not been sufficient experience with the third rail on the New York & New Haven to fully demonstrate whether the change from the trolley to the third rail would be advisable. I certainly do not approve of the unprotected third rail, when it is open to all kinds of accidents and malicious interference. I understand there have been several accidents on the New York & New Haven from the exposed third rail. Liability to accident could be easily avoided by the substitution of a rail at the side of the track, with a side contact, and then have the exposed parts covered over and insulated in such a way that any object falling from above, or persons stepping across, would not be so liable to come in contact with the exposed live rail.

There are many advantages, however, in the construction of a third rail, over the trolley system, as it has been demonstrated by the conclusions arrived at by Colonel Heft, electrician of the New York & New Haven Railroad Company, that the cost of the third rail is about one-half that of the trolley system. It would therefore appear that it would commend itself to all practical railroad men as the best method of supplying the current.

The newspapers have reported a number of accidents to laborers from receiving shocks from the rail, but no serious effects have resulted, except from muscular contraction. As is well known to all electrical engineers, the voltage used for trolley roads is not necessarily fatal. I recall an experience: some years ago, while testing a 600-volt current machine, the switch was closed by an attendant. I had both terminals in my hands, and I received the entire charge of 600 volts through my body for a period of about one minute. Notwithstanding the fact that it was extremely disagreeable, I did not experience any severe effects from it a half hour afterwards.

In conclusion, I wish to say that the locomotive has still a long lease of life; but it must be apparent to all that electricity is about to supersede the steam locomotive in special cases.

Convention of the Ohio State Tramway Association.

The Ohio State Tramway Association held its sixteenth annual meeting at Columbus, O., June 14.

Superintendent Kelly, of the Columbus Street Railway, took charge of the party in the forenoon and among the pleasant features was a visit to Olentangy Park, the beautiful pleasure resort operated by the street railway company. After a splendid luncheon at the Hotel Chittenden, Fred. N. Bendelari, of the Columbus Central Railway Company, took the party in charge, placing the company's handsome special car Minerva at the command of the visitors. The afternoon was pleasantly passed at Minerva Park, the handsome resort of the Columbus Central Railway Company.

The members of the association present went into executive session at the Hotel Chittenden in the evening and elected officers for the ensuing year as follows: president, A. A. Anderson, Youngstown, O.; vice-president, T. R. Catlin, Canton; secretary and treasurer, Frank J. J. Sloat, Akron; executive committee: H. P. Bradford, Cincinnati; F. L. Nelson, Springfield; W. F. Kelly, Columbus. It was voted to hold the next meeting at Columbus, June 8, 1898. There will be some specially prepared papers read and the association has the assurance of a much larger attendance by holding the meetings at the early date given instead of in autumn as heretofore.

The street railway men in attendance were A. A. Anderson, Youngstown Street Railway Company; T. R. Catlin, Canton & Massillon Electric Railway Company; J. F. Flood, Steubenville Traction Company; W. F. Kelly, Columbus Street Railway Company; F. L. Nelson, Springfield Railway Company; Fred. N. Bendelari, Columbus Central Railway Company; Alfred M. Hinckley, Toledo Traction Company; A. E. Bendelari, Columbus Central Railway Company. Others present were D. B. Dean, Terre Haute Car & Manufacturing Company, Chicago; Scott R. Hayes, of Hayes & Arthur, Cleveland; A. L. Wilkinson, the Ohio Brass Company, Mansfield; J. A. Hanna, the Peckham Motor Truck & Wheel Company, Chicago; Chas. Powell, Westinghouse Electric & Manufacturing Company, Cleveland; F. H. Strieby, General Electric Company, Cincinnati; E. H. Oswald, Benedict & Burnham Company, Waterbury, Conn; W. A. Dutton, the Dorner & Dutton Company, Cleveland; C. L. Jones, the Western Gear Company, Milwaukee, Wis.; Col. S. J. Wich, the Electric Railway Equipment Company, Cincinnati; John B. Bennett, The STREET RAILWAY JOURNAL, New York.

THE Boone Electric Street Railway & Light Company, of Boone, Ia., has been granted a franchise for several new lines by the City Council. L. W. Reynolds, president of the company, states that work will be commenced at once. The boiler and dynamo capacity of the power house will be double. A park is to be fitted up a few miles from the city and a line run to it.

SCIENCE · ENGINEERING · INVENTION ·

ON July 1, 500 new automobile cabs will be put in service on the streets of Paris. It is estimated that there are now 1500 of these cabs in Paris.

SINCE the recent election in Toronto by which the running of Sunday cars was permitted, it is stated that the strict Sunday observers in that city have refused to patronize the Sunday cars, and the result has been almost a boycott.

A SPEED of 45 miles per hour has recently been attained by the long double truck cars of the Twin City Rapid Transit Company, running on its interurban line between Minneapolis and St. Paul. The car carried forty-five passengers.

THOMAS ELLIOTT, master mechanic of the Atlanta Consolidated Street Railway Company, has designed an electrically driven pneumatic snow plow in which the snow is blown from the track instead of being removed by a scraper or broom.

A VERY extensive power transmission scheme is proposed in California by the Southern California Power Company. The proposition is to transmit 4000 h. p. from Santa Ana to Los Angeles, a distance of 80 miles. The pressure to be used on the line will be 33,000 volts.

THE Massachusetts State Board of Gas and Electric Lighting Commissioners has presented to the Legislature a report on the fatal explosion, of Mar. 4, in the Boston subway. The responsibility for the accident is laid upon the Boston Gas Light Company and the Metropolitan Construction Company.

THE rapids of the Rhine, at Rhinefelden, Germany, have been recently utilized for the generation of electricity. The minimum flow at that point is sufficient, with the available fall, to generate 13,800 h. p., and twenty turbines, each of 840 h. p., have been installed. These are directly connected to horizontal, polyphase, alternating generators, and power will be transmitted to various plants, more or less distant, requiring power.

THE Queen's Jubilee was celebrated by the Toronto Street Railway Company by putting on the road twenty handsome open cars, to be known as "The Jubilee Set." Each car measures 27 ft. long and 7 ft. 6 ins. wide. The cars are painted white and gold, carry bicycle racks on the back and have double steps at the sides. The latest style of motor made by the Canadian General Electric Company is used, and each car will seat seventy passengers.

THE competition for the 1000 guinea prize, offered by the London *Engineer* one year ago for the best self-propelled common road carriage, is a complete failure as gaged by results, and the judges have recommended that the prize be not awarded. Only five competitors appeared, though requests to postpone the decision were made by many other inventors. The *Engineer* sums up the matter by saying "there is no motor car industry in this country. There is no such thing as a thoroughly satisfactory self-propelled carriage."

THERE is a decided tendency toward the construction and use of gas engines in the higher horse powers, under certain circumstances. The corporation of Belfast, Ireland, has been employing for over two years a plant of 750 h. p. gas engines, divided into four units of 120 h. p. each and two of 60 h. p. each. The engines have been used to drive Siemens & Halske dynamos. The Midland Railway Company, of England, has a 250 h. p. plant at Leicester. The Lancaster (O.) Traction Company is employing a gas engine of 130 i. h. p. to drive a 80 k. w. generator in its power station. There is also a gas engine of 130 h. p. and one of 90 h. p. in the power station of the Marietta (O.) Electric Company. These are simply a few instances of some large installations of gas engines.

THE fears expressed by the legal department of the Metropolitan Street Railway Company, of New York, that the use of open cars on the Broadway, Columbus Avenue and Lexington Avenue lines would considerably increase the number of accidents, have been found to be unjustified, as the number of accidents has been in fact slightly less with open than with closed cars, owing probably to the knowledge on the part of both the public and employes that greater care is necessary. There is no doubt that the use of open cars has greatly increased the summer earnings, particularly in the evening, and the company has found that the evening traffic below Fourteenth Street which, in the summer of 1895 when closed cars were used was exceedingly small, jumped up immediately on the introduction of open cars and is now an important source of revenue.

UNITED States Consul Germain at Zurich, Switzerland, in a recent communication to the State Department gives some interesting statistics in regard to the production of aluminum in different countries. Mr. Germain estimates the total daily production of aluminum at about 14,600 lbs., requiring a consumption of power of 11,740 h. p. This is divided about as follows:

United States	4200 lbs.
Switzerland	5000 "
France	5400 "

In addition, extensive works are being erected by the British Aluminum Company near Belfast, Ireland, and in Scotland. Other works are contemplated at Sarpfoss, Norway; Rheinfeld, Germany, and elsewhere.

THE West End Street Railway Company, of Boston, now operates its road with six power stations, having a total capacity of 22,308 k. w., distributed as follows:

Central power station	11,984 k. w.
East Cambridge power station	2,380 "
Dorchester power station	2,000 "
Charlestown power station	1,600 "
Allston power station	744 "
Harvard power station	3,600 "

In the Central power station there is space for the installation of about 1500 k. w. additional generating apparatus; in the Dorchester station for about 1000 k. w., in the Charlestown station for about 800 k. w., and in the Harvard power station for about 2400 k. w.

THE Compagnie des Chemins de Fer du Nord, of France, is about to order the construction of an electric motor for the purpose of experimenting with it on those of its roads which have steep grades. The motor is to be attached to a train going down grade, and the power obtained by the descent of the train is to furnish the motive power of the electric motor. The equipment consists of two dynamos set on a frame, and a storage battery occupying the place of the boiler in an ordinary locomotive. The dynamos, being set in motion by the moving train, generate an electric current which charges the storage battery. As long as the train is running the generation of the current continues, and the motor acts as a brake which can be accurately regulated. As soon as the train begins to go up the grade the dynamos are converted into electromotors, which derive their power from the accumulators. The motor now pushes the train, and does the work of a pulling engine by means of the power it has accumulated on the down grade.

Swivel Trucks in Electric Railway Service.

One of the notable tendencies during 1897 in electric railroading has been an increased use of the swivel truck. Electric railway science is constantly changing, and to be fully abreast of the times, the electric railway engineer and builder must be as active in studying the developments in electric railway work as in any other business in which improvements are following upon each other as rapidly as in this industry. While the single truck will undoubtedly always hold its own and be preferable for many classes of work, yet the increasing use of the swivel truck for lines on which high speed is desired or where there are sharp curves, is undeniable.

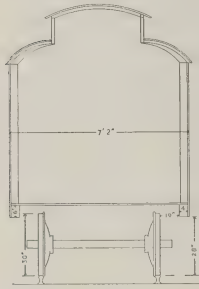


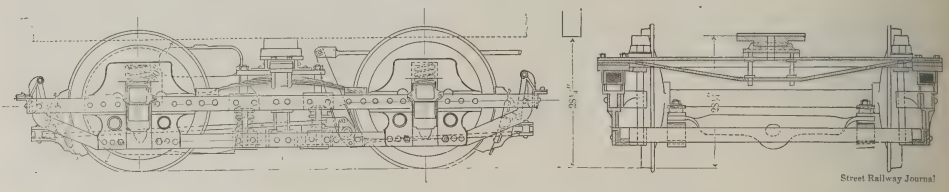
FIG. 3.—SECTION OF CAR

The former theory that the use of the single truck was necessary on steep grades to secure necessary traction, has been effectually disproved by repeated experiments with the swivel truck in California and elsewhere. In Oakland, by a judicious arrangement of trucks and motors, swivel truck electric cars are ascending daily a 14½ per cent grade, a feat which two years ago would have been considered impossible without the use of a single truck because it was thought that it was necessary to have every axle of the truck motor driven. This result has been accomplished by the Piedmont & Mountain View Railway Company using Peckham swivel trucks, and is done by mounting both motors on the same truck. The motor truck is then placed far enough under the car so as to throw the greater portion of the weight on the driving wheels, the driving truck being the rear truck in ascending the grade. Since experience has shown that there will be no difficulty in ascending 14½ per cent grades by this "maximum traction" idea applied to the car and not to the truck, it is easy to see that the descent of a steep grade is much more safe and easy with a double truck car than with a single truck car of the same, or nearly the same weight, because double the number of brake shoes can be applied, and there are double the number of points of contact between the car and the rail. There is therefore with the double truck car under these conditions a factor of safety twice that existing where a single truck car is used.

As readers of the STREET RAILWAY JOURNAL know from previous articles, Mr. Peckham, of the Peckham Motor Truck & Wheel Company, has been devoting a good deal of attention of late to the problem involved in the use of swivel trucks, and has succeeded in eliminating many of the difficulties which have heretofore stood in the way of the general adoption of swivel trucks. One objection often raised to the use of the swivel truck is the fact that the car body had to be raised a considerable height above the rails. This required the use of a second step, and while this might not be objectionable in long runs, the desirability of keeping the car floor low and thus making the car easy of access is an axiom among street railway managers who cater to a short haul traffic. The force of this necessity was carefully considered in the design of the Peckham swivel truck, and the way in which the result has been accomplished is shown in the design of the trucks (Figs. 1 and 2). As will be seen, the bolster is kept very low so that the distance between the bottom of the side sills and the top of the rail is only 28½ ins. with a 30 in. wheel. The wheel base of the truck when mounted with two G. E. 800 motors is kept down to 5 ft.. This enables a car to pass around a curve of very short radius. With the G. E. 1000 motor, the wheel base can be made 5 ft. 7 ins.

A type of car equipped with Peckham swivel trucks and one which promises to have a great popularity for suburban lines is shown in Fig. 5. It is one of the cars built by the Jackson & Sharp Company for the Union Traction Company, of Rutherford, N. J. The principal dimensions of the car and truck are as follows:

Length of car body, 24 ft.
Length over all, 33 ft.



FIGS. 1 AND 2.—SECTION AND SIDE ELEVATION OF SWIVEL TRUCK.

Distance from rail to bottom of car sill, 28 ins.
Distance from rail to car steps, 16 ins.
Width of car body, 7 ft. 7 ins.
Style of truck, Peckham No. 14.
Thickness of side sill, 5 ins.
Wheel base of trucks, 5 ft. 7 ins.

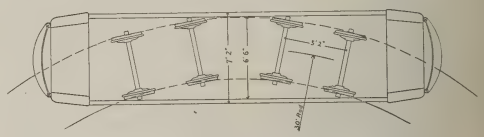


FIG. 4. PLAN OF CAR ON 30 FT. CURVE, SHOWING POSITION OF AXLES.

Diameter of axles, 4 ins.
Diameter of wheels, 30 ins.
Style of motors, G. E. 1000.

The car passes through the 30 ft. curves on this line with remarkable smoothness and with the absence of that grinding so disagreeable to passengers and destructive of both rails and wheels. The position of trucks with a wheel base of 5 ft. 2 ins., under a car 7 ft. 2 ins. wide, is shown in Fig. 4. A section of the car showing clearance of wheels is shown in Fig. 3.

FIG. 5.—DOUBLE TRUCK CAR—UNION TRACTION CO.

For double decked cars, so common upon foreign roads, this truck promises to have a wide field of usefulness. With the double deck car the problems surrounding proper truck construction are intensified. It is difficult enough, as both truck builders and railway managers realize, to reduce the oscillation of the ordinary long single deck cars when mounted on single trucks, and the analogy between an ordinary single truck electric car with its long over-

hang, and a building with an unstable support, has been often made. When, however, as with the double decked car, the center of gravity of the loaded car is transferred from a point a short distance above the car floor to one near the middle of the car body, the tendency to oscillation must be enormously increased. It is largely for this reason that the Peckham trucks, in which the tendency toward oscillation is reduced to a minimum, have received such cordial adoption abroad upon roads using American apparatus. With the double truck all oscillation is, of course, eliminated, so that it is not difficult to prophesy a large demand for swivel trucks from foreign tramway companies. The ability of the truck illustrated to pass curves of the shortest radius, and at the same time to keep the car floor down to a point where the car is as easy of access to passengers as a single truck car, would seem to indicate an especial adaptibility for its use under double deck cars.

Elsewhere in this issue news is given of Peckham trucks in use in Bristol, England; Buenos Ayres and Sydney, Australia.

Power Brakes for Electric Cars.

BY G. E. PRATT.

In several papers of late articles have appeared commenting upon the criminal neglect of general managers and the heads of electric railway companies for not giving more attention to the repeated demands made upon them by the public for the adoption of improved safety appliances, designed to protect lives and guard against accidents. So far as these criticisms go I am inclined to defend the caution that has been taken by railway managers in this respect. It is well known that since the advent of electric power for our street railways, demands have been made by the public for quicker service and larger cars. The result has been that many of the methods, suitable and adequate for the short, light horse car, have been transferred to the heavier electric car; consequently we find in vogue the ratchet brake, operated by hand, on cars twice as long and several times heavier than the old horse car and operated at speeds of from 18 to 50 miles per hour.

It has been said "that so much money and time has been expended in improving motors and trucks, increasing the strength of cars, applying fenders, etc., for the prevention of accidents, that the most vital point, the brake, has been forced into a subordinate place" and further, it has been stated that managers will not take heed to the repeated calls made through the medium of the daily press, of the great need of safety appliances in the way of power brakes for handling the long and heavy cars. For the sake of argument, I will admit this to be true, but on the other hand, the managers of our electric roads do deserve credit for having taken up the safety devices which have been mentioned, and after thorough trial, for adopting them. During this time, perhaps, there may not have been a power brake which, after trial, would be found practicable and reliable for their equipment. Nevertheless, the heads of our electric roads certainly are deeply concerned in finding a reliable and practicable power brake. To prove how earnest and anxious they are in this matter, the letter files of our office will show in the way of inquiries as to the size of brake cylinders required, etc., to properly brake cars of different weights. Does not this show a disposition on the part of our railway managers to get light and information on this subject?

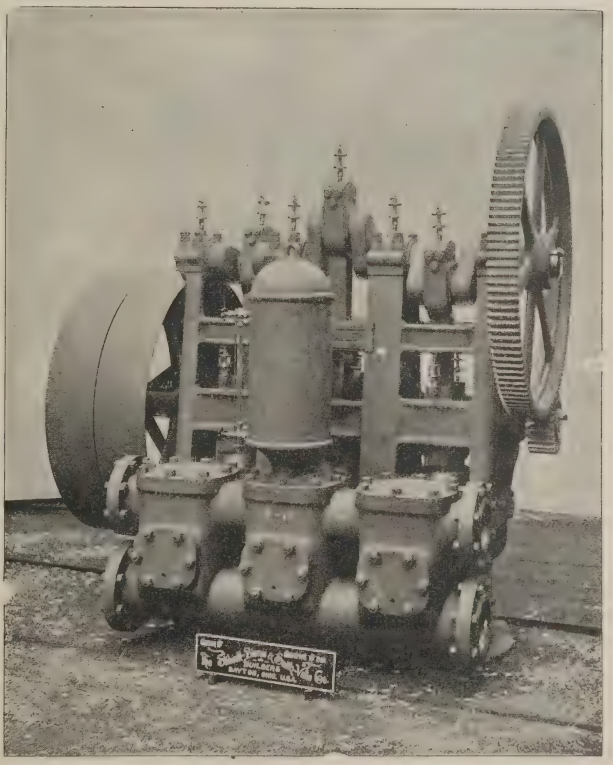
I, for one, being at the head of an air brake company, do not feel inclined to criticise or condemn the manager of a road because he does not at once take notice of repeated attacks made upon his good nature to try this or that, but I am willing to abide the earnest and critical investigation which the importance of this subject deserves and must secure. Let me assure those of the public, who, perhaps, are condemning the sluggishness of the officials of our electric roads in adopting power brakes, that I have to thank the officials of those roads whose cars we have equipped, for their valuable suggestions, and above all, for their patience in making trials of the brake. This certainly goes to prove beyond any question of doubt that they are not trying to smother the demands of the public for a practicable power brake, no matter under what form that power brake may be applied.

I do not care under what name the power brake may be known, or who the manufacturer of it may be, the time is coming, in fact is here, when the best appliance in the way of a power brake must be adopted.

Triplex Power Pumps.

The problem of pumping water for towns and cities, filling tanks, hydraulic elevators, etc., at a minimum cost and maximum efficiency, is one that has taken up the attention of many of our most eminent engineers, and the application of the gas engine and the electric motor in connection with power pumps has come into quite general use for this service. In this connection the accompanying illustration shows an improved type of vertical triplex power pump, recently put on the market by the Stilwell-Bierce & Smith-Vaile Company. These pumps are built on the principle that a continuous action of the plungers produces a constant flow of water and resultant high efficiency. They have three plungers connected to a three-throw crankshaft, with the cranks set at an angular advance of 120 degs. The crankshaft is supported by four housings and bearings, forming a very rigid construction and perfectly balancing the strains, which in this type of pump are very unequal. The plungers are provided with crossheads and guides. The crossheads have adjustable bronze shoes for taking up wear. The connecting rods have strap heads, brass boxes and taper key adjustments.

The pumps are made both single and double acting. The double acting pumps are fitted with removable cylinders. The gears are machine cut; the countershaft, guides and connecting rod bearings are self-oiling, and the pumps have an extra large valve area, which permits a high speed of piston travel. Ample room has been allowed for getting at the moving parts, to adjust the packing, etc., the idea throughout being to make this the most perfect machine of its type. The pumps are made in a number of sizes and weights, adaptable to all kinds of service.



TRIPLEX POWER PUMP.

AN order has been introduced in the Chicago Common Council authorizing the Mayor to appoint a committee of four to investigate the Chicago city railways for the purpose of obtaining information regarding expiration of franchises, inventory value and original cost of tangible assets, gross receipts and operating expense from the beginning of operation, amounts of dividends and taxes paid, and other financial characteristics. The measure was referred to the Committee on Judiciary, and has not yet been acted upon.

Switchboard Instruments.

The Keystone Electrical Instrument Company is manufacturing a line of switchboard and other electrical instruments which are meeting with general adoption. Special attention has been directed to securing apparatus which shall be both accurate and durable, so that the time element which is often such a large factor in the deterioration of an instrument will not have any effect on the products of this company. The company's standards are kept absolute and in constant check, so that the liability of a fundamental error in

FIG. 1.

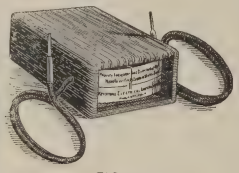


FIG. 3.

FIG. 2.

FIG. 4.

calibration is eliminated, while the methods and facilities for mechanical construction are so complete that the chance for mechanical defect is reduced to a minimum.

The company makes two types of volt and ammeters, as shown in Figs. 1 and 2. That illustrated in Fig. 1 has an illuminated dial and is supplied in either brass case, full nickel, or adapted for flush mounting, while that shown in Fig. 2 is made with iron, nickel, brass or copper cases, or adapted for flush mounting. The voltmeters for railway work read up to 600 volts, with 10 volt divisions in each instrument, while the ammeters are supplied in different working ranges up to 10,000 amps.

The instrument shown in Fig. 3 is a most convenient one for station work, as it is a polarity indicator and detector galvanometer. It is so constructed that a short circuit cannot be made through it and is mounted in a neat polished walnut case, small enough to be carried in the pocket, 3½ ins. × 2½ ins. × 1⅜ ins., and has a weight of 4½ oz. The pointer always deflects toward the positive terminal. There is no liquid employed in this instrument.

Also, for portable use the company manufactures the voltmeter shown in Fig. 4, adapted for either alternating or direct current circuits. There is nothing incorporated in the device which is subject to change or deterioration, and the voltmeter is dead beat without the use of a mechanical brake. It is mounted in a polished mahogany case with key and lock and leather carrying handle. In the railway size the meters read from 100 to 700 volts. The instrument is made with 5 volt divisions, but readings can, of course, be made between the divisions to a much closer accuracy.

The stockholders of the South Side Elevated Railroad Company of Chicago, Ill., have authorized an issue of $1,500,000 of bonds. But $750,000 of the bonds are to be issued, and the money realized on their sale, together with the cash on hand and the $100,000 still held by the Master in Chancery, will be sufficient to build the extension to the loop, erect the company's power house, and change the equipment of its road from steam to electricity.

The Mayor of Baltimore, Md., has issued a permit to the Falls Road Electric Railway Company for the erection of poles and wires within the city limits. Geo. R. Webb is general manager of the company.

Special Swivel Truck.

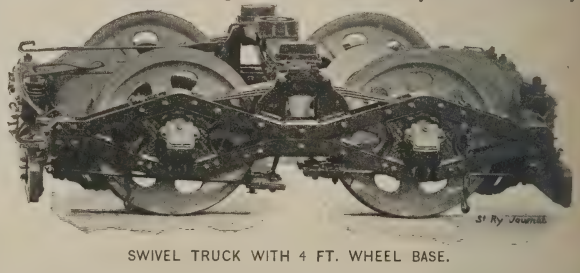
A number of special double or swivel electric trucks have just been completed by the Diamond Truck & Car Gear Company for a railway company in New England. The sharp curves of this road limited the permissible wheel base to 4 ft.; at the same time the heavy traffic required the use of two powerful motors upon each truck, or four motors to the car.

To produce a truck with such a short wheel base and mount thereon two ordinary motors was accomplished by hanging the motors on the outside of the axles and supporting them on the tie or brace bar at the extreme end of the truck frame. This tie bar was bent inward and upward immediately after leaving the tie at the end of either frame member, so as to just allow the admission of the motor, the malleable spring pockets being firmly bolted on the inside to the tie bar or end brace. By bending this tie bar, as described, the side frames of the truck were in nowise lengthened, so they do not strike the side steps of the open car body when rounding the shortest curve on the road.

The brakes used in this truck were also of a new and unique design, and were especially adapted to the peculiar construction of the truck. They are on what might be called the "center draw" principle, as the main draw lever is located near the center of the truck. There was no brake beam extending across the truck at either end, as is usual, but instead, fitted to each brake head, was a short steel bar, which in length was equal to the thickness of the wheel. Attached to either end of this short beam, and machine fitted thereto, were two draw rods, which straddled the under semicircle of the wheel on each side, and were fastened to the main eveners at the center of the truck by two machine fitted malleable castings. By having the four brake shoes fitted in this manner, an opportunity was secured to interpose between the two center eveners the center draw lever. By raising one evener about 2 ins. above the other in this manner the connection or fulcrum made with the lever allowed of a draught upon each swinging evener, and thence through the rods direct to the brake heads and shoes. Of course, this construction left the spaces allotted to the motors entirely clear.

The design of this truck in most other respects is similar to that of the standard Diamond swivel truck, except, of course, that the side frame members between the angles of the diamonds run parallel with each other a shorter distance than in the truck with a longer wheel base. By this parallel center construction of the side frame members an opportunity is secured of locating advantageously the side steady guides and draught plates for the bolster. These plates are firmly riveted to each side frame member and accomplish two distinctive results, that of firmly bonding the truck side frame members at their centers and that of providing a guide and draught plate for the bolster.

The bolster is of heavy channel steel with two under truss supports, or re-enforcing girders, of heavy flat steel bars. Both girders are firmly riveted at each end of the bolster channel bar to the heavy steel casting, which in turn is bolted to the main semi-elliptic spring at its apex or center. This steel casting or cross head acts also as a vertical guide for the bolster in the jaws of the side steady



SWIVEL TRUCK WITH 4 FT. WHEEL BASE.

or draught plates. Immediately at the center of the truck and within the area of the steel channel bolster and its truss (the maximum width of which is midway between its ends) is a separating casting through which the king bolt passes. This casting is also firmly bolted on either side of the king bolt to the channel by two long bolts which also serve to hold the center plate surmounting the channel. This center casting forms a perfect truss, from whose center the steel truss bars are tensioned with the bolster and firmly riveted thereto as described above.

The load of the car body is carried by two extra long semi-elliptic springs, one on either side of the truck, located between the steady plates and the side frame members. These springs are seated at either end upon cast steel wearing pieces which rest on solid shelves, which are cast as part of the pedestal and are located nearly over the journal bearing. On account of the extreme length of the supporting springs, it is claimed a very easy riding service is secured. At either end of the steel channel bolster and surmounting it, are the improved spring anti-friction side bearings which receive the side lurch of the car body first, thus assisting the main semi-elliptics and modifying the thrust of the car body upon them. These side yielding bearings also impart a very easy riding quality to the truck.

The first impression upon looking over the truck, is one of exceptional strength combined with easy riding qualities, and upon a thorough examination of the construction it is found that the efforts of the manufacturers to produce a double motor swivel truck with an exceptionally short wheel base have met with success. It is claimed by the manufacturers that this new truck is especially adapted to roads having very short curves and for high speed and heavy service.

Some Recent Air Brake Equipments.

The Hunt Air Brake Company, reports a number of new orders during the past month, among them one for three motor brakes and seven trail car brakes, from the Wilkesbarre (Pa.) & Northern Railway Company.

The company has also received from F. W. Darlington, consulting engineer, an order for a compressor for the Brooklyn electric fountain operated at the plaza entrance to Prospect Park, Brooklyn.

FIG. 1.—SIDE VIEW NO. 25 MOTOR.

The Washington, Alexandria & Mount Vernon Railway Company, of Washington, D. C., is also making a trial of the Hunt air brake to determine future orders. The cars on this line are very heavy and as the road is operated on rules governing steam roads, the necessity of reliable air brakes is evident. The company has also equipped the cars of the Olean Mountain road, which will be opened July 4, and two cars at Winsted, Conn., recently built by the Worcester Construction Company.

The improved air brake controller or pressure regulator of the company, will act on a voltage as low as 120, and can be regulated to cut in or out as may be desired. The former method employed of making the circuits with copper contacts has been changed to one employing carbon contacts, thus preventing arcing.

A TELEGRAM from St. Louis, Mo., announces that a traction company with a capital stock of $7,500,000, has been organized to consolidate the Lindell and Missouri systems. It is reported from Chicago that the National Railway system will be included in a more general consolidation to be effected shortly.

Some Recent Work in Heavy Electric Railroading.

The Walker Company manufactures four railway motors which can be properly said to come under the head of heavy railroad motors. These are the Nos. 10, 15, 20 and 25. No. 10 can exert a drawbar pull of 1000 lbs at a speed of 10 miles per hour and is well suited for working singly on very heavy cars or in pairs for interurban work. It has a maximum speed of 35 miles per hour. No. 15 is suited to give more rapid transit in interurban service, having a maximum speed of 50 miles per hour. The drawbar pull is 3000 lbs. when the motor is heavily loaded, so that the speed is but 10 miles per hour. No. 20 is a motor designed for elevated and mining service where heavy trains are to be hauled. Its drawbar pull at 10 miles per hour is 5000 lbs. An illustration of this motor is shown in Fig. 1 and until the appearance of the No. 25 it was the most powerful railway motor manufactured as a standard product. The No. 25 motor can easily exert 200 h. p. and its drawbar pull is 5000 lbs. at 18 miles per hour. Its maximum speed is 60 miles per hour. This motor was designed for similar but more powerful service than the No. 20.

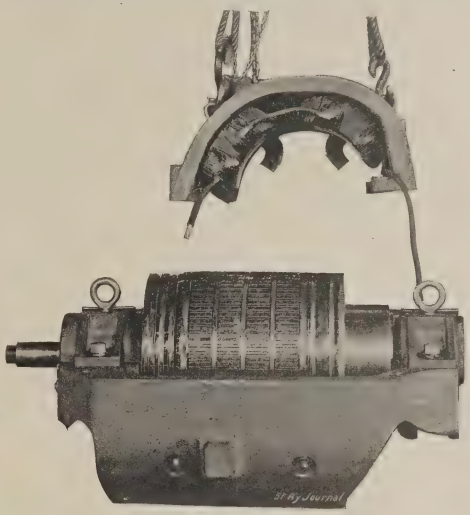


FIG. 2.—NO. 25 MOTOR WITH CASE OPEN.

FIG. 3.—MOTOR CAR DRAWING SIX TRAIL CARS—NORFOLK & OCEAN VIEW RAILWAY.

It has been a difficult matter always to find room for heavy motors in the limited space allowed by a standard gage, 6 ft. wheel base bogie truck with 33 in. wheels. To design a 200 h. p. motor so that it will easily occupy these narrow confines would be sufficiently remarkable, but to design such a motor so that a pair of them can be comfortably placed in the space just specified is nothing less than

an engineering triumph. Two excellent views of the motor No. 25 are given in Figs. 1 and 2.

A double equipment of No. 25 Walker motors will propel a 100 ton train at the rate of 30 miles per hour.

It may be argued that 200 h. p. is an excessive amount for such

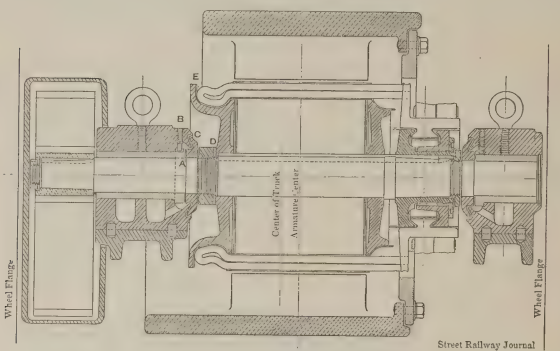
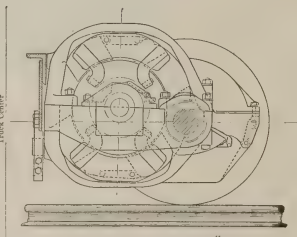


FIG. 4.—SECTION OF NO. 25 MOTOR.

service as this, but a little reflection will show such a supposition to be erroneous. The average elevated car equipped with these motors will weigh from 32 to 40 tons or 80,000 lbs., of which each pair of wheels carries 20,000 lbs. Now if horizontal effort exceeding 25 per cent of the weight on the wheels be applied by the motor the former will skid, thus demonstrating that the power is excessive. Therefore by this reasoning anything over 5000 lb. drawbar pull would be excessive, and this is just the drawbar pull of the No. 25 motor. Drawings of and curves from the No. 25 motor are herewith presented and they will be found very interesting, partly because of the power of the motor and partly because what is true of this motor is largely true of the other Walker types, suitable modifications being made for their lesser capacity.



The armature of this machine is wound on the barrel or "straight out" plan, and particular attention is called to the remarkably short armature that has been designed, despite the natural disadvantages of this winding in this respect. An Eickemeyer winding would produce, it is claimed,

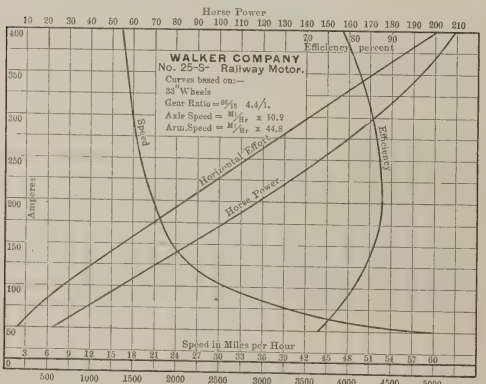


FIG. 6.—CHARACTERISTIC CURVES—NO. 25 MOTOR.

a head which would be just double the thickness of the conductors with which the armature is wound. The head of this armature is scarcely 50 per cent longer and it overlaps the bearing so that it does not in any way limit the dimensions of the motor. To design such a winding so as to adapt it to electric railway service and thereby secure its great advantages in construction, repair and efficiency to a class of machine in which such features are most important, is a great step in advance of modern electric railroading.

The windings are all continuous loops without joints except at the commutator lugs. Instead of being wound with wire, a flat copper ribbon is used with its edge on a radial line with the center of the armature. This permits a most compact winding and leaves a tooth of considerable thickness which not only makes the field and therefore the torque much stronger, but it also is proof against mechanical injury should the bearings be so neglected that the armature strikes on the pole pieces.

It will also be noted that the ends of the coils are thoroughly protected by an iron shell from both dust and mechanical abrasion. On the commutator end the commutator lugs perform part of this service and the protecting flange is cut away to make room for them. It is also worthy of notice that the lugs of the commutator, coming out flush with the head of the armature, form a head the parts of which are of the same potential as the adjacent brushes. Thus arcing between the brushes and the head is impossible and therefore these machines will not come in with large holes burned in the heads due to weak fields, a most familiar accident in many motors.

The thrust collars which also form the oil flanges are of interest. They are somewhat intricate in section and make it very difficult for the oil from the bearing to creep to the armature coils. If this occurs at all the oil must travel over the path, A, B, C, D, (Fig. 4), and it will be readily realized that this is next to impossible. In addition to this there are numerous oil wells and drains which catch the oil as it flies off the sharp edges of the oil flange by centrifugal force. The commutator of this machine is built to prevent the

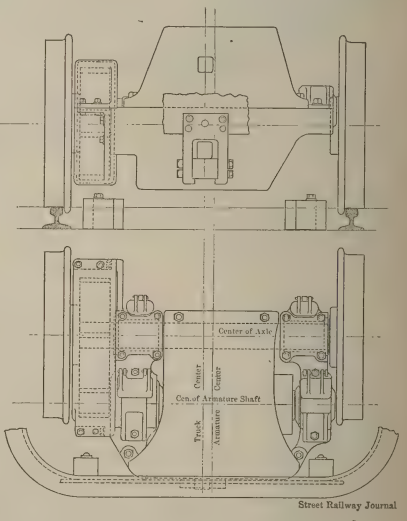


FIG 5.—PLAN, SIDE AND END ELEVATIONS OF NO. 25 MOTOR.

flashing of an arc from the positive bars to the shell on which the commutator is mounted. On the inner side, where there is no danger of mechanical injury, the insulating collar is extended until it forms a fence of micanite over which the arc must travel to ground the commutator. On the other end the collar is cut off flush with the end of the bar, but as the sleeve does not extend out as far as the end of the bar an arc would have to travel a considerable distance to find the ground. The full depth of the commutator bar is shown on the end of the commutator and thus the state of wear can be seen at all times.

Diagrams of the suspension are shown in Fig. 5. With the heavy types of motor it has not been found necessary to use the patent suspension as the vibration of such heavy equipments at high speeds is not such a serious matter, the motor riding more like a locomotive. The performance of this motor is shown in the curves of Fig. 6. The efficiency at two-thirds load, it will be noted, is over 85 per cent and is high for such a machine. From the horse power and horizontal effort curves the performance of the motor at different ampere loads can be noted. The fields attain saturation at between 200 and 250 amps. and therefore beyond that point the speed is quite constant at and over 18 miles per hour.

While in practice the Walker Company has not as many instances of heavy railroading to point to as have its competitors who have been in the field ever since the latter existed, yet in the three years of its existence the Walker Company has made a most creditable showing. Cuts of a train on the Norfolk & Ocean View Rail-

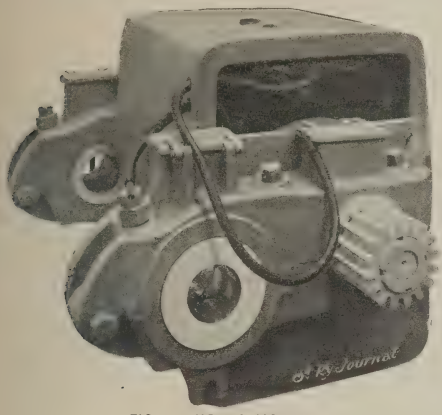


FIG. 7.—NO. 20 MOTOR.

road, and of another on the Porto (Portugal) road are shown herewith. These roads have been doing a heavy traffic with the Walker machinery for some time.

Trolley Excursion.

A very pleasant trolley excursion was extended June 6 by R. H. Derrah, secretary to President Little, of the West End Street Railway, of Boston, to a number of gentlemen connected with the West End Company, the Boston press, city government and others. A start was made at Grove Hall, Boston, at nine o'clock and a run was then made via Charlestown to Malden, where a change was effected to a special car of the Lynn & Boston Railroad Company, which took the party to Lakeview Park on the line of the Lowell & Suburban Street Railway Company, about five miles beyond Lowell, Mass. A part of this run was over the lines of the Reading & Lowell

FIG. 8.—ELECTRIC TRAIN ON PORTO ELECTRIC LINE—PORTUGAL.

Railway Company. Here dinner was served, after which the party returned to Boston. The distance traveled was a little over 80 miles.

An interesting accessory of the trip was a handsome souvenir containing many half-tone illustrations of the charming lake and landscape views at Wakefield, Billerica and Lakeview. The Lowell & Suburban Company also presented each member of the party with a copy of its booklet, showing the best scenes along the various lines of the company.

A Convertible Booster and Direct Current Generator.

A patent has just been granted to J. Lester Woodbridge, covering improvements in the booster system for long distance transmission. Broadly, the patent includes combinations of generator, bus bars, feeders and switching devices, so proportioned and ar-

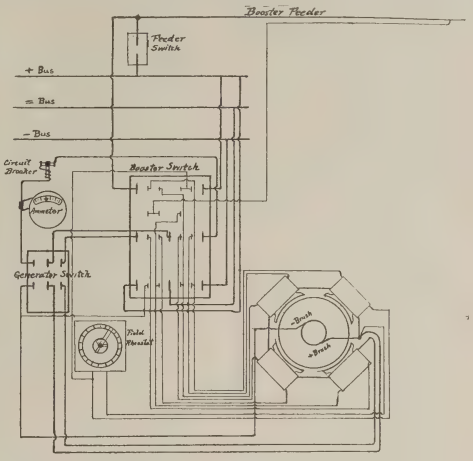


DIAGRAM SHOWING CONNECTIONS FOR CONVERTING A GENERATOR TO A BOOSTER.

ranged that the generator may be utilized either as a constant potential machine or as a booster in series with a feeder, or with any one of several feeders.

This system has already been put into successful operation on several electric railway lines and has been giving good satisfaction. An ordinary railway generator is connected up so that it may be used as a booster when required, while at other times it can be operated as a generator the same as formerly. The cost of such installation is comparatively insignificant, no new machinery being required. Both the series and the shunt windings are utilized, but the effects secured when boosting are the same as with a series machine.

Although each case naturally involves special features which alter the details, the accompanying diagram will give a general idea of the connections. A special double throw switch is introduced, having seven blades, three for the heavy currents and four lighter for the currents of the shunt fields. When thrown up this switch connects the generator as a booster between the positive bus bar and the feeder, the feeder switch being open. At the same time the shunt fields are connected in parallel with each other and with a certain portion of the feeder, whereby a part of the current on the feeder is diverted through them, the whole being so proportioned that the combined effect of series and shunt coils gives the desired ratio of volts to amperes, determined by the resistance of the feeder. When the booster switch is thrown down the machine is restored to its former condition and is used as a constant potential generator.

This system has been in operation in Chester, Pa., for two years, and in Pittsburgh, Pa. (on the Second Avenue Traction Company), for over a year, and was introduced in Philadelphia on the line of the Roxborough, Chestnut Hill and Norristown Road some months ago. Mr. Woodbridge has other installations nearly completed.

THE question of the municipal ownership of gas plants is thoroughly presented in a discussion between Hon. Edward M. Grout, of Brooklyn, and Allen Ripley Foote, of New York, in the June number of *Municipal Affairs*.

A New Motor, G. E. 52.

The General Electric Company announces a new street railway motor, of less capacity than the G. E. 1000, but of greater capacity than the G. E. 800. In the nomenclature of its railway motors the General Electric Company has abandoned the method formerly derived from the drawbar pull, and has adopted an arbitrary nomenclature. The present motor is therefore known as the G. E. 52. Its design has been followed along lines indicated by years of experience and no pains have been spared to make it light in weight, compact in form and simple in construction, while retaining all the excellent features of the G. E. 1000 motor.

The G. E. 52 motor has an output of 28 h. p. rated according to the G. E. standard basis, i.e., a maximum rise of 75 degs. C. in the temperature of the windings after a run of one hour at rated lead, the temperature of the surrounding air not exceeding 25 degs. C.

The motor is intended only for ordinary street railway work and is not recommended for the heavier service to which the G. E. 1000 motor is adapted. The motor has been designed similarly to the G. E. 1000 motor, and will accommodate electric brakes, but as some additional capacity is required for brake service the company does not recommend this motor for such work except in purely street railway service.

The frame is of steel, cast in two bowl-shaped pieces and hinged and bolted in such manner that the motor is practically water and dustproof. A hand hole, fitted with cover and plate and gasket, is let into the lower half, directly beneath the commutator, permitting easy access to the bottom of the motor for inspection or for the removal of any foreign substance. The motor has four poles, each with its own coil. The pole pieces—and in this feature the motor differs from the G. E. 1000—are laminated, but are bolted to the frame in the same manner as in the G. E. 1000, the bolts extending through the frame.

A large percentage of the cost of motor maintenance is due to the expense of renewing the bearing linings, and too much attention cannot be bestowed upon the design of these. The large bearing surface of this motor is one of its most important features. The armature bearings, designed for the use of oil or grease, or both, are of the following dimensions: pinion end, 7¾ ins. × 2¾ ins.; commutator end, 6⅝ ins. × 2½ ins., and are constructed on the "outboard" plan. The upper support for the lining is cast with the upper half of the motor frame, and when the lining is in place there is a space of 1 in. in the cored recess, between the inner end of the lining and the motor frame. This space is occupied by a combination thrust collar and oil guard. The thrust collar is extended through the motor frame into the recess where it acts as an oil guard. This portion of the collar is a tapered disk, 6½ ins. in diameter. The lower support for the lining is a cap bolted to the upper half, but not enclosing the lower half of the oil guard. This allows free outlet to the oil or grease. With this construction it is impossible for the lubricant to work into the motor. The upper grease or oil cups are of ample size and are provided with wicks or wipers, which wipe the shaft through openings cut in the linings. The axle bearings are also fitted with two wipers to each bearing.

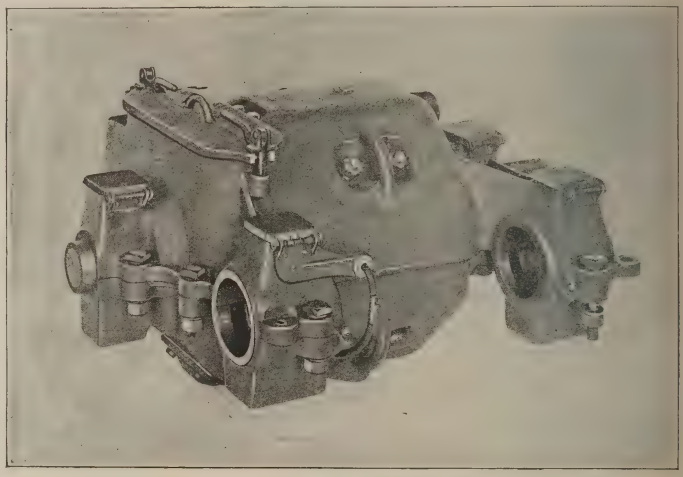


FIG. 1.—NO. 52 MOTOR CLOSED.

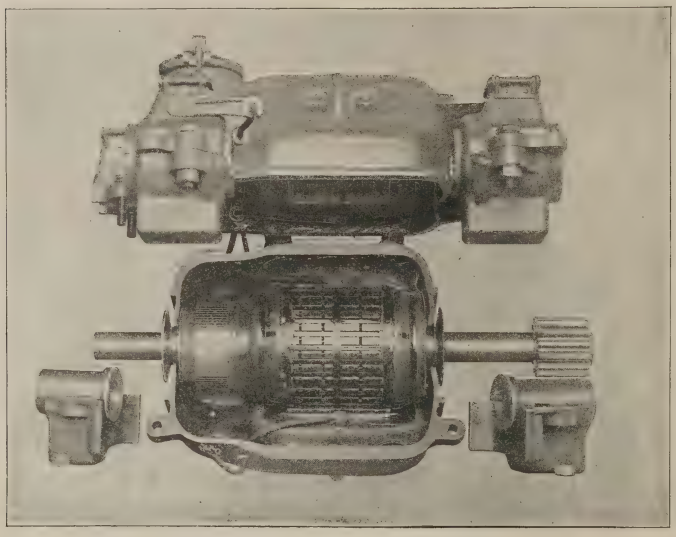


FIG. 2.—NO. 52 MOTOR WITH CASE OPEN.

The field coils are wound with asbestos covered wire and "mummified." Each is held in place on its respective pole by means of the pole piece projections, supplemented by a spring steel plate, and is placed in position before the pole piece is bolted to the frame. For convenience in car wiring and opening of motors, the field connections between the upper and lower fields have been made on the outside of this motor, and both the field and armature leads are brought out at the front of the motor as in the G. E. 1000 motor.

The armature is of the well known iron clad, hollow core type, 11 ins. in diameter, with a spread of 9 ins. The core is built up of well annealed laminæ, and to increase the circulation of air, is provided with three ventilating ducts, as in the G. E. generator armatures. The armature has no spider, but it is assembled directly on the shaft. There are twenty-nine slots in its periphery, each slot containing three coils formed into a compact unit, consequently, there are twenty-nine slots of coils and eighty-seven commutator bars. The small number of coils is of special advantage in the matter of armature repairs, while the method of forming them in groups of three admits of a substantial insulation of high quality. The comparatively small weight of the armature, and its consequent small inertia, will be readily appreciated, as it is well known that the stored energy in the mass of an armature must be overcome by means of the brake when the car is brought to a stop.

The standard gear ratio is 4.78, with taper-bore pinion having fourteen teeth, and a cast steel gear having sixty-seven teeth. Higher speed gear ratios may be used, furnishing increased speed with proportionately decreased tractive effort.

The commutator is constructed on the same lines as that for the G. E. 1000 motor. The segments are of hard drawn copper, $1\frac{1}{8}$ ins.

deep, allowing a wearing depth of 1 in. In assembling, clamping bolts have been dispensed with, and the clamping ring is held in place by a ring nut. The brush holders are standard and staggered to prevent the wearing of ridges in the center of the commutator. Each holder contains two radial brushes, 2¼ ins. long, 1¼ ins. wide and ½ in. thick. The brush holder yoke is carefully treated with an insulating compound and rubbed to an enamel finish, preventing the lodging of carbon dust.

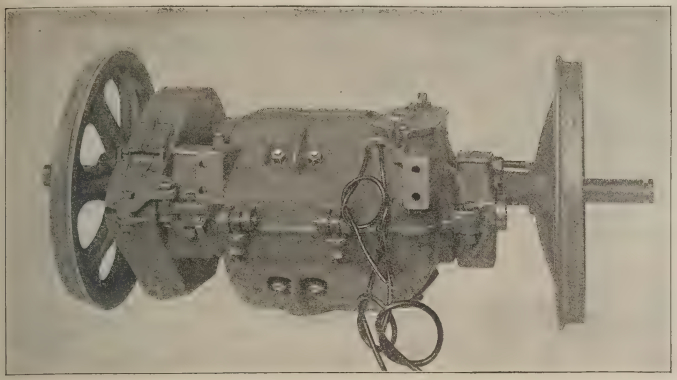


FIG. 3.—END VIEW OF MOTOR.

The suspension can be either the nose, the yoke, or the side bar, as with the G. E. 1000 motor. The yoke suspension is especially recommended, as with this suspension the weight of the motor is carried on springs, placed upon the side frames of the car trucks. Lugs are cast on the upper half of the motor frame, to which the suspension bar is bolted, the motor being suspended from the top half. This permits easy access for inspection or repairs, as the lower half can be swung down into the pit without disturbing the upper half, which remains suspended from the axle and suspension yoke. The same adjustable axle collar is furnished as with the G. E. 1000 motor.

When the motor is mounted on 33 in. wheels, the clearance between the bottom of the motor and the top of the track rails is 5⅞ ins. The clearance between the bottom of the gear case and the top of the track rail is 4⅝ ins.—a feature which railway men will appreciate.

The motor without gear or gear case, weighs 1460 lbs.; complete, with sixty-seven tooth gear and malleable iron gear case, the weight is 1725 lbs.

Air Brakes in Wilkesbarre.

The accompanying engraving shows a train of electric cars on the recently opened Wilkesbarre & Northern Railroad. The closed cars are about 35 ft. long and are built after the steam pattern. They are vestibuled and are finished in quartered oak of selected grade. The seats, which are reversible, are of the Walkover pattern and are upholstered in rattan. The open trailers, which are about 36 ft. long, have eleven benches and vestibuled fronts.

The motor cars are equipped with the Hunt automatic air brakes. The compressor of the brake is placed in one corner of the car, and is inclosed in a box having same finish of car, and forming a seat. The action of the compressor while at work is hardly perceptible in the car.

TRAIN IN WILKESBARRE.

The air gages are upon the vestibule in front of the motorman. The automatic controller is placed in the rear of the vestibule, as is also the resistance box. The air pipes running to the controller as well as to the trailer, are run inside of the moulding in the car, out of sight, so that one would hardly know the car was equipped with air. The car has whistles on both ends.

The trail cars are equipped with the Hunt trail brakes, and cars all run in trains. The connections between cars are made by air hose, the motorman on the motor car handling the train with air.

The Disposition of Worn out Metals.

How best to dispose of worn out trolley wire, brass journal boxes, burned out armatures and the like is a question of constant interest to street railway superintendents. The Swarts Metal Refining Company has long made a specialty of purchasing worn out trolley wire, rail bonds, burned out armatures, brass gears, journal bearings, controller and brake handles, etc. Wire of long lengths and in good condition is tested, rebound and sold as second hand wire. All scrap brass and copper is refined and cast into ingots for brass foundries. After several years of experience the company has perfected a high grade "XXX metal" for the bearings of motors and other high speed machinery. This babbitt has been tested by several leading street railways with most satisfactory results. It is an amalgamation of pure tin, copper and antimony, each in its proper proportion, and will not heat or pound out. The company also manufactures high grade bar and wire solder for electrical purposes. Another specialty is cotton and woolen waste in bales of 100 lbs. and 500 lbs., a large supply of which is kept in stock for ready shipment.

REFINING FURNACES FOR OLD METALS.

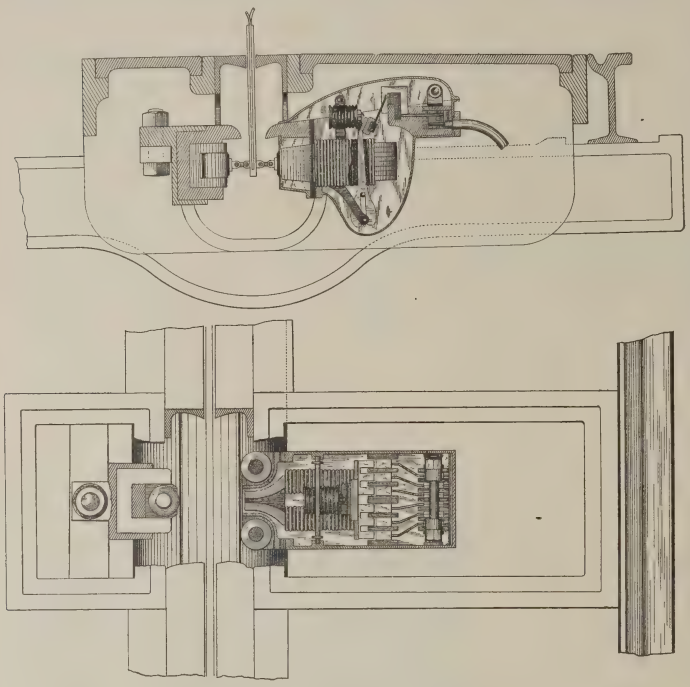
The increasing business of the company has made necessary a movement to new and more commodious quarters. The illustration shows the company's refining furnaces. The officers of the company are Seymour Swarts, president, and Louis Schwab, secretary.

Consolidation of Manufacturing Companies.

It is stated that the Siemens-Halske Electric Company, of Chicago, is now being consolidated with the Pennsylvania Iron Works, of Philadelphia. A majority of the stock of the Chicago Company has already been exchanged for the stock of the Pennsylvania. The minority stockholders have been given sixty days in which to accept the offer of the Eastern concern. With a combined capital of $3,250,000, the two companies will manufacture street railway machinery for the four large cities of Chicago, New York, Philadelphia and Pittsburgh. The consolidation has been effected through the efforts of Charles T. Yerkes. The directors elected for the new company are Charles T. Yerkes, W. L. Elkins, Jr., and B. W. Grist.

A New Sectional Underground Electric Railway.

The accompanying engravings illustrate the de Redon sectional underground electric railway system, invented by Constant de Redon, in which the use of live conductors in the conduit is avoided. These are replaced by contact points, consisting preferably of rollers, which are automatically thrown in and out of circuit as the car passes. These contact points are located every 15 ft. or 20 ft. apart, and are connected to the main feeders, which are carried at the side, through the intermediary of a switchbox. The latter is of metal and tightly closed; its mechanism consists of a permanent magnet, or horseshoe magnet, mounted as a pendulum (Fig. 1). To this pendulum is attached a lever, which opens or closes the electric current, as desired. To this lever is attached a retarding device, preferably a rubber bellows, which keeps the lever in the same position for several seconds, as explained further on.



FIGS. 1 AND 2.—PLAN AND SECTION OF YOKE, SHOWING CONTACT BOX.

To take the current from these points, each car is fitted with a flexible iron ribbon shaped plow, shown in Fig: 7. This plow is carried in the conduit and is long enough to extend from one contact box to another, so that it will always reach one box before leaving the preceding one.

The mode or operation in this system is as follows: When the plow passes a switchbox, being of iron, it acts through the metal partition of the box, and attracts the pendulum formed by the permanent magnet which is inside of the box. This pendulum moves the lever which establishes the current between the main line and the plow, whence it passes to the motor. From the motor, the current returns by another cable parallel to the first one, to another roller on the other side of the conduit (Figs. 1 and 2), and from this second roller the current is carried to the main return feeder.

When a car leaves a switchbox, the circuit remains closed for several seconds, on account of the retarding device placed on the lever. By this means the current is sent to the next box; in case the pendulum of the latter should not act immediately, thus obtaining a regular current. The retarding device also prevents too prompt a rupture and arcing at the contact blocks inside the box as the plow leaves it.

A few seconds after the passage of the plow the pendulum of each box resumes its first position, and there is no connection between the main line and the contact rollers on the outside of the switchbox, hence the current is absolutely insulated when there is no car before the box.

All the component parts of this box can be instantly changed, and without difficulty, it being merely necessary to remove the box cover, when the entire interior may be seen. As the current passes around the permanent magnet before going to the motor, the magnet will preserve its attractive power, and need not be replaced from time to time.

Instead of having a switchbox every 15 ft. or 20 ft., as described above, a modification of this system consists in having only one switchbox every 200 ft. or 300 ft., dividing the line into sections of that length, and placing between these switchboxes intermediary contact rollers, 15 ft. to 20 ft. apart as shown in Figs. 4 and 7. These intermediary contracts will receive the current from the switchbox by a secondary feeder. In this case the switchbox has an electromagnet placed at its base (Fig. 3) through which the current passes. In this way the contact blocks are kept closed inside of the switchbox, as long as one or more cars are on that section.

Each intermediary contact roller is provided with a safety fuse, which will indicate any improper insulation when a car is in a section. Where a contact is in bad condition of insulation, the fuse will blow and the traffic will only be interrupted in a section of 15 ft. or 20 ft. This will be easily repaired by replacing with a new fuse and inspecting the contact to determine the cause of the trouble. It must be understood that these contact rollers, as well as the switchboxes, are placed in small receptacles on the side of the conduit, as can be seen in Fig. 5 or 7, so that by removing the covers it will be very easy to reach them. This modification of the system reduces the number of switchboxes to about twenty to the mile, and greatly simplifies the system in its mechanical construction.

Fig. 4 is a plan showing the portion of the plow when the car is passing around a curve. At these points a number of small wheels are used at the sides to prevent the plow from touching the side of the conduit. The system can also be operated just as well by using the track as the return current.

The advantages claimed for the system are as follows:

First, an excellent insulation of the current. This will be easily seen, for instead of a continuous line, which is very difficult to insulate, there is a contact which requires insulation only every 15 ft. or 20 ft.

Second, there is a great saving of current as there is no continuous line in the conduit. Humidity, which would otherwise cause a great loss of current, may be ignored and as there is a good insulation, leakages and short circuits are avoided, or if there be a leakage or a short circuit, it will be only when the car passes before an imperfect contact or section, while in the case of a continuous line any leakage or short circuit continues to exist until discovvered and repaired.

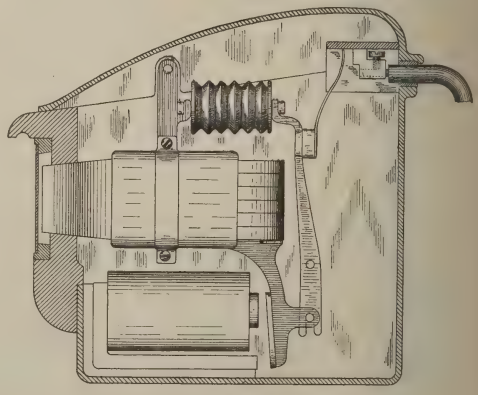


FIG. 3.—CROSS SECTION OF CONTACT BOX.

Third, if there be an accident to a switchbox or contact the car passing before it will indicate it. Thus accidents may easily be located while traffic along the rest of the line is not interrupted.

Fourth, as there is a contact box only every 15 ft. or 20 ft. inspection of the line is very much facilitated, since it is only at such points that an accident can occur.

Fifth, this system will be less expensive than a continuous line system; because it does not require so large and deep a conduit, since there is nothing in the conduit but contacts placed on the side of the conduit.

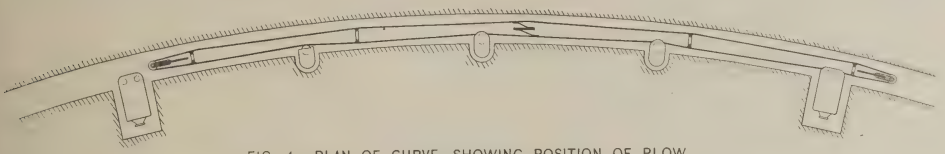
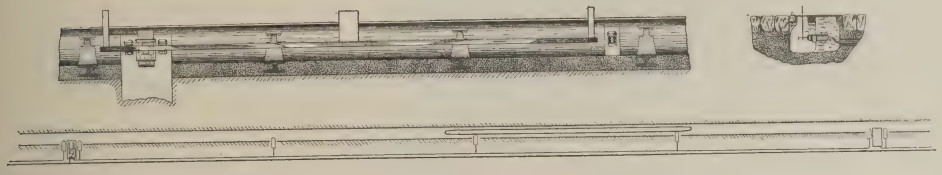


FIG. 4.—PLAN OF CURVE, SHOWING POSITION OF PLOW



FIGS. 5, 6 AND 7.—PLAN AND SECTIONS OF CONDUIT, SHOWING INTERMEDIATE CONTACT POINTS.

Cars for the Cincinnati & Miami Valley Traction Company.

Some very fine interurban electric cars have recently been built by the Barney & Smith Car Company, for use on the Cincinnati & Miami Valley Traction Company's line, running between Dayton and Hamilton, O. These cars are 32 ft. long over the body, with 5 ft. vestibuled platforms at each end, making the total length 42 ft. They are built exceptionally strong with heavy underframing of Southern pine and exceptionally strong platforms, the nose pieces being faced with steel to prevent damage in case of contact with anything.

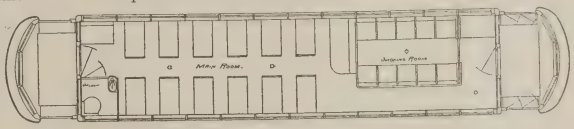
These cars are finished inside with quartered oak, the finish is handsomely decorated with carved work and is rubbed down in oil so that the entire inside of the car has the appearance of a drawing room. The seats in the main room are of the Wheeler pattern and are upholstered in woven rattan. The smoking room, which is shown on the plan herewith, is about 8 ft. long and is upholstered in maroon leather.

The cars are equipped with water closets and water coolers, and the main room is lighted with two three-light clusters and the smoking room is lighted with one two-light cluster. There are coat and hat hooks on the sides for the convenience of the passengers.

These cars are mounted on the Barney & Smith standard class "F" trucks with 6 ft. 4 in. wheel base.

The windows are protected on the outside with guard rods, so constructed that they can be dropped away from the sash for the purpose of cleaning. The windows are very large and made in two parts, upper and lower; the top sash is arranged to drop level with the stool of the car. The deck sash are divided into small lights and are supplied with chipped glass. The outside finish is royal blue with silver ornamentation.

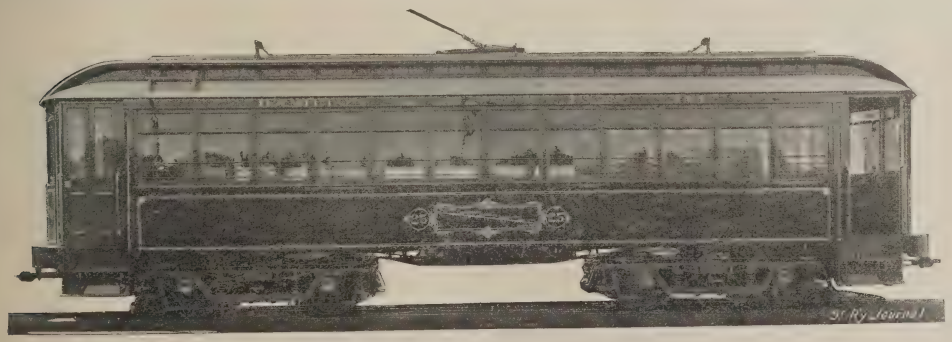
One engraving shows the exterior of the car. At either end is the Barney & Smith improved trolley protector, a device for preventing the throwing down of the trolley pole and injuring the roof of the car, and is so constructed that it catches all the rebound of the pole. These cars will certainly attract attention from all sources and will be the means of raising the standard of electrical equipment.



PLAN OF CAR.

Railway Contracts in Buffalo.

The Buffalo Traction Company placed orders late in June for the construction and equipment of the initial portion of its system.



DOUBLE TRUCK CAR—CINCINNATI & MIAMI VALLEY TRACTION CO.

The vestibules are arranged to close up tight with trap doors to cover the steps and swinging doors to cover the side openings. The vestibule sashes are arranged so they can be raised or lowered to suit the motorman. The windows in the cars are supplied with tapestry curtains mounted on Hartshorn spring rollers and supplied with Acme curtain fixtures.

Twenty car bodies were ordered from the J. G. Brill Company, and twenty trucks from the Peckham Motor Truck & Wheel Company. The contract for 15 miles of rails was given to the Pennsylvania Steel Company. Power is to be furnished from Niagara Falls. George A. Ricker is the company's chief engineer, and C. W. Ricker its electrical engineer.

Electric Launch for Pleasure Bay.

Pleasure Bay is the pleasure resort of the Atlantic Coast Line Electric Railway, the line connecting Asbury Park, Long Branch and other seashore resorts along the northern shore of New Jersey.

ELECTRIC PLEASURE LAUNCH.

Last year the railway company presented upon several evenings each week elaborate entertainments, but this year the entertainments will be on even a larger scale. The accompanying engraving shows a type of electric launch of which four will be employed at that place this summer.

Two of the boats will be fitted with removable awnings, as shown in the engraving. These awnings will be in place in the day time, but will be removed on fireworks evenings so as not to interfere with the view of the passengers.

The afterpart of the boat will contain at the sides, which can be taken out, adjustable seats to accommodate the larger crowd on such occasions.

Grease for Street Railway Motors.

Adam Cook's Sons, of New York, proprietors of the Albany lubricating compound for motors and car journals, have had remarkable success with this grease. This lubricant is not an experiment, but has stood the test of twenty-five years, and many of the best known manufacturers in the country give an unqualified indorsement of its merits. The grease is especially adapted for electrical machinery, street railway motors, and in fact machinery of all kinds, and all the makers ask is a test. The principal advantages claimed for it are as follows: (1) The different consistencies make it effectively applicable to any motor now in use. (2) It can be used in any temperature. (3) It saves burning out of armatures. (4) The brasses are preserved from cutting and will wear longer. (5) It will save in repairs and give better lubrication. (6) When all these facts are considered it is the cheapest lubricant in the market notwithstanding its first cost. A special point made by the manufacturers is that users should be careful to secure the genuine and see that each package or barrel bears the trade mark and the words "Albany Grease." Among the users of this grease are Fraser & Chalmers, of Chicago, who report that although they have used the compound for many years they have never received a complaint about it. They also say that they have supplied this compound and the company's cups throughout the world and that they may be depended upon as patrons of it at all times. The question of the use of oil or grease is an important one owing to the great expense of repairs. In connection with this, the instructions of a large corporation of electrical machinery to its patrons are of interest. They are as follows: "Do not use oil —use grease. This may require stirring when starting a cold machine. From nine years' experience we recommend the original Albany lubricating compound as the purest and best article for use on dynamos. Do not use any of the mineral greases (products of petroleum). They are seldom pure and generally contain enough free acid or alkali to injure the insulation of a machine."

Albany grease has also been used with very great success in the lubrication of engines in power stations. One important advantage resulting from its employment for this purpose is, of course, its greater cleanliness over oil, and this point is one which many power station engineers who have been troubled with oil soaked floors appreciate. Of course, the grease must be used with some common sense. It will not perform miracles, but its employment with discretion should be followed with satisfactory results. It has been used on engines of as high as 1000 h. p., with satisfactory results, and it is said that when used the engine cranks run cooler on one-half ounce of grease per day than on a quart or more of oil.

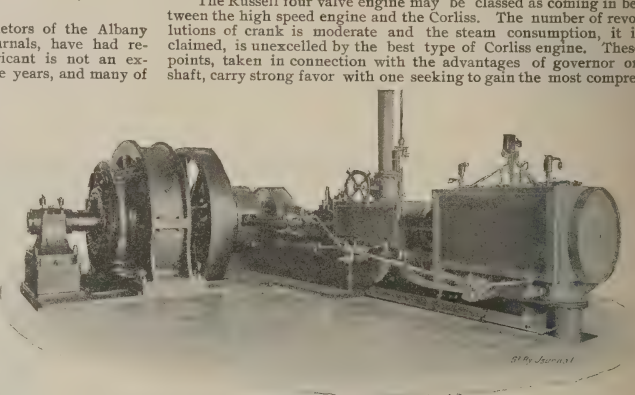
A New Railway in Washington, D. C.

The Capital Railway Company is the title of a new corporation which has recently opened a line between Congress Heights and the Navy Yard, crossing the Potomac by Anacostia Bridge. That portion of the line in the city is equipped with the Johnson Company's Brown magnetic underground system, and that outside the city with the overhead system. The length of the line is about 4 miles, of which 1 mile is within city limits. The road was completed May 27, but will not be put in continuous operation for a few weeks, pending alterations in the Anacostia Bridge. E. H. Moxham & Company were the engineers of the road, and the contractors for the underground system were the Johnson Company. The president of the Capital Railway Company is A. E. Randle, and the secretary and treasurer Edward H. Way.

Compound, Four Valve Condensing Engine.

The accompanying engraving shows a compound, four valve condensing engine recently installed by Russell & Company in the power house of the Pittsburgh, Allegheny & Manchester Traction Company, Allegheny, Pa. The engine shown is the latest output of Russell & Company's factory and has cylinder dimensions 18 ins. and 31½ ins. × 27 ins. stroke. The engine is directly connected to a General Electric 300 k. w. generator, running 150 r. p. m. Both engine and generator are mounted on an iron sub-base, making the whole outfit self-contained. The engine has been in use continuously since Jan. 1 and though frequently carrying loads 50 to 75 per cent beyond its rated capacity there has been no apparent strain on its mechanism, and its uniformity in speed has been maintained within the prescribed limit.

The Russell four valve engine may be classed as coming in between the high speed engine and the Corliss. The number of revolutions of crank is moderate and the steam consumption, it is claimed, is unexcelled by the best type of Corliss engine. These points, taken in connection with the advantages of governor on shaft, carry strong favor with one seeking to gain the most compre-



COMPOUND, FOUR VALVE CONDENSING ENGINE.

hensive machine in simplest form. The bed is fashioned after the well known "Tangye" type which rests on the foundation its entire length, possesses great strength and rigidity, is graceful in appearance and meets the requirements of the critic.

The cylinder is ground and bolted to the bed, its outer end supported, but not bolted down, leaving it free to expand or contract as its temperature changes; it is jacketed with non-conducting material to reduce radiation, and is made of a special mixture of iron to insure a long life and efficient service. The steam valves are of the gridiron form, triple ported, light, and as nearly balanced as a slide valve can

be. This balance is had by admitting steam between the valve faces, leaving narrow strips or bridges for the valves to ride on. Across these bridges the "Plus Robinson" principle of the steam extends, preventing actual contact of the surfaces, and thus the valves are carried between layers of steam making their movement very easy indeed. The cut-off valve slides on the back of the main valve and is operated by its own eccentric which is connected to the governor in such a manner as to cut off proportionately to the load.

The engine has given good satisfaction where used.

Revolving Tower Wagons.

The revolving tower wagons placed upon the market some time ago by the Leonhardt Wagon Manufacturing Company have had a remarkably successful career. These wagons do not have to stand on the track, but can be placed at the side while the wire is being repaired, the platform projecting over the track at the side of the wagon. In this way they do not block traffic.

With the tower lowered no part of the wagon projects above the driver's head, the highest point being less than 8 ft. from the ground. This feature permits of fast driving along the streets without danger of upsetting, and hence the vehicle is a combined tower and emergency wagon, which is ready for any kind of work at all times. It will pass under a low doorway and has large and roomy lockers for tools, materials, etc., on both sides and rear.

The wagon is built with a platform gear, and is therefore easily handled in narrow streets and close places.

The tower is easily and quickly raised, lowered and turned in any direction, by one man, by means of a very simple gearing acting upon two short chains. When elevated, the two wooden uprights are swung in position, fastened with split keys, thus forming rigid supports and taking the strain off the gearing and chains. A simple but strong lock quickly fastened, prevents the tower from turning. The platform is fastened to the ladder by heavy forged hinges, stayed by two braces and is provided with a substantial folding guard rail. Perfect insulation under all circumstances is positively guaranteed.

The materials used in the construction of the wagon and tower are strictly first grade, are carefully put together by skilled mechanics, under personal supervision. The company has shipped its wagons all over the United States as far as California, also to South America and Australia, quite a number of the companies having duplicated their orders, and has yet to receive the first complaint of their operation.

Wheel Grinding Machines.

That car wheels can be ground by a company in its own shops without complicated or expensive machinery admits of no question. The Murphy car wheel truing machine, illustrated in the STREET RAILWAY JOURNAL for March, 1897, has been very favorably received and proves this conclusively. It was invented by a practical street railway operator of many years' experience, to obviate the flat wheel evil on his own road. The success with which this end was accomplished has led to their manufacture.

The requirements demanded of such a machine are: first, a machine which will quickly true the wheels without removing them from their position under the car; second, that the wheels should be ground absolutely round; third, that the machine should be simple and easy of operation, but of such massive design as to be absolutely rigid and with nothing to get out of order.

How well these problems have been solved, any railway man can judge on seeing the machine in operation. By centering the axle carrying the wheels to be ground on heavy center pins, and making the emery wheel shafts, bearings and all other parts of ample size, an absolutely round and true wheel is obtained, not merely a polished tread.

A car having a flat wheel is run over the machine, the end of the car carrying the wheel to be ground is jacked off the rail, the box lids are let down and the centering pins are run into the end of the axle. The car motor is then started, its speed being controlled by a resistance. The emery wheels, which are mounted on another shaft, are then moved to press against the wheels and are revolved in the opposite direction. In from fifteen to forty-five minutes the car is ready for the road with an absolutely round pair of wheels. This company controls broad patents on this and other forms of machine for grinding car wheels in place.

Overhead Insulating Material.

The necessity for exceedingly high insulating qualities as well as for strength in overhead line equipment is apparent when the large number of parts used upon a road of even a short length is taken into consideration. The leakage from a single hanger or pull-off may be insignificant, but when multiplied through a line of several miles becomes a serious loss. In considering the necessary qualities for a good overhead insulator many points have to be considered. The insulator must, of course, be impervious to water or it would soon become useless to prevent the leakage of current. It must be of closest texture and the greatest strength in order to endure the more or less frequent blows of trolley wheels or poles. Even a slightly brittle substance soon chips away and makes a renewal of insulators necessary. Great strength is also necessary to stand the strains of the line. Each part is in most cases a key to the construction as well as an insulator, and a failure in its office in any particular impairs the efficiency of the whole line. For this reason glass, so serviceable as an insulator in telegraph and telephone construction, cannot be used on railroad lines.

The Fiberite Company, the manufacturer of the Medbery overhead material, has been long in the business of manufacturing overhead line equipment and claims to have solved all the problems involved in the manufacture of overhead parts in a satisfactory manner. The material has had an extensive sale, a fact naturally indicative of ability to withstand all of the destructive influences of heat and cold, the effect of rain, snow, sleet and ice, and to retain unaltered efficiency under all circumstances.

The Medbery insulation is used in connection with aluminum bronze fittings, which material is claimed to have a tensile strength three times that of ordinary red bronze, and is also manufactured by the Fiberite Company.

At the urgent request of the managers of several prominent roads, which are equipped with standard cap and cone type of material, the Fiberite Company has decided to make the cap and cone type of material in the Medbery insulation, and is now supplying large quantities of it to roads which are compelled to replace these goods.

The necessity of having a suitable insulating supporter for heavy electric light cables, as well as electric railway service, has caused the adoption, by some of the largest stations through the country, of the Medbery "heavy Brooklyn strain," which is being used very largely by many concerns. These strains are calculated to carry 12,000 lbs. strain, and have been found very desirable, and disposes of the difficulty found by many managers of a proper support. The Medbery arc lamp hanger, which has been on the market for some time, is also meeting with a favorable demand, and where it has been used, it has proved a decided success.

The Fiberite Company is also manufacturing a line of graphite trolley bushings, which are giving a very great degree of satisfaction.

The Patton Motor.

The principle of the Patton motor is now fairly well known. A gasoline engine is used to drive the dynamo, which in turn is connected with the motors on the axles in the ordinary manner. The car also carries a storage battery connected in multiple with the motors and serves to render the load on the engine constant under all conditions and accumulates the surplus energy generated by the dynamo when the output exceeds the requirements of the motor.

These motor cars can be built of any capacity, either for speed or hauling; the mechanism is extremely simple and practically automatic in operation. They are free from noise and smoke. They can be used under any franchise that permits the use of the trolley. The system does away with power houses, trolley wires, rail bonds and other electrical apparatus exterior to the car.

A car of this type has been in operation in the vicinity of Chicago during the past year and the record made by it, both in economy of operation and maintenance, it is claimed, substantiates the claims made for it by the inventor. During the past two months one of these cars has been used in the construction work of the Suburban Electric Railway Company in Chicago. Concerning its operation, Mr. Walker, chief electrician of the road states: "we have used the motor on construction work for about two months, hauling from one to five freight cars, part of them being heavily loaded at times. The motor has pulled almost constantly one loaded construction tower car, stringing trolley and putting up overhead trolley fixtures. The service has been very severe and I had no idea that the outfit was able to perform even half the service we have gotten from it. I must say that I am very much surprised, both at the reliability and economy of its operation. In performing the work above described we have used about 15 gals. of gasoline per day of ten hours. I am all the more surprised at the reliability and economy of this system, having criticised it at the beginning with a great deal of prejudice."

During this period the motor has several times run continuously for twenty-four and even thirty-six hours. The Patton motor is recommended for roads where the expense of installation and maintenance of power houses and line wire would render such a system unprofitable. It is particularly adapted for long distance or lines where the traffic is sufficient to require only a small number of cars, or for night work on trolley and cable lines after the power houses are shut down.

THE Wall Street *Journal*, of New York, prints the following: "The General Electric Railway has won its fight and Chicago will have a new street railway system with nearly 60 miles of track within a year. The Supreme Court has affirmed the decree of the lower court in the action brought by Attorney General Moloney. That decree denied the petition for an injunction to prevent the construction of the General Electric Railway and dismissed the bill. A. G. Wheeler, of New York, has left for the East to start the work. He represents J. P. Morgan & Company who are the financial backers of the enterprise, and declares there will be no trouble about funds to carry on the work."

STREET RAILWAY NEWS

Circular Letter to Street Railway Accountants.

The committee appointed at the Cleveland meeting of the Street Railway Accountants' Association of America, to prepare a standard classification of operating and construction accounts, has sent out the following circular letter under date of June 10:

A meeting of some forty gentlemen, representing many of the large street railway properties in the country, all interested in a uniform, comprehensive and economical system of accounting, was held in Cleveland, O., Mar. 13, and 24, 1897. A permanent organization was perfected, known as the Street Railway Accountants' Association of America, the aims and objects of which are clearly defined in the copy of the constitution and by-laws enclosed herewith.

At the suggestion of Mr. H. J. Davies, of Cleveland, upon motion of Mr. E. D. Hibbs, of Jersey City, a resolution was unanimously adopted appointing a committee to consider the question of a standard system of street railway accounting, covering the classification of operating expense accounts, classification of construction and equipment accounts and form of annual report, in a comprehensive and concise manner, which will enable the managements of the different roads to make quick and just comparisons, thus forming a uniform basis for the interchange of information between companies, when such is desired.

The committee was instructed to correspond with the officers of all street railways, earnestly request that for their mutual interest and good, they acquaint us with their methods and system of accounting, furnish us with a set of blanks and forms used by their companies, covering the classification of operating expense accounts, classification of construction and equipment accounts and form of annual report, with the special request that they give us the benefit of their experience, help us with their advice and suggestions, to enable the committee to make such recommendations as they may deem advisable and proper, and report at the next meeting of the association to be held at Niagara Falls, Oct. 19-22, 1897, when the report of the committee will be discussed and some action taken.

The committee desires to assure you that any information that may be given it, as well as all blanks and forms entrusted to its keeping, will be treated as strictly confidential and will not go outside of the three members whose names appear on this letter.

We trust, that you are in sympathy with and heartily endorse the aims and objects of the Street Railway Accountants' Association of America, and that if your company is not a member, you will have them join at once and be represented at the next meeting.

Your prompt and favorable reply will be gratefully appreciated by the committee and will materially aid and expedite the successful completion of the work assigned to them.

Please address all communications to C. N. Duffy, 3800 Easton Avenue, St. Louis.

Relying on your co-operation and valued assistance, and thanking you in advance of any courtesies you may extend, we are,

Very respectfully,

C. N. DUFFY,
WM. F. HAM, } Committee.
J. F. CALDERWOOD,

The Allen Street Railway Bill in Illinois.

The principal features of the Allen bill, which was passed by the Legislature and signed by the Governor of Illinois last month are contained in the following abstract:

No street railroad corporation shall have the right to enter upon, appropriate or use the whole or any part of the property or tracks of another street railroad owned or used by it in the operation of its road, except to cross the same at any necessary angle, without the consent of the corporation whose property or tracks it seeks to use.

All street railroad corporations shall have the right to contract with each other for the use of their respective tracks or to lease to each other or to purchase from each other any portion of the whole of their property or tracks upon such terms and conditions as they may agree upon for the purpose of operating the same. And every such corporation shall have the right and authority to consolidate its stock, property and franchises with any other like corporation; provided, however, that no such corporation shall consolidate with any other corporation running a parallel or competing line.

* * * *

All contracts, leases or purchases heretofore made by or between such corporations shall be valid the same as if made subsequently to the passage of this act.

No such company shall have the right to locate or construct its road upon or along any street or alley, or over any public grounds in any incorporated city, town or village, without the consent of corporate authorities of such city, town or village; nor upon or along any road or highway or upon any public ground without any incorporated city, town or village except with the consent of the county board.

Such consent may be granted for any period not longer than fifty years on the petition of the company upon such terms and conditions not inconsistent with the provisions of this act, as such corporate authorities or county board, as the case may be, shall deem for the best interests of the public.

Provided that no such consent shall be granted except upon the petition of the owners of land representing more than one-half of the frontage of the street, or so much thereof as is sought to be used for street railroad purposes * * * * * and except upon the condition that the company will pay all damages to owners of property abutting upon the street, alley, road, highway or public ground upon or over which such street railroad is to be constructed which they may sustain by reason of the location or construction of the street railroad, the same to be ascertained and paid in the manner provided by law for the exercise of the right of eminent domain.

No owner of property fronting or abutting upon any street where it is proposed to construct or operate a street railway shall, after having petitioned the City Council or other proper corporate authority, as the case may be, as required by law, be permitted to revoke or cancel such signature to such petition after the said petition shall have been filed with the said City Council or City Clerk or other corporate authorities, as the case may be.

The right to charge a fare of five cents given under any existing ordinance or grant of right to construct and operate a street railroad shall remain, and such rate of fare as is now charged shall not be lessened or increased during the life of or the remainder of the term of such ordinance or grant.

The City Council or other proper corporate authorities, as the case may be, shall have the power without said petition of said land owners, to extend any ordinance heretofore granted and now in force, granting the right to construct and operate a street railway in any street or highway at any time before its expiration, for a period of not longer than fifty years.

In every ordinance so extended for carrying passengers on the street railroad operated under such ordinance, and where an ordinance shall be extended, the rate of fare shall be five cents during the first twenty years of the period of such extension; provided, however, that the rate of fare shall not be fixed by said corporate authorities in any case for a period of longer than twenty years, and the fare so fixed shall in no case exceed five cents for a single ride within the limits of any city, town or village.

The City Council or other proper corporate authorities shall have the power to fix the rate of fare to be charged in any ordinance hereafter granted, provided such rates shall not exceed five cents, and when the rate is so fixed it shall not be lessened by the said City Council or other corporate authorities, as the case may be, at any time during the period of twenty years after the passage of the said ordinance.

Meeting of the National Electric Light Association.

One of the most successful meetings of the National Electric Light Association was held at Niagara Falls, June 8-10. The attendance was larger than that at any previous meeting of the association, the papers were good, and a most enjoyable time was participated in by all. The papers were mostly on electric lighting subjects, but one by J. G. White, was on the "Power Transmission Line between Niagara Falls and Buffalo," and is printed elsewhere in this paper. The many electric lighting, power and railway installations in and about Niagara Falls were visited by the delegates and proved very

interesting. The officers elected for the ensuing year are: president, Samuel Insull, Chicago, Ill.; first vice-president, A. M. Young, Waterbury, Conn.; second vice-president, Geo. W. Stetson, New Bedford, Mass.; executive committee: F. A. Gilbert, W. Worth Bean, W. McLea Walbank and E. H. Stearns.

The exhibits, while not as extensive as those usually made at the conventions of the American Street Railway Association, were very complete and attractive.

Convention of the Canadian Electrical Association.

The Canadian Electrical Association held its seventh annual meeting at Niagara Falls, Ont., June 2-4, and about seventy delegates were present out of a total membership of 163 active and twenty associate. A number of interesting papers were read and considerable time was spent in sight seeing. The annual banquet was held at Dufferin Café. Montreal was chosen as the place of meeting of the association in 1898.

The election of officers for the ensuing year resulted as follows: president, John Yule, manager Guelph Light & Power Company, re-elected; first vice-president, Charles B. Hunt, manager London Electric Company; second vice-president, J. A. Kammerer, general agent Royal Electric Company; secretary and treasurer, C. H. Mortimer, publisher *Electrical News*, Toronto, re-elected for the sixth time. Executive committee, J. J. Wright, A. B. Smith, John Carroll, F. C. Armstrong, Ormond Higman, F. T. Bowman, W. H. Browne, A. A. Dion and Wm. Thompson.

Conventions of the American Railway Master Car Builders' and Master Mechanics' Associations.

The annual conventions of the Associations of Railway Master Car Builders and Master Mechanics were held at Old Point Comfort, Va., June 8 to 17. The convention of the latter followed that of the former, and both were very largely attended. A great deal of interest was taken in the question of the use of the third rail for the electric transmission of power by steam railroad companies and the published reports of the performance of the cars of the New York, New Haven & Hartford Railroad on its Hartford-New Britain-Berlin branch. The president of the Master Mechanics' Association recommended the appointment of a committee to report on the subject at the next annual meeting. The paper on "The Application of Electricity to Steam Railroads," by P. H. Brangs, electrical engineer of the Delaware, Lackawanna & Western Railroad, presented at the meeting of the Master Mechanics, is published on page 427.

As an index to the growing interest of steam railroad companies in the employment of electric power, it is interesting to note that there were several representatives of electrical companies present. The General Electric Company was represented by C. C. Pierce, of Boston, New England agent, and L. H. Parker, assistant engineer of the Railway Department, Schenectady, N. Y. The company exhibited a section of the third rail in use on the New Britain-Hartford line, and also distributed a number of pamphlets descriptive of its apparatus. The Walker Company was represented by J. M. McMahan, of New York.

Among the other exhibits at Old Point Comfort interesting to electric railway engineers were the following:

The J. G. Brill Company, of Philadelphia, was represented by G. M. Haskell, and showed a model of its truck for suburban and interurban service.

The Composite Brake Shoe Company, of Boston, exhibited a line of composite brake shoes with cork insets, and was represented by W. W. Whitcomb who was busy answering the many inquiries addressed him on the subject of brake shoes. These brake shoes, it will be remembered, were given a very high rating for efficiency and economy by the official committee on brake shoes at the previous meeting of the Master Mechanics' Association.

The Dressel Railway Lamp Works, of New York, was represented by E. C. Sawyer and C. H. Dressel and showed a number of lamps.

The Adams & Westlake Company, of Chicago, showed a line of car fixtures, lamps, Acme car curtains, etc., and was represented by H. E. Keeler, W. S. Bartholomew and L. A. Gray.

The Detroit Lubricator Company was represented by C. B. Hodges and W. E. Bryant, and showed a line of lubricators for different purposes.

The Gold Car Heating Company, of New York, had one of the finest exhibits at the convention, and showed samples of its steam heating and electric heating systems. The company was represented by E. E. Gold, E. H. Gold, George E. Sevey, W. E. Banks, John Holzhauer, and A. S. Winslow. Fourteen different styles of electric heaters were shown, as well as a complete electric car heating equipment of six heaters, all connected with a three point switch, using 2 amps., 4 amps. and 6 amps. at 500 volts. The company also exhibited a large stationary heater for transfer rooms or depots, regulated by a switch, and using 10 amps., 20 amps. or 30 amps; also its hot water circulating system of heating as applied on the Broadway and Third Avenue lines in New York City.

The Hale & Kilburn Manufacturing Company, of Philadelphia, was represented by H. T. Bigelow and B. F. Pilson, and exhibited its new "Walkover" seat with movable foot rest and oval pedestal base, also its "reversible" car seat.

The H. W. Johns Manufacturing Company, of New York, exhibited an attractive assortment of asbestos goods, vulcabeston, pipe coverings, packings, etc., and had as representatives, F. S. Miller, F. M. Patrick, D. S. Dickson, J. H. Lawson and E. D. Sparks.

The Keasbey & Mattison Company, of Ambler, Pa., was represented by Messrs, Wilson and Johnson, and showed the coverings manufactured by it for boilers and pipes.

Jenkins Brothers, of New York, showed the Jenkins valves.

The Kinzer & Jones Manufacturing Company, of Pittsburgh, Pa., had a very attractive exhibit to illustrate the forms of brake shoes manufactured by it; the company was represented by Messrs. Kinzer and Weierbach, and the brake shoe was very favorably commented upon by many of the delegates.

Niles Tool Works, of Hamilton, O., showed one of the American Pulley Company's mild sheet steel pulleys.

The Pantasote Leather Company, of New York, was represented by John M. High, and showed a full line of car curtains, car seats and car headlinings.

One of the finest exhibits at the convention at Old Point was that of the Pearson Jack Company. This company showed a full line of its patent hoisting jacks, which was highly appreciated by the railroad men present. The good points of the jacks were fully explained by the inventors, G. F. Pearson, P. B. Israel and G. M. Brown, who were in attendance during both the Master Car Builders' and Master Mechanics' conventions.

EXHIBIT OF THE KINZER & JONES MANUFACTURING CO.

The Peerless Rubber Manufacturing Company, of New York, showed a full line of mechanical goods, including the famous "Rainbow" packing. The company was represented by Messrs. Caldwell, Prosser and Courtney.

Pratt & Letchworth, of Buffalo, showed malleable iron car castings, steel castings and an automatic freight car coupler, and had as representatives H. C. Edson and O. P. Letchworth.

The Q. & C. Company, of Chicago, exhibited a very interesting line of specialties. Messrs. Hodgkins, Ely and Leucke represented the company.

The Standard Paint Company, of New York, manufacturers of the well known P. & B. compounds, was well represented by F. S. De Ronde, and showed samples of Ruberoid roofings and other products.

The Shickle, Harrison & Howard Iron Company, of St. Louis, had a very complete exhibit in charge of Mr. Johann, including various castings for cars.

Watson & Stillman, of New York, were represented by Mr. Stillman, and showed their punches, rail benders, presses, jacks, etc.

Wendell & MacDuffie, of New York, were represented by Mr. Wendell, who looked after the interests of Jerome metallic packing.

Injunction to Prevent Transfer of Engineering Data.

The Cleveland *Leader* reported in its issue of June 8, that a restraining order had been granted by the United States Circuit Court at Cincinnati, to the Waker Company, preventing W. H. Bone, the company's acting secretary and manager, and R. T. Bone, its assistant manager, from delivering to supposed competitors of the Walker Company, certain plans, specifications, data and figures, said to be exclusively the property of the Walker Company. In its suit the company stated that the defendants were the custodians of valuable papers, plans, etc., containing secrets of its business and that these cost the plaintiff in excess of $50,000 and were of great value to it; that the defendants acting in connection with other parties who the company believed to be competitors in busines, but whose names it

had not been able to ascertain, have been taking copies of plans, specifications, data, figures, and practically all of the valuable secret business equipment of the Walker Company. The bill of complaint further alleged that the defendants had been secretly carrying on their plans in connection with other employes of the plaintiff; that they had been continually carrying away tracings and drawings used in the business, contemplating to deliver such; and that they were contemplating quitting the employment of the plaintiff and disposing of the plans which they had acquired by means of their employment in the plaintiff's service.

The temporary restraining order prevents the delivery of any of these plans or duplicates to any party, association, combination, firm or corporation. Further proceedings have been taken to bring about a return of the plans and blue prints.

Equipment Contracts and Bond Issue of the South Side Electric Railway, of Chicago.

In addition to the contracts for equipment announced last month, the "Alley L" railway has placed others as follows: through Frank J. Sprague, who has the bulk contract for the car equipment subject to the satisfactory operation of a six car train, equipped with his controller system, the contract for twelve motors to the General Electric Company, for twelve bogie trucks to the McGuire Manufacturing Company, and for six sets of independent electric motor air brake equipments to the Standard Air-Brake Company. Green Fuel economizers will be used in the station. Atkinson and Roebling rail bonds are specified, and the copper will be furnished by the Western Electric Company. The Electrical Installation Company has secured the contract for the construction work.

At a special meeting of the company held on June 24, an issue of $1,500,000 of 4 per cent bonds was authorized, of which one-half will be sold to cover the cost of improvements and the construction of the loop connection.

Foreign Notes.

Algiers, Algeria.—La Compagnie des Tramways Algériens is busily engaged upon the construction of its electric line, and expects to have the same in operation before long.

Amiens, France.—The tramway company of Amiens has reached a basis of agreement with the municipal council upon the equipment of its line by the trolley system. The franchise compels the company to extend its line at least 3 km., the work to commence within six months after the issuing of the franchise, and to be completed within a year. The company is to pay a certain tax upon each car operated.

Barcelona, Spain.—A Madrid dispatch to the London *Times* says: "After a keen competition at a public tender, principally between an English and Belgian firm, a concession has been granted to the former to lay a network of tramways, to be worked by electricity, uniting Barcelona with the surrounding districts. The total length will be about 40 miles and the capital involved about £1,000,000. It is to be worked on the overhead system—a rather bold innovation for a populous city like Barcelona."

Clermont-Ferrand, France.—An electric railway is proposed in this place.

Douai, France.—The project of building a line of electric tramways from Douai to Aniche and Dorignies seems soon to be realized. The plan has been favorably reported upon by the Conseil Supérieur des Ponts et Chaussées.

Italy.—It is proposed to operate in the near future the railway line of Treviso to Belluno by means of electricity. The length of the road is 86 km. (53 miles). The motive power is to be furnished by a waterfall of the Alleghe Lake, the height of the falls being 433 ft. Electric street railways are also projected from Salerno to Cava, and from Lecce to S. Catalde. A Berlin firm is said to be negotiating for the construction of the latter line.

London, England.—There now seems to be every probability that the projected underground electric railway from Moorgate Street, London, to a point near Finsbury Park, where it would effect a junction with the Great Northern Railway, will be carried out. The scheme was originally brought forward in 1894, but was not proceeded with on account of the death of the contractor. Since then, however, an arrangement has been made for the construction of the line, and with this object in view the promoters have introduced a bill to authorize an extension of time for the execution of this project. The preamble of the bill has already been proved before a Select Committee of the House of commons. Among other matters in connection with the bill is to be noted the proposal to partially substitute brick or other material for lining the tunnels in lieu of the use of iron tubes. The gage of the line will be the same as that of the Great Northern Railway, and the trains of the latter will travel over the new electric railway.

Madras, India.—An Indian daily says that the overhead system having been sanctioned on the section of the Madras Electric Tramway line extending from the Beach to Egmore, the materials for carrying out the same have arrived, and the work is being taken in hand.

Madrid, Spain.—The electrical concern of Falco, Hermida & Pena, in Madrid, states that it has the contract for two or three central stations, and is trying to secure other government electrical contracts for which machinery and material will be required.

Marseilles, France.—The committee appointed to investigate the different tramway systems has reported to the Municipal Council. The report is, in brief, in favor of the trolley system while awaiting the development of a practical conduit system.

Mentone, France.—Two tramway products are before the Municipal Council; one, by M. Nave, is for an extensive system, the method to be employed to be selected by the city. The other, by M. Gadot, is for an overhead trolley system, and proposes five lines, of which the most important extends to Monte Carlo. The length of franchise asked for by both petitions is sixty years.

Oran, Algeria.—M. Faye, who has received the franchise for an electric tramway in this city, has assigned his concession to the French Thomson-Houston Company.

Paris, France.—A company has just been formed in Paris, with a capital of £20,000, to be known as the Société Française de Traction Mecanique et Electrique.

Pau, France.—M. Sancery has received a franchise for an overhead electric trolley system on four lines in this place.

Perth, Western Australia.—Two schemes for the construction of a tramway have been laid before the City Council, one from Mr. Leake, on behalf of an English company, who promises to construct an electric tramway on the overhead trolley system; and the other from George Grey, on behalf of the Colonial Finance Corporation, which also proposes to construct electric tramways, but on somewhat different terms.

Rheims, France.—A petition has been sent to the municipal authorities by a number of the principal inhabitants asking for an early decision on the franchises now before the city asking for right to build electric roads.

St. Etienne, France.—By a recent decree the Department of the Loire authorized the electric company of this place to build a number of additional lines. A short section of line is now in operation.

Strasbourg, Germany.—During the coming year the tramway company in this place proposes to increase its equipment.

Vallauris, France.—Messrs. Pécout frères, of Vallauris, Alpes-Maritimes, are applying for the contract for an electric street railway between that city and Golfe Juan. The plans have been approved.

Notes from England.

(By Our London Correspondent.)

Some contracts just secured by Dick, Kerr & Company, Ltd., indicate how the promised activity in electric tramway construction in this country is fast becoming actual. One contract is for the construction of the permanent way and buildings of the Blackpool & Fleetwood Tramroad Company. The line is 8 miles long, double track throughout, or 16 miles reckoned by single track, and it will be operated by the overhead trolley method. The electric equipment is to be supplied by Mather & Platt, Ltd., Manchester, who have already equipped several electric lines in this country. In Blackpool and in Fleetwood the line will run on the streets as a street railway, but in the country district between the two towns it will have its own right of way, skirting the seacoast for the entire distance. The road is almost certain to be well patronised, especially in summer and autumn, as about 3,000,000 holiday makers visit Blackpool every season.

Dick, Kerr & Company are also constructing the permanent way of a new electric line at West Hartlepool which will be 3½ miles long. The Company owning the road is also going to build another line 3½ miles long to Seaton Carew, but this line, for which contract has not yet been settled, will be constructed under the recently passed Light Railways Act. Both lines will be operated electrically. I am inclined to believe that in future all electric lines which can possibly be shown to be not of the nature of street tramways will be built under the Light Railways Act, as in that way the purchase powers of local authorities under the Tramways Act of 1870 may be evaded.

Sufficient time has not yet elapsed since the beginning of operation on the Glasgow District Subway for the publication of working accounts, but I learn on very good authority that the working expenses will come out wonderfully low. The traffic is increasing and a more frequent service of cars is necessary, and probably trains of two cars each will soon be running. This will still further diminish the cost per car mile. As your readers may remember, this line is the first underground railway in Britain to be worked by cable haulage, and should the results financially prove as successful as I am told they will, the underground electric railway companies in

London, whose lines are in no case very long, will have some matters to reflect upon. I hardly anticipate that the net profits on the Glasgow road will be very high for a few years, as the circuit of the railway (6½ miles round) is not very big, as there is great competition from underground steam railways and from the Town Council's street tramways, and as the fares on the subway are very low. But I do anticipate that the working expenses in themselves will be found most moderate. The power house contains the only sample we have of the American method of cable driving, as all our cable street lines use the S drive.

There is now a definite prospect of the whole tramway system of Dublin being electrified, and if this is carried out Dublin will have the largest system of electric lines up till now existing in the United Kingdom. The present horse lines extend to 66 miles of track, occupying 37 miles of street. The local tramway company has agreed to pay the Town Council a rental way-leave of £500 per mile, with a minimum rental of £10,000 per annum, and to maintain the paving. The public in the Irish capital is to be congratulated, as the Town Council has hitherto opposed the introduction of trolley wires in the city. Where the profit of the company is to come in is not so easy to see.

Among other new ventures which will shortly take shape are an extension for a distance of 2¾ miles of the Bristol electric lines, the installation of electricity on the Cork tramways, and the building of an electric railway on its own right of way from Laxey to Ramsey (Isle of Man). A committee of Hull Town Council has reported in favor of electric traction, and the Leeds electric lines are expected to be open in August.

The Town Council of Glasgow has at last taken the bull by the horns in a mild way at all events, and has adopted the report of its committee in favor of equipping as an experiment one line, 2½ miles long, double track, on the overhead wire system. This is the result of the visit of a deputation to America last autumn, a summary of whose report was published in your columns. Should the experiment prove satisfactory, no doubt extensions will follow. The cost is to be £20,000, and is lower than would otherwise be the case, as a suitable building for a power house already exists, and renewal of track rails will probably be charged to revenue.

Street Railway Exhibition at Hamburg.

An exhibition of street railway supplies will be held in Hamburg, Germany, Aug. 5–9, 1897. The exhibition will be at the "Falkenried" Depot of the street railway company in Hamburg, and will be held under the auspices of that company. The exhibit will be divided into the following groups:

I. Roadbed Construction: rails, switches, crossings, etc.
II. Motor cars: trucks, axles, wheels, brakes, etc.
III. Electrical car equipment: motors, controllers, lamps, etc.
IV. Overhead trolley parts and equipment.
V. Measuring instruments.
VI. Literature: drawings and models concerning the above sections.

News Notes.

Brooklyn, N. Y.—The DeKalb Avenue & North Beach Railroad Company has been incorporated with a capital of $200,000, to construct an electric railway 7 miles in length from Covert Avenue and Stanhope Street in Newtown to Metropolitan Avenue and Bowery Bay. The directors are Henry B. Hyde, of Bay Shore; Louis Fitzgerald, Alfred Wagstaff and Duncan B. Cannon, of New York City; John N. Partridge, John L. Heins, Thomas Clark, Jr., Thomas Ennis and George W. Benton, of Brooklyn. This road will be controlled by, and is an extension of the lines of the Brooklyn City & Newtown Railroad Company.

Chicago, Ill.—A consolidation of several of the surface railway systems under the name of the Chicago Traction Company now seems assured, but the Chicago City Railway Company has so far refused to join the consolidation. A plan is also on foot to consolidate the elevated railroads of Chicago. This has not yet developed.

Hartford, Conn.—The Rockville City Council has voted to allow the Hartford, Manchester & Rockville Tramway Company to extend its lines to that city. The officials of the company say that the extension will be constructed as soon as possible.

Leavenworth, Kan.—It is stated that Street, Wykes & Company, brokers, of 44 Wall Street, New York City, are interested in an electric railway which it has been proposed to build connecting Kansas City and Ft. Leavenworth. J. F. Getty, attorney, of Kansas City, Kan., is also said to be interested.

Mansfield, O.—The Richland Railway Company, of Mansfield, has been incorporated by Chas. W. French, A. W. French, L. Walker, V. A. Dehnel and C. H. Workman. It will build a railway to be operated by steam or electricity between Mansfield and Shelby. The capital stock is $10,000.

Saddle River, N. J.—The Saddle River Traction Company has been incorporated to build an electric railway. The authorized capital stock is $100,000 and the amount paid in $25,000. Bird W. Spencer, Michael F. Burns and Gilbert S. Bogart are the incorporators.

Personals.

Mr. H. M. Littell, and family have recently returned from a European trip.

Mr. S. Y. Hyde has been chosen as vice-president of the La Crosse City Railway Company.

Mr. A. C. Wade has been elected president of the Waverly, Sayre & Athens Railway Company.

Mr. J. E. North has been appointed secretary and treasurer of the La Crosse City Railway Company.

Mr. Frank Pooler has been elected president of the La Crosse City Railway Company, to succeed Mr. B. E. Edwards.

Mr. Percy L. Lang succeeds Mr. F. M. Stevens as vice-president of the Waverly, Sayre & Athens Railway Company.

Mr. Fred. Fish, of Boston, Mass., has been engaged as electrical engineer for the Olean, Rock City & Bradford Railroad Company.

Mr. Percy Martin, of the Union Elektricitäts Gesellschaft, Berlin, returned to Europe last month after a brief visit in this country.

Mr. Wm. B. Walker has resigned from the board of directors of the Chicago City Railway Company, as he is about to leave the city for several months.

Mr. L. N. Downs has assumed the duties of the general manager of the Citizens' Street Railway Company, of Kalamazoo, recently discharged by Mr. E. E. Downs.

Mr. Geo. A. Chambers, formerly general manager of the Steinway Railway Company, has been appointed general manager of the Buffalo Traction Company.

Mr. E. E. Downs has severed his connection with the Citizens' Street Railway Company, of Kalamazoo, and has, we understand, accepted an important position with a new company in St. Louis.

Mr. D. G. Hamilton, president of the National Railway Company, has been elected a director of the Chicago City Railway Company, to fill the vacancy caused by the resignation of Mr. Wm. B. Walker.

Mr. Lincoln Van Cott has been appointed purchasing agent for the Brooklyn Heights Railroad Company. He was formerly connected with the New York Central & Hudson River Railroad, and had been in the employ of that company for twelve years.

Mr. John A. Brill, vice-president of the J. G. Brill Company, returned last month from a European tour which included Great Britain and the Continent. Mr. Brill was in rather poor health before leaving for Europe, but returns greatly benefited by the trip.

Gen. J. B. Frisbie, of the city of Mexico, is paying a visit to the United States, and has been at the Windsor Hotel, New York, during the past three or four weeks. General Frisbie is interested in the Jalapa & Coatepec Railroad, of Jalapa, Mex., which is about to adopt electrical equipment.

Mr. J. J. Coleman, general manager of the Allentown & Lehigh Valley Traction Company, will sever his connection with that company July 1, to engage in street railroading in another city. Mr. A. F. Walter has been appointed to the office of manager of the company, and James Uhl will be the new superintendent.

Mr. John C. Henry, the well known pioneer in electric railroading, who has been making his residence in Denver during the past few years, spent a short time in New York last month. Mr. Henry is still engaged in electric railroading and has taken out a number of patents during the last year for improvements in different details of electric railway practice.

Mr. W. S. Jewell, general manager of the Toledo Traction Company, presented his resignation last month, to take effect July 1. Mr. Jewell becomes the general superintendent of the Marsden Company, of Philadelphia, which is producing a new product—corn cellulose. The company has a strong financial backing, and the material promises to have a wide range of usefulness. Among other applications for it is a cushion to the armor plate for war vessels.

Mr. P. M. Moar, who has been for some time connected with Thomas & William Smith, of New Castle-on-Tyne as an expert rope splicer has left this position and has gone to Glasgow to take charge of the ropes in the new Glasgow subway. Mr. Moar was for a long time chief splicer of the Washington & Georgetown Railway Company, of Washington, D. C., now the Capital Traction Company, and was previously connected with one of the cable lines in Australia.

Mr. M. R. McAdoo, manager of the Paterson Railway Company, and Mr. David Young, vice-president of the Consolidated Traction Company of New Jersey, extended last month to the newspaper fraternity of Northern New Jersey and New York a special trolley excursion over the new line connecting the systems of these two companies. A start was made from Paterson at ten o'clock, June 10, and the cars were run to Orange, where lunch was served at the Essex County Club. The trip was then continued through Newark to Bergen Point, where dinner was served, after which the party returned to Paterson. This run, made possible by the connecting link opened this spring, was heartily enjoyed by all, who

expressed their appreciation of the hospitality extended in no uncertain voice.

Mr. F. B. Brownell, president of the Brownell Car Company, received last month a very complimentary biographical notice in *Dyer's News Letter*, of St. Louis, in his capacity of vice-chairman and treasurer of the Republican State Committee. Mr. Brownell has taken a very active and important position in public affairs in Missouri, but has steadily refused to be a candidate for an office, either elective or appointive, and has never yielded but twice, once for School Commissioner and once for Presidential Elector. He entered the State Committee in 1892, being made treasurer at the beginning, and at that time was also made vice-chairman, to which double position he was re-elected in 1894 and 1896. Mr. Brownell is a firm believer in the principles of the party with which he is connected, as well as in party organization and discipline.

Mr. James G. Heyward, general manager of the City & Suburban Railway Company, of Baltimore, Md., who upon the consolidation of that company with the Baltimore Traction Company was elected secretary of the consolidated company, has resigned from that company. Mr. Heyward has been connected with street railroading for a long period. His first railroad service was with the Baltimore & Halls Spring Railway Company, now part of the Baltimore City Passenger Railway Company's system. Later he was made superintendent and was connected with that company from 1874 to 1885. In the latter year he engaged in the gas business, after which he become assistant secretary of the Anaconda Mining Company with headquarters in New York. He was elected general manager of the City & Suburban Railway Company, in April, 1892. He is generally recognized as a most enterprising and alert street railway manager.

Mr. Victor O. Wandruszka, the well known European engineer, has been making a short visit in this country during the past month. He returned June 15, to Europe, where he will act as European representative of the Steel Motor Company, with headquarters in Berlin. Mr. Wandruszka is a graduate of the Polytechnical High School in Vienna, in the course of mechanical engineering. His first practical work was with the Imperial Gas Association in Vienna. In 1889 he removed to Paris and accepted the position of chief engineer of the Compagnie Parisienne de l'Air Comprimé. In 1893, he accepted a position with the Thomson-Houston International Company in London, afterwards returning to Paris in the service of the French Thomson-Houston Company. He remained with this latter company until the end of 1894, when he associated himself with the Compagnie de Traction de la Électricité in Paris, representing the Walker interests. In behalf of this company, he was sent to Berlin and assisted in organizing the German Walker agency with the title of Felix Singer & Company Elektricitäts Gesellschaft. He has recently resigned from that company to take, as stated, the general European agency of the Steel Motor Company.

Mr. E. Lavalard, manager of the Compagnie Générale des Omnibus of Paris, the principal tramway and omnibus company in that city, is well known in Europe and America through his published works on the care of horses in their application to tramway service and his contributions to the technical press, and is regarded as one of the most progressive tramway managers in Europe. Mr. Lavalard, after his graduation in 1860 from the Veterinary School at Alfort, spent a few years in the army, but resigned in 1865, to join the staff of the Compagnie Générale des Omnibus. He passed through every position in the company from the lowest, being elected manager in 1880. In this way he has been identified for the greater part of his life with tramway work in Paris. The growth of the company's business during this time can be appeciated when it is stated that in 1865 the company owned only from 6000 to 8000 horses, while to-day it is the owner of over 16,000 horses. Under Mr. Lavalard's régime the company has been most progressive in adopting improvements which tended to insure a better service or greater economy, especially in the care of horses, to which Mr. Lavalard has devoted a great deal of attention, and in which he has introduced a number of important reforms in the way of shoeing, harnessing, feeding, etc. In this connection it might be stated that Mr. Lavalard is also professor at the National Agriculture Institute of France, and is a member of most of the national societies in his department. Since the earliest experiments with cable and electric traction, Mr. Lavalard has been an earnest student of these improved motive powers, and is an ardent advocate of the introduction of mechanical traction under conditions which warrant its use.

E LAVALARD,
MANAGING DIRECTOR COMPAGNIE GÉNÉRALE DES OMNIBUS, PARIS.

Mr. D. R. Eunson, general manager of the Dunedin City & Suburban Tramways Company, of Dunedin, New Zealand, and consulting engineer of the Mornington Tramways Company, of the same city, is a native of Scotland, and at an early age entered the engineering establishment of James Bertram & Sons, at Edinburgh, where he acquired a working knowledge of mechanics. After leaving this firm he went to New Zealand to recuperate from an illness, and soon became engaged in engineering work in Dunedin. He was associated with the founders of the New Zealand Manufacturers' Association in 1883, when he was appointed secretary of that body, and still retains the connection as honorary secretary. He acted as local secretary of the New Zealand Industrial Exposition of 1885, and also of the Indian & Colonial Exposition in 1886. He was also appointed a delegate to the conference on the question of intercolonial free trade held in Adelaide, Australia, in 1887. His first connection with tramway work was in 1887, when he became associated with the Mornington Cable Tramway Company, which he succeeded in establishing on a dividend paying basis. Owing to the success secured by him with this line, he was appointed last year to the office of general manager of the Dunedin City & Suburban Tramway Company, the principal line in New Zealand.

D. R. EUNSON.
GENERAL MANAGER CITY & SUBURBAN TRAMWAY CO., DUNEDIN, N. Z.

J. J. ROBINS.
GENENAL MANAGER SOUTH STAFFORDSHIRE TRAMWAYS CO.

A Complimentary Dinner to John Fritz.

An interesting and enjoyable occasion was that of June 18 last, at the house of Col. N. H. Heft, at Bridgeport, Conn., when one hundred guests, numbering some of the foremost men in technical, engineering and railroad circles, were invited to honor Mr. John Fritz, the founder of the Bethlehem Iron Works and probably the leading mineralogist of the world. The dinner was held in Colonel Heft's beautiful art gallery which contains some of the finest paintings to be found in any private collection in this country, and was preceded by a reception in the north drawing room where all had the privilege of meeting Mr. Fritz.

Mr. Fritz has had an interesting and eventful history. Born a poor boy, he has worked his way by pure force of character to a position in the scientific world which few enjoy, not only on account of his fundamental knowledge of his chosen profession, but also because he is revered and honored beyond most men by those who have the privilege of his friendship. His sterling integrity was so thoroughly known to President Lincoln and his War Department that he was called upon at a critical period of the war to build great iron works at the South, and was given full authority to purchase all the necessary supplies without consultation or check in any way from the Department—a most rare exhibition of confidence. Later

N. H. HEFT.

JOHN FRITZ.

on he was the chief of a commission of three who were engaged by the Czar of Russia to prepare plans for an immense iron works in Russia for the manufacture of ordnance and other war material, and a short time ago the most coveted recognition of merit in the mechanical world was given him in the conferring upon him of the Bessemer medal—the first time that an American has been so honored.

Among the railroad and other guests present by Colonel Heft's invitation, were Charles P. Clark, president of the New York, New Haven & Hartford Railroad and Judge John M. Hall it's vice-president and general counsel; C. Peter Clark, president of the New York & New England Railroad; C. A. Coffin, W. J. Clark and W. G. Bushnell of the General Electric Company; Henry Sanford, ex-president of the Adams Express Company; Hon. Amos J. Cummings; ex-president Wm. D. Bishop, of the New Haven system; Oliver Williams, Judge Morris B. Beardsley, Clark Bell, Lynde Harrison and Edward E. Higgins, editor of the STREET RAILWAY JOURNAL.

Obituary.

JAMES E. GRIST, late mechanical engineer and superintendent of the Pennsylvania Iron Works Company, Philadelphia, a member of the A. S. M. E. and also of the A. I. E. E., died of Bright's disease, May 23.

Mr. Grist was born in Wolverton, England, in October, 1864, and was the son of B. W. Grist, vice-president and general manager of the Pennsylvania Iron Works Company. He came to this country with his father at an early age. After a preparatory education and studies under private tuition, he entered the shops of his father at Reading, Pa., where he remained until he had served his apprenticeship. Developing marked ability in this direction, he rose rapidly until he obtained the position of superintendent of the shops. In 1887, the firm of B. W. Grist & Company was consolidated into the Pennsylvania Iron Works Company, Philadelphia, and Mr. Grist was offered and accepted the position of superintendent of that company which position he held with merited success until 1894 when he resigned to accept the position of mechanical engineer and superintendent of motive power and mechanical equipment of the Philadelphia Traction Company. He occupied this office for two years, when he resigned to accept the position of engineer-in-chief of the Pennsylvania Iron Works Company, who desired his services in the construction of several very large steam and power plants. He conducted this work up until the time of his death. Mr. Grist was a great student, having taken a special course in mechanical engineering and higher mathematics at the University of Pennsylvania, under the tuition of Professor Goodspeed.

J. E. GRIST.

His loss will be keenly felt by the many who knew him, as he was not only congenial, but, having a fund of information at hand, a most interesting companion, and his death has caused a vacancy in the profession of his choice which it will be hard to fill.

WALTER C. SMITH, formerly electrician in charge of motor repairs with the Milwaukee Electric Light & Railway Company, was drowned while bathing at Norfolk, Va., Apr. 30. Mr. Smith had recently come to New York and was at the time of his death in the employ of J. G. White & Company, and was on his way to Portsmouth, Va., to look after some work for this company.

AMONG THE MANUFACTURERS.

The Wheeler Rail Joint Company, of Marion, Ind., has secured the contract for the equipment with its joints of the Marion, Anderson & Indianapolis Railway.

The Electric Storage Battery Company, of Philadelphia, Pa., has moved its New York office to the Commercial Cable Building, located at 20-22 Broad Street and 18-20 New Street.

The R. D. Nuttall Company, of Allegheny, Pa., has appointed as agents in Cleveland Messrs. Hayes and Arthur, Cuyahoga Building. These gentlemen will represent the Nuttall Company over a considerable territory.

W. R. Mason, who is a well known pioneer in the electric railway supply business, has been appointed selling agent for the State of Missouri of the Walker Company, of Cleveland, O. Mr. Mason has a large circle of friends in the street railway trade.

The Western Gear Company, of Milwaukee, Wis., announces that it has established an Eastern office for the sale of motor gears and pinions at 8 Oliver Street, Boston. George C. Ewing is the company's Eastern representative and has headquarters at this office.

The Standard Air-Brake Company, of New York, has contracted with the Hull Electric Company, at Ottawa, for supplying a motor compressor air brake for braking a 25 ton electric locomotive and will furnish one of its chime whistles with the outfit. The brake will enable the locomotive to handle freight trains in the yard.

The National Conduit & Cable Company, of New York, is supplying the full conduit system for the feeders of the St. Anthony Falls Water Power Company, described in the last issue, as well as the cables used in it. The system of conduit employed will be the company's standard cement lined pipe conduits, and not vitrified clay conduits as stated in the last issue.

The Ball Engine Company, of Erie, Pa., is building two 125 h. p. horizontal tandem compound engines, which will be used for the electric transmission of power and light in a large works in the city of Moscow, Russia. The Ball Engine Company has recently appointed the Pierce & Miller Engineering Company its export agents and also its Eastern representatives.

The General Electric Company, of Schenectady, N. Y., has recently added to its list of important pamphlets, a treatise on the "Use and Abuse of Transformers." The pamphlet is handsomely illustrated by half-tone engravings and diagrams showing the characteristic curves of the different types of transformers manufactured by it, their output, efficiency, core loss, etc.

Wm. A. Cullen, of Paterson, N. J., has recently been engaged on the construction of the track work of the Union Traction Company, of Rutherford, N. J. The building of this line involved a number of difficulties in the way of sharp curves, etc., but Mr. Cullen has succeeded in laying a very easy riding track which is noticeable for its substantial construction and smoothness.

The Ohio Brass Company, of Mansfield, O., is doing an excellent business in its specialties, particularly in "Dirigo" insulation and reports that for foreign work especially, its apparatus is meeting with a large demand. During the last month the company has made shipments to Mexico, Portugal, Japan, France, England and Germany, and it anticipates an excellent demand for its products in Europe.

Fred. F. Fischer, designer of the Fischer, Fischer-Gates and Gates automatic engines, and until recently chief engineer and head salesman of the steam department of the Gates Iron Works, has withdrawn from this company, and will probably in the near future place upon the market the improved Fischer engine, which it is intended shall embody the experience gained in designing and operating the above named engines.

The Berlin Iron Bridge Company, of East Berlin, Conn., is erecting a new roof for the power station of the Scranton Illuminating, Heat & Power Company, of Scranton, Pa. The building is 42 ft. × 195 ft., divided into two portions—a boiler room and an engine room. The framework of the roof construction is of steel and absolutely fireproof. It has been the aim of the Scranton Company to erect a substantial and fireproof building to replace the one which was recently lost by fire.

The Westinghouse Machine Company, of Pittsburgh, Pa., has recently published a very attractive and well illustrated pamphlet giving views of the different types of engines manufactured by it and of prominent installations in which its engines are employed. The pamphlet shows that these engines are employed on many of the largest electric light, power and railway plants of the country, and the economy tests made on the engines, results of which are included in the pamphlet, show a high degree of efficiency for these machines.

Mayer & Englund, of Philadelphia, the well known dealers in electric railway material and supplies, have recently published a pamphlet upon the overhead insulation and construction material dealt in by them. The pamphlet is very complete, giving views of the different overhead parts, poles, crossarms, bonds, etc., with sizes, prices, and some descriptive matter. This firm has won the confidence of the trade through its business methods and enterprise, and is enjoying, it is understood, an excellent trade. The firm is exclusive agent in a large territory for a large number of prominent manufacturers.

The Ball & Wood Company, of New York, has received so many orders for engines recently as to compel an increase of its selling department. Mr. Greenwood has been transferred from the company's works, of which he has had charge for the past year and a half, to the New York office to assist Mr. Vincent. John D. Bird, formerly superintendent of the George H. Corliss Steam Engine Works, of Providence, R. I., has resigned his position there to accept a similar one with the Ball & Wood Company, and he will in future be the superintendent and in charge of the Ball & Wood Company's plant at Elizabeth.

The Western Gear Company, of Milwaukee, reports recent sales of its material in all parts of the country. This company has recently appointed as representatives Geo. C. Ewing, Boston; Wendell & McDuffie, New York; L. P. Quentin, St. Louis, and F. A. Lawson, San Francisco. The process used by this company of forming the teeth in the castings before finishing is said to produce very much closer metal in the teeth and consequently longer life in the gears. The Western Gear Company's malleable gears, it is claimed, will show results practically equal to those of steel gears, both as regards strength and wearing quality.

The **Hoadley-Knight** air motor car, which was put in operation recently on the Eckington & Soldiers' Home Railway of Washington, was tested June 27 by Mr. McFarland, engineer for the District Commissioners. The test was an official one to determine the question as to whether the company would be permitted to adopt these motors on its line. The car was repeatedly started and stopped on grades and its performance was in every way satisfactory. As a result Mr. McFarland has recommended the Commissioners to accord the desired permission. If this be granted it is stated that the entire line will be equipped with air motors.

The **E. T. Burrowes Company**, of Portland, Me., has recently brought out a new curtain fixture or rather an improvement on the company's present well known device. This fixture admits of a curtain equipped with it being operated either by pressing the handles provided, thus saving the bottom finish of the shade, or by raising or lowering by grasping the curtain at the bottom. A curtain fitted with this device will stay at any desired point and cannot become tilted in the groove as both sides move simultaneously. There are no cables to rust, fray, crystallize, or stretch. This fixture may be adjusted to fit window openings of varying widths. It is claimed to be strong, made on mechanical principles, positive working, attractive and cheap.

The **Berlin Iron Bridge Company**, of East Berlin, Conn., has received a contract for the erection of the steel framework and covering for a new electric light plant for the Queen Construction Company, of Flushing, N. Y. The building is divided into two portions —a boiler house, 40 ft. × 42 ft., and an engine and dynamo room, 43 ft. × 71 ft. The walls are of brick and have substantial stone foundations, and the roof is of iron covered with metal covering. The building, when completed, will be absolutely fireproof. The roof of the engine and dynamo room is lined with the Berlin Iron Bridge Company's patent anti-condensation roof lining, which prevents condensation of moisture on the under side of the roof, a result which is absolutely necessary to obtain in a building filled with electrical apparatus.

The **Pearson Jack Company**, of New York, made a good showing of its device at the Master Car Builders' and Master Mechanics Conventions at Old Point Comfort. Many saw it for the first time and all agreed as to its superior merits as a wrecking car jack. Being the company's first experience at these annual gatherings, its managers are much encouraged at the reception accorded them and feel confident of doing a larger business than ever. Not only is the company's trade increasing with the street and steam railways in America, but it is receiving orders from foreign countries. Many inquiries for catalogues and prices from foreign houses have come to the company lately, and arrangements are in progress to have agencies established in the principal European countries, England, France, Germany and Russia.

Scott R. Hayes, and Chas. B. Arthur, have lately gone into partnership under the firm name of Hayes & Arthur. This firm has located in the Cuyahoga Building, Cleveland, and will handle electric railway supplies exclusively. They have the Nuttall agency for gears, pinions, etc., for Western Pennsylvania, Western New York and most of Ohio. They are also handling fare registers, rail bonds, car springs, a line of overhead material, etc. Mr. Hayes was connected with the old Thomson-Houston Company, later with the General Electric Company, and afterwards with Sperry Electric Railway Company. He has a very large acquaintance and a host of friends in the street railway field. Mr. Arthur is an energetic young man with a good and successful record in the manufacturing business in Cleveland. The STREET RAILWAY JOURNAL wishes and predicts success to the new firm.

The **Snow Steam Pump Works**, of Buffalo, N. Y., have in their catalogue for 1897 one of the most tasteful and attractive trade catalogues which have been produced this year. The catalogue is very thoroughly illustrated with fine half tone vignetted engravings of the various types of pumps manufactured by this company, and a glance through its pages will give a very comprehensive idea of the extent of the work in which this company is engaged. Accompanying each illustration is a description of the main features of the pump illustrated, together with data of the different sizes in which that type is manufactured, length of stroke, gallons per revolution, etc. The catalogue also contains skeleton sections of the standard pumps, with an index giving the names of each part to facilitate ordering, also useful tabular information upon the friction of water in pipes, a table of effective fire streams, the steam consumption of duplex pumps in pounds per hour under different pressures, etc.

The **E. P. Allis Company**, of Milwaukee, Wis., reports its works busy with a large number of recent contracts. Among them are three cross compound, direct coupled engines, with cylinders 28 ins. and 56 ins. × 50 ins. stroke, for the West End Street Railway Company, of Boston. The South Side Elevated Railroad Company, of Chicago, has also recently placed a contract with the E. P. Allis Company for four cross compound, direct coupled engines, having cylinder dimensions 26 ins. and 54 ins. × 48 ins. stroke. The company has also received a cablegram from Sydney, Australia, stating that its engines have been adopted for the Government tramways of that city. There are to be installed at the start four cross compound direct coupled engines, with cylinder dimensions 26 ins. and 50 ins. × 48 ins. stroke. As these tramways are under the supervision of the Colonial Government, the order is particularly gratifying, as showing the adoption of American engines for British Government work.

The **Electric Railway Equipment Company**, of Cincinnati, O., one of the largest manufacturers of iron poles, pole trimmings, cross arms, etc., overhead material, journal and motor boxes and other electric railway supplies, reports business as unusually good in its various departments. Among other large orders that the company has closed lately is one for poles and overhead material for the Milwaukee Electric Railway & Lighting Company for the reconstruction of its overhead equipment. One of the specialties of this company is an iron pole that is shipped in sections. It is particularly adapted to South American trade, where material is often from necessity freighted on burros. There are some 10,000 of these poles in use in this country giving perfect satisfaction. The company has just brought out a new trolley hanger for universal use, in which the possibility of the ear or cap becoming loose or unscrewing is entirely overcome, and this is accomplished in the most simple, original and practical manner conceivable. There are no lugs, set-screws or ratchets to bother with and yet the cap and ear are practically locked automatically.

The **McGuire Manufacturing Company**, of Chicago, has been awarded the contract for the electric trucks which are to displace the steam trucks now in use on the Alley Elevated Railway of Chicago. The competition for this order was unusually sharp, but the success of the McGuire trucks in the severe service of Brooklyn Bridge, practically decided the placing of this order. The McGuire Company has also just received an order from the Consolidated Traction Company, of Pittsburgh, Pa., for 102 single trucks. The above are the two largest orders placed last month, and the McGuire Company is to be congratulated upon securing them. The company's ratchet brake handles and "Columbia" heaters have been specified by the Consolidated Traction Company on its new cars. The company is also doing a good foreign business, and mentions among other orders closed within the last week one for a number of trucks for Cologne, Germany. Elmer P. Morris, the company's popular Eastern representative has taken offices at 15 Cortlandt Street, New York, and is doing an excellent business, shipping some material during the past month to Mexico.

The **H. W. Johns Manufacturing Company**, of New York, not long ago placed upon the market its toggle-clamp feed wire or cable insulator. This was immediately pronounced a good thing by all those who have to do with pole insulators, and the orders which have been received would indicate that its success from a commercial point of view will come up to expectations. The practical features of the insulator are quickly realized. The absence of the necessity for expending labor and time upon the usual tie wires, screw caps, and other means heretofore employed for fastening the wire to the insulator are apparent. The action of the automatic toggle-clamp in grasping the wire is instantaneous; there is no other fastening which permits the wire to be instantly removed without damage to either the insulator or insulating covering of the wire. The company has received a number of large orders recently for its trolley insulating materials. Through its foreign connections the company has also made large sales abroad. Notwithstanding the fact that the heater business is presumably all out of season, the Johns Company is constantly in receipt of inquiries for its "H. W. J." electric heaters, which promise an active business when the season actively opens in the fall.

The **Bridgeport Deoxidized Bronze & Metal Company**, of New York, is kept very busy filling orders for deoxidized genuine No. 1 babbitt metal and is continually receiving reports of the remarkably long service that its metal is giving in motor armature and axle bearings. One prominent Eastern road is now using this metal in a novel manner. Having had some trouble with the iron shells for the bearings breaking, etc., the company had new jigs made of the proper size to cast the babbitt to fit the motor frames, leaving out the iron shells entirely and reports that these solid babbitt bearings are a great improvement over the old style. It is very difficult indeed to get a babbitt metal that is both hard and tough, but from the above successful experiment it appears that deoxidized genuine No. 1 babbitt does possess these two qualities combined. The way a bearing is finished also has a great deal to do with its service. In some repair shops no boring at all is done and although the babbitt may be the best, there is so much play between the box and shaft that very poor results are obtained. A box scraped and fitted perfectly will give enough better service to amply pay for the extra time spent and good work combined with good metal will produce a bearing that will run for a good many thousand miles without noticeable wear.

The **Electric Launch Company**, of New York, reports an increasing demand for its launches for pleasure resorts operated by electric railway companies. The following is a nearly complete list as furnished by the company of the railway companies using its boats at present: Akron, Bedford & Cleveland Railroad, Cuyahoga Falls, O.; Altoona & Logan Valley Electric Railway, Altoona, Pa.; Atlantic Coast Electric Railroad, Long Branch, N. J.; Cincinnati, Newport & Covington Railway, Ludlow, Ky.; Irondequoit Park Railroad, Rochester, N. Y.; Milwaukee Electric Railway, Milwaukee, Wis.; Portland Railroad Company, Portland, Me.; Pueblo Electric Street Railway, Pueblo, Colo.; West End Street Railway, Boston, Mass. At public parks and hotel resorts the company has fourteen boats distributed at follows: Breslin Hotel, Lake Hopatcong, N. J.; Colorado Hotel, Glenwood Spring, Colo.; Denver City

Park, Denver, Colo.: Prospect Park Lake, Brooklyn, N. Y.; Saranac Lake, Adirondacks, N. Y.; Tampa Bay Hotel, Tampa, Fla.; South Park, Chicago, Ill. The chief advantages claimed are cleanliness, i. e., absolute freedom from smoke, gas, odor, etc.; simplicity, i.e., no Government inspection or licensed engineer required; great carrying capacity, noiselessness, economy; availability as the stored energy is always ready for immediate use; safety and stability.

The National Air Brake Company, of New York, has equipped all of the six new double truck cars (four open and two closed) of Atlantic Highlands, Red Bank & Long Branch Electric Railway Company, of Red Bank, N. J., with its air brake. Each of these cars is equipped with four G. E. 1000 motors, and their maximum speed per hour will be 40 miles to 45 miles. This road runs partly over the tracks of the Central Railroad of New Jersey. The wheels are 33 ins. diameter and 4 ins. tread, which is the standard passenger car wheel. The National Air Brake Company had no difficulty in installing its equipments upon these cars, the only axle space required for the air brake was 7½ ins. There have been a number of tests made, and the air brakes have proved reliable in every instance, the air being maintained at the predetermined maximum pressure at all times. The platform equipment for the application of the brakes is very simple, the motorman requiring no instructions in its operation. The cars of the above named road weigh about 17 tons empty. This company has also installed ten brakes on the double truck cars of the Union Traction Company, Rutherford, N. J., and is now equipping fifteen more cars of the same road with its apparatus. Identical air brakes have been in successful operation on the mail cars of the Brooklyn Heights Railroad, Brooklyn, N. Y., since August, 1896, running from twenty to twenty-three hours per day without repairs of any kind being made.

The Taunton Locomotive Manufacturing Company, of Taunton, Mass., is receiving excellent reports of the operation of its snow plows from roads which used them last winter. H. R. McLeod, general manager of the Portland (Me.) & Cape Elizabeth Railway Company, among others, reports a very satisfactory experience with this plow. In a recent letter to the Taunton Locomotive Manufacturing Company, he says: "The large No. 1 nose plow purchased in 1895 proved so satisfactory that in 1896 we purchased one of your double truck share plows, which has done excellent service the past winter. We have experienced no difficulty in plowing through 3 ft. and 4 ft. of snow with either plow. During the severest storm we experienced the past winter, we were without power on our line for over seven hours, owing to an accident in the station, during which time our cars and the plows were completely snowed under. The universal opinion of the traveling public was that we were buried for two weeks, but in less than eight hours, all our tracks (viz., 12 miles) were free of snow and mostly done with one plow, the field on one of the motors having burned out during the first five hours we were under headway. When the storm ceased, the snow at certain points along our tracks was piled to the depth of 6 ft. and 7 ft. above the rail. The plows are strongly made, and their mechanism is such as to enable three men to operate a plow in any kind of a storm; we have as yet found no weak points, and have had no repairs other than those incident to constant work, such as replacing brakeshoes, etc. I will be pleased to have you refer any person to me for further particulars, and will take pains to show the plows to any persons from neighboring towns and cities who contemplate buying snow plows."

The Link Belt Engineering Company, of Nicetown, Philadelphia, was recently awarded an important patent decision by the United States Circuit Court of Appeals for the Third Circuit, on an appeal from the Circuit Court for the Eastern District of Pennsylvania. The bill in this case was filed by the Ewart Manufacturing Company, whose general agents are the Link-Belt Engineering Company, against James H. Mitchell to enjoin the alleged infringement of the claims of letters patent No. 264,139, issued Sept. 12, 1882 to James M. Dodge for an improvement in chain cables. That court was of the opinion Mitchell's device did so infringe and decreed an injunction. The respondent appealed from this decree, and the case went before the Court of Appeals for review. The important feature of the decision is its emphatic assertion of the principle that the inventor and patentee of a really new and valuable improvement is entitled to the protection of the law under a broad view of the scope of the invention, and cannot be deprived of his rights by the substitution of differing details in a substantially equivalent device. The breadth of the decision is shown by the following extract: "In our judgment the device shown by Dodge's patent was novel in character, disclosed an invention of very decided merit and was a substantial advance over mechanical constructions theretofore used in the art to which it appertained, and the claims of the patent should have such a construction as will give the patentee the full benefit of the advance which he has contributed to the mechanical arts and claimed. While the respondent's device is different in apperance, of seemingly different construction, and manufactured in a different way, yet when we go beneath these surface variations and measure it by the test of functional purpose and operation we find it is in substance, purpose and operation the same mechanism."

W. R. Brixey, of New York, reports an excellent business in his famous "Kerite" products. Mr. Brixey is to be congratulated upon the addition to his staff of assistants of two such valuable men as G. F. Porter and F. G. Fuller, both of whom are well known in the trade. Mr. Porter, who has assumed the office of general manager, is best known through his connection with the National Electric Light Association of which he has been secretary-treasurer for several years. Under his management, the association has become one of the most prosperous societies of its kind in the country. That he is held in high esteem by the members was illustrated by the chorus of protests there were heard when, at the last convention, he stated that he wished to resign his office. Another great financial success which was due to Mr. Porter's managing ability was that of the electrical exhibition held in New York last year. He is also known in the street railway field as secretary of the Lock Haven Electric Railway Company, of Lock Haven, Pa. Considering Mr. Porter's supurb managing ability, a more judicious choice could hardly have been made. The many friends of Mr. Fuller will be pleased to learn that he is back in his old position as salesman for the "Kerite" products. Mr. Fuller is one of the pioneers in the wire business. He became identified with the old Edison Machine Company soon after it was started, and continued with that company through its successive changes to Edison General Electric Company and afterwards to General Electric Company. When the General Electric Company formed a wire department under the name of the U. S. Wire & Cable Company, Mr. Fuller was put in charge of the Western business, and was located at Chicago. He did excellent work here up to the time of his resignation to accept a position with Mr. Brixey. About two years ago he resigned from the position which he has again accepted. Mr. Fuller is known as a great "hustler," and has a large acquaintance among the electric light and street railway men. Under the joint efforts of these men the company will undoubtedly enjoy, if possible, greater prosperity in the future than in the past.

The Central Electric Company, of Chicago, during the ten years of its existence has acquired not only the good will of its patrons, but has met with success in the introduction of numerous specialties, and the establishment of a large number of products. The company is constantly on the outlook for the best, and is ever alert in the interests of its customers. Thus it has always been prepared to make prompt shipments from a large and complete stock of "up to date" materials. And as knowledge is acquired only by time and experience, the company feels fully justified in assuming that it is in a position to most satisfactorily and fully meet the wants of the trade. There is no better proof that the foregoing is true, than the letters daily received, of which the following is a sample: "As to what hangers we are using, it will be necessary for us to say 'Central,' as we sent you an order for 300 more the day before yesterday. The hangers we are receiving from you are so satisfactory that I am keeping a sample on my desk, and won't accept anything that is not as good." There are three essentials requisite to the maintenance and successful transaction of business: first, the good will of your patrons; second, the ability to meet their demands; third, a knowledge to appreciate their wants. That these three essentials are understood and practiced by the Central Electric Company is evinced by the large trade which it enjoys. The company represents many of the oldest and most reputable concerns in the country; as for instance, in the railway line, the Billings & Spencer Company, of Hartford, Conn., for whose patent drop forged copper commutator bars and overhead products the company is general Western agent, also the Changeable electric headlight, the Bound Brook graphite bushing, and motor bearings, the DeWitt sand box, etc. The company is constantly supplying both in this country, Europe, Japan and South America, quantities of electric light and power supplies, and is much gratified by the constant growth of its railway business, both in this and foreign countries. The company is supplying a complete line of overhead materials of various designs, and is sending folders and price lists to all applicants. Garton lightning arresters are one of the company's chief specialties, and it is constantly filling large orders for these devices.

New Publications.

ILLUSTRATED BINGHAMTON. Annual souvenir of the Binghamton Railroad Company, Binghamton, N. Y. Thirty-two pages. Illustrated.

This is a fine example of the high class of souvenirs published by some of the street railway companies to advertise the resorts reached by their lines. The half-tone engravings with which this pamphlet is generally illustrated are exceedingly tasteful and well printed, and we should think that the circular would answer admirably the purposes for which it is intended, to popularize the routes of the company and attract traffic to the many parks and beautiful resorts which surround Binghamton.

CORPORATION FINANCE. A study of the principles and methods of the management of the finances of corporations in the United States, with special reference to the valuation of corporation securities. By Thomas L. Greene, auditor Manhattan Trust Company. Cloth, 8vo., 181 pp. Published by G. P. Putnam's Sons, New York. Price, $1.25.

Mr. Greene, formerly the financial editor of the New York Evening Post, is always an interesting and clear writer on financial topics, and this book is one from which the student of corporation finance can get a broad outline of the principles of corporation accounting, examination of railway reports, reorganization and receiverships. There is perhaps no department of special or technical literature in which there has been so little thoroughly good work done as in this—the field of corporation finance—and books of this character should be heartily welcomed.

Trade Catalogues.

Catalogue of Overhead Material. Published by Mayer & Englund, Philadelphia. Sixty pages. Illustrated.

The Use and Abuse of Transformers. Published by the General Electric Company. Thirty-four pages. Illustrated.

The Westinghouse Steam Engines. Published by the Westinghouse Machine Company, Pittsburgh, Pa. Forty-three pages. Illustrated.

Sioux Corliss Engines, Catalogue No. 28. Published by the Murray Iron Works Company, Burlington, Ia. Seventy-two pages. Illustrated.

Catalogue of the Snow Steam Pump Works for 1897. Published by the Snow Steam Pump Works, Buffalo, N. Y. 113 pages. Illustrated.

List of Street Railway Patents.

U. S. Patents Issued May 25, to June 15, 1897, Inclusive.

May 25.

Automatic Railway Switch.—John H. Lomax, Brooklyn, N. Y. No. 583,148.

Underground Electromagnetic Railway System.—Joseph Hoffman, Schenectady, N. Y. No. 583,178.

The combination with a feeding wire and a contact rail, of separated contact boxes, each provided with a horizontal extension projecting toward the feeding wire, a movable electromagnetic contact device within each contact box, and a flexible conductor for conveying the current from the feed wire to the said movable contact device, inclosed partly within the extension.

Electric Motor.—Joseph Conner, James R. McMillan and Allen J. Fuller, Philadelphia, Pa. No. 583,210.

In combination, an armature and its shaft, a frame furnished with a vertical and with a horizontal opening the former of which connects with the latter, a bearing formed in two sections in which said shaft is journaled, the upper section being seated in a recess in the upper part of said vertical opening, and the lower section of which is vertically movable in said opening and which has its lower face inclined, a wedge-shaped adjusting block furnished with a vertical opening and placed in said horizontal opening in said frame the inclined face of which engages the inclined face on said lower sections, screws passing through said frame and engaging the ends of said wedge-shaped bearing block, and a screw passing upward through said frame and slot in said bearing block, and into said lower section.

Series Multiple Controller.—Thorsten von Zweigbergk, Cleveland, O. No. 583,273.

In a series multiple controller, in combination, two motors, contact fingers with which the motors are respectively connected in series and in multiple arc, a switch movable in both directions from the "shut off" position, motor contact strips thereon, on opposite sides of said contact fingers when the switch is in said shut off position, and adapted to contact with said contact fingers, trolley strips thereon, connections between the motor strips and trolley strips, and fixed contact fingers which connect the trolley strips with the source of current, whereby the movement of the switch in one direction causes the current to pass through the motor in series, and the movement of the switch in the opposite direction causes the current to pass through the motors in multiple arc.

Street or Station Indicator.—August C. Goetz, Cleveland, O. No. 583,304.

Operating Mechanism for Car Bells.—Joseph T. Haskins, Malden, Mass. No. 583,305.

Bond for Electric Railways.—James McLaughlin, Chicago, Ill. No. 583,309.

In a bond for electric railways a terminal head or heads and a pin or key held permanently in said terminal head by casting or forming the head about the key or pin, and means for expanding and locking the head by driving the pin or key.

Current-Collecting Device for Electric Railways.—William M. Brown, Johnstown, Pa. No. 582,324.

In combination with an electrically propelled vehicle and a magnet carried thereby, a flexible member depending below each magnet pole, and a spring between, and bearing against the pole and flexible member.

Safety Gate for Street Cars.—John L. Condon, Boston, Mass. No. 583,327.

Automatic Railway Switch.—William Lickstrom, New York, N. Y. No. 582,381.

Car Fender.—Samuel C. Bole, Leechburg, Pa. No. 583,393.

June 1.

Fare Register.—John W. Meaker, Chicago, Ill. No. 583,496.

In a register the combination with a resetting slide bar, of a handpiece for operating the same, and a lock adapted to automatically engage said handpiece to lock said slide bar in its normal position.

Underground Railway Conduit.—Albert G. Wheeler, New York, N. Y. No. 583,524.

A slotted conduit comprising slot rails, supports to which the same are bolted, and guide rails which are secured to the slot rail supports by being inserted between said slot rails and their supports.

Electric Railway.—Albert G. Wheeler, New York, N. Y. No. 583,525.

The combination with a supporting bar and traveling contact devices carried by the same, of a guide flange locked on the bar above the traveling contact devices and projecting laterally therefrom to engage the opposite sides of the slotted conduit, said flange being provided with a sleeve which surrounds the bar.

Fare Register.—John R. Murray, Walter Magee and August Wagniere, Los Angeles, Cal. No. 583,539.

Collector for Electric Railways.—Louis J. Hirt, Brookline, Mass. No. 583,575.

Railway Switch Thrower.—William W. Boone, Baltimore, Md. No. 583,591.

Street Car Fender.—Charles S. Coom, Philadelphia, Pa. No. 583,734.

Street Tram Car.—Andrew McGill, Dunedin, New Zealand. No. 583,764.

In combination with the subway with the tracks therein, the car, the truck, running in the subway, the standards extending upward from the truck through the subway and having turntables at its upper and lower ends, and the rollers carried by the said turning standards.

Trolley Finder.—George E. Johnson, Los Angeles, Cal. No. 583,868.

Electric Brake.—Rudolph M. Hunter, Philadelphia, Pa. No. 583,880.

An electric brake consisting of the combination of an axle of a longitudinal sliding core encircling the axle and having conical friction heads and a solenoid or helix having a stationary frame with a conical socket adapted to receive the conical head of the core.

Self Adjusting Trolley.—Charles S. McIntire, Allegheny, Pa. No. 583,881.

The combination with a trolley arm and trolley wheel carried thereby, of a pair of lateral upwardly inclined guard fingers each composed of a part rigidly secured to the trolley arm and a connected yielding portion adapted to be pressed against the side of the arm and terminating below the outer periphery of the trolley wheel.

June 8.

Rail Bond.—Samuel H. Harrington, New York, N. Y., and George E. Somers, Bridgeport, Conn. No. 583,902.

In combination, a rail bond having a shoulder near its end and a separate sleeve adapted to slip over said end and to bear against said shoulder.

Series Parallel Controller.—William B. Potter and Frank E. Case, Schenectady, N. Y. No. 583,935.

In a controller, the combination of a cylindrical switch, contacts thereon, and sets of stationary brushes engaging therewith, the brushes and contacts bearing such a relation to each other that the circuit is alternately completed or broken at one set, then at another.

Pneumatic Controller.—Edward D. Priest, Schenectady, N. Y. No. 583,938.

In a controller, a plurality of separate pneumatically operated contacts for varying the resistance of the motor circuits.

Pneumatically Actuated Controller.—Edward D. Priest and Frank A. Merrick, Schenectady, N. Y. 583,939.

In a controller, the combination of a valve, means for operating the valve, and contacts controlled by the valve for establishing various motor combinations, the relation of the valve and operating mechanism being such that the first time the operating mechanism is brought to a predetermined position, one relation of the motors is established, and the next time a different relation.

Street Railway Switch.—Albert M. Dimmick, Wilkesbarre, Pa. No. 583,985.

A switch rail operating mechanism having slotted track rails, a rocking lever operatively connected with the switch rail, pivotal treads mounted in said slots and normally arranged flush at their upper edges with the upper surfaces of the rails, cables connecting the treads with said rocking lever, and direction pulleys traversed by the cables and arranged contiguous to the free ends of the treads and above the plane of the points of connection of the cables with the treads, whereby the treads are returned to their normal positions by the tension of the cables.

TURNTABLE FOR SURFACE CONTACT ELECTRIC RAILWAYS.—Edward M. Hewlett, Schenectady, N. Y. No. 583,997.

In a surface contact electric railway, sectional conductors in the roadway, a turntable, studs upon the turntable, contacts above and below the turntable and switches in circuit with the conductors and contacts, whereby by the operation of the turntable the invariable relation of the contacts on the turntable and in the railway is preserved.

PAT. NO. 584,103.

PAT. NO. 583,324.

RAIL BOND.—William B. Potter, Schenectady, N. Y. No. 584,013.

In a rail bond, the combination of roughened plates, a conductor connecting the plates, a plastic compound of good conductivity filling the roughened portion of the plates and means for securing the plates to the rails.

RAILWAY BRAKE.—Samuel T. Williams, Plainfield, N. J. No. 584,028.

In a double brake for railway cars, the combination of two L-shaped depending rods carrying between them rollers, two vertical sliding rods carrying at their lower ends brake shoes adapted to impinge against the tracks, wheel brakes mounted upon said L-shaped rods and chains leading to the operating mechanism, attached to the said vertical sliding rods and passing underneath said roller.

SYSTEM OF ELECTRICAL DISTRIBUTION.—Joseph L. Woodbridge, Brooklyn, N. Y. No. 584,029.

The combination of bus bars, a feeder, a generator whose field magnets are provided with a winding that may be used as a shunt winding, and means for connecting said generator at pleasure either across the bus bars as a constant potential machine, or in series between the terminal of said feeder and the bus bar of like polarity, and means for restoring the feeder to direct connection with the said bus bar when the generator is connected across the bus bars.

DEVICE FOR ENABLING STANDING PASSENGERS IN STREET CARS TO STEADY THEMSELVES, ETC.—Jacob N. McIntire, New York, N. Y. No. 584,133.

As a means by which a person may be conveniently and comfortably steadied or sustained in a standing position, while riding in a car, a strap holder device adapted, at one end, to be easily engaged with and disengaged from the ordinary pendent car strap; and constructed at the other end with a handle-like portion adapted to be comfortably and conveniently grasped by the hand of the person to be supported.

AIR-STORAGE MOTOR CAR.—Robert Hardie, Rome, N. Y. No. 584,146.

The combination with air storage reservoirs, wherein the air is stored at comparatively high initial pressure, and an air engine, wherein the air is used at comparatively low pressure, of an automatic fluid pressure regulator or reduction valve, in the main supply connections to said engine, controllable to pass the air from the storage into the working system either at normal or higher than normal working pressure at will, and supplemental or starting connections to said engine tapping the working pressure system and controllable at will, whereby air at increased pressure may be supplied to the engine either through said starting connections or said main supply connections as may be desired.

SWITCH OPERATING DEVICE.—Eduard von Haken, Charlottenburg, Germany. No. 584,174.

The combination of a switch point and a lever having three arms, one of said arms having two pins embracing the switch point, and the other two arms being each provided with an upwardly projected cam, whereby the lever may be turned by the movement of an object against either of the cams.

DETACHABLE SUPPORT FOR STREET CARS.—John H. Hammer, Allegheny, Pa. No. 584,223.

This invention consists of a hinged hook for supporting a person standing in a car.

JUNE, 15.

CAR FENDER.—Anton Mazzanovich, New York, N. Y. No. 584,386.

RAILWAY SWITCH.—Arthur E. Nesper and George J. Habermann, Cleveland, O. No. 584,398.

CAR FENDER AND STOP.—Israel Benjamins, New York, N. Y. No. 584,452.

CAR SIGNAL.—William J. Gubitz, Brooklyn, N. Y. No. 584,470.

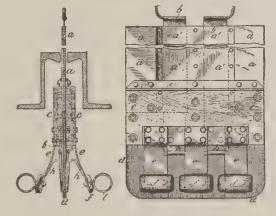
A danger bell for trolley or other cars in combination with a platform and near the outer end thereof a bell, the convex or rounded surface thereof being downwardly directed, a hanger secured to the under portion of said platform behind said gong, a lever pivotally connected therewith, one end of said lever being adapted to operate in connection with said bell, the further end extending backwardly, a sprocket or toothed wheel engaging the same, a shaft having the said wheel mounted thereon, hangers supporting said shaft and arranged transversely of said platform, a belt or chain engaging said shaft and passing backwardly over the rear axle of said car, a wheel on said rear axle engaging said belt, a spri g secured to the platform of said car and adapted to press the hammer end of said lever downwardly.

ELECTRIC RAILWAY.—Theodore W. Kloman, Montclair, N. J. No. 584,511.

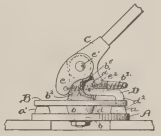
In an electric railway a continuous stationary rail attached to one side of a slitted conduit; a series of sectional rails or conductors provided with curved ends, said rails or conductors being pivotally supported by the opposite side of the conduit and in the same plane with said stationary rail and provided with means for connecting movable contacts with fixed contacts attached to a current feeder or main, in combination with a rigidly supported two part cup shaped trolley one part of which is adapted to bear continuously against the stationary rail, the other part being adapted to yieldingly lift the sectional rails in such manner as to operatively connect the current feeder or main through circuit connections, and a propelling motor carried by a car, said sectional rails being provided with means for restoring them to normal position by gravity after the trolley has passed from beneath them.

CAR, STREET, OR STATION SIGN.—William R. McDowell, Philadelphia, Pa. No. 584,598.

A sign consisting of a hollow transparent body having an indicating device therein, caps adapted to fit the ends thereof and form a closure for the same, an arm connected with each of said caps for supporting the same, a rod passing through openings in said arms and provided with a clamping nut, and illuminating means within said body, said body being adjustable within said caps.



PAT. NO. 583,575.



PAT. NO. 584,607.

TROLLEY STAND.—Sidney H. Short, Cleveland, O. No. 584,606.

The combination of a base having a slot, a trolley arm support pivoted to the base on a vertical axis, a trolley arm pivoted to the support on a horizontal axis, and a finger rigid with said arm and extended below its axis and adapted to enter said slot when the trolley arm is in service, but to be withdrawn therefrom when said arm is drawn down.

TROLLEY STAND.—Sidney H. Short, Cleveland, O. No. 584,607.

The combination of a base having the two slots at diametrically opposite points, and a trolley arm support pivoted to the base on a vertical axis between said slots, with a latch lever pivoted to said support and adapted to engage in either slot, and a trolley arm pivoted to the support and having a finger adapted to engage in either slot, and a trolley arm pivoted to the support and having a finger adapted to engage said latch lever and swing it out of engagement with said slots when the trolley arm is drawn down, and means exerting a constant force to swing the trolley arm upward.

ELECTRIC RAILWAY.—Henry M. Jones, Meriden, Conn. No. 584,639.

In an electric railway, a conduit having a longitudinal slot at its top, and a tubular cable for normally closing said slot, the cable consisting of a spiral coil, the spirals being arranged close together, yet adapted to open or stretch at points lifted from the slot.

SELF OILING TROLLEY WHEEL.—Benjamin T. Henry, New Haven, Conn. No. 584,686.

A self oiling trolley wheel cast in one piece, having a transverse axle opening for the reception of the axle upon which the wheel runs, and a deep peripheral groove for the reception of the trolley wire, and formed with a large oil chamber concentric with the periphery of the wheel having inwardly extending frusto-conical side walls between which that portion of the axle extending between them is completely exposed, and each of which walls is formed with a circular series of radially arranged, inwardly inclined grooves, which lift portions of the oil in the chamber to a point above the axle, and then convey it thereto, preventing it from flowing laterally downward over the side walls, and thus around the axle instead of directly to the same.

We will send copies of specifications and drawings complete of any of the above patents to any address upon receipt of fifteen cents. Give date and number of patent desired. THE STREET RAILWAY PUBLISHING COMPANY, HAVEMEYER BUILDING, NEW YORK.

LIST OF STREET RAILWAY COMPANIES IN THE UNITED STATES IN THE HANDS OF RECEIVERS.

Name of Company.	Date of Receiver-ship.	Funded Debt.	Miles.	Cars.	Gross Receipts*	Receiver.
Adrian (Mich.) St. Ry.	Jan., 1894	$ 36,500	3.0	8	. . . .	Frank E. Snow
Asbury Park (N. J.) & Belmar St. Ry. Co.	Mar., 1896	75,000	2.3	. .	$17,777	W. L. Dayton
Asheville (N. C.) St. R. R. Co.	Feb., 1895	300,000	7.0	14	25,285	J. E. Rankine
Austin (Tex.) Rapid Transit Ry. Co.	Feb., 1897	343,000	13.5	20	. . . .	I. H. Evans
Highland Avenue & Belt R. R. Co., Birmingham, Ala.	Apr., 1897	. . . .	28.0	20	. . . .	P. Campbell
Park City Ry. Co., Bowling Green, Ky.	Dec., 1896	75,000	3.5	11	. . . .	Jas. H. Wilkerson
Brooklyn (N. Y.) Elevated R. R. Co.	a Mar., 1897	14,333,000	41.1	381	1,719,398	Frederick Uhlmann
Kings County Elevated Ry. Co.	Aug., 1896	4,750,000	21.5	198	781,737	Jas. Jourdan
Charleston (W. Va.) St. Ry. Co.	. . .	10,000	4 0	. .	. . . .	C. B. Couch
Calumet Electric St. Ry. Co., Chicago, Ill.	May, 1897	3,000,000	90.0	227	. . . .	John C. McKeon
Englewood & Chicago Electric St. Ry., Chicago, Ill.	Jan., 1897	1,175,000	21.5	40	. . . .	G. Herbert Condict
Metropolitan West Side Elevated R. R. Co., Chicago, Ill.	Jan., 1897	15,000,000	36.0	180	. . a .	Dickinson MacAllister
Columbus (O.) Central Ry. Co.	Sept., 1896	1,500,000	32.0	55	. . . .	Geo. H. Worthington
Dallas (Tex.) City St. Ry. Co.	Mar., 1897	350,000	23.9	76	. . . .	Chas. E. Bird
The Defiance (O.) Light & R. R. Co.	. . .	100,000	3.5	6	. . . .	W. R. Faben
West End St. Ry. Co., Denver, Col.	Nov., 1893	300,000	10.3	17	. . . .	Geo. E. Randolph and Cornelius S. Sweetland
Dubuque (Ia.) Light & Traction Co.	Dec., 1894	385,000	10.5	23	. . . .	Horace Torbert
Fort Wayne (Ind.) Consolidated Electric Ry. Co.	Sept., 1896	1,800,000	34.0	65	. . . .	J. H. Bass and M. S. Robison
Great Falls (Mont.) St. Ry. Co.	. . .	150,000	8.7	11	26,091	W. D. Dickinson
Harvey (Ill.) Transit Co.	J n., 1895	115,000	3.0	3	. . . .	Chicago Title & Trust Co.
Johnson City (Tenn.) & Carnegie St. Ry. Co.	Apr., 1897	. . . .	4.0	4	. . . .	J. E. Brading
Pennsylvania Traction Co., Lancaster, Pa.	Nov., 1896	1,561,200	50.0	90	198,304	W. B. Given
Lawrence (Kan.) Transportation Co.	. . .	25,000	5.5	9	. . . .	
Lincoln (Ill.) Electric St. Ry. Co.	Feb., 1897	50,000	6.0	6	. . . .	Wm. H. Traner
Lincoln (Neb.) St. Ry. Co	Jan., 1895	1,460,000	55.0	90	. . . .	Brad. D. Slaughter
Logansport (Ind.) Ry. Co.	June, 1895	. . . .	5.5	12	. . . .	D. D. Fickle
McKeesport (Pa.) Duquesne & Wilmerding Ry. Co.	June, 1897	350,000	14.4	8	38,295	Fidelity Title & Trust Co.
Madison (Wis.) City Ry. Co.	Mar., 1895	150,000	8.0	20	. . . .	F. W. Oakley
New Albany (Ind.) Ry. Co.	Mar., 1894	230,000	7.0	29	. . . .	John MacLeod
Newark (O.) & Granville Electric St. Ry. Co.	Apr., 1896	150,000	13.0	22	28,022	J. F. Lingafelter
Norfolk (Va.) & Ocean View R. R. Co.	Apr., 1896	300,000	12.0	28	. . . .	O. E. Smith
East Oakland St. Ry. Co., Oakland, Cal	Apr., 1894	250,000	11.0	14	b 99,934	J. C. Johnson
Highland Park & Fruit Vale R. R., Oakland, Cal.	. .	200,000	10.5	8	. . . .	W. F. Rudolph
Olympia (Wash) Light & Power Co	. . .	147,000	4.0	5	. . . .	Hazard Stevens
Suburban Traction Co., Orange, N. J.	Dec., 1894	537,000	10.0	22	68,247	Watson Whittlesey
Lake Ontario & Riverside Ry. Co., Oswego, N. Y.	Oct., 1896	287,000	12.3	23	27,101	F. H. Tidman
Ottumwa (Ia.) Electric Ry. Co.	Apr., 1896	200,000	7.3	11	. . . .	J. H. Merrill
East Side Ry. Co., Portland, Ore.	. . .	300,000	22.0	22	. . . .	
Belle City St. Ry. Co., Racine, Wis.	Jan., 1897	300,000	15.0	26	. . . .	Hiram J. Smith
Rockaway (N. Y.) Village R. R. Co.	. . .	25,000	1.3	3	600	D. L. Haight
Union St. Ry. Co., Saginaw, Mich.	May, 1897	325,000	31.8	52	. . . .	Homer D. Loring
St. Cloud (Minn.) City St. Car Co.	—— 1895	125,000	7.3	8	. . . .	E. E. Clark
Fourth Street & Arsenal Ry. Co., St. Louis, Mo.	Mar., 1897	200,000	5.0	15	. . . .	Chas. Green
Alamo Heights Ry. Co., San Antonio, Tex.	Mar., 1897	50,000	5.5	7	. . . .	W. H. Hume
Citizens' Traction Co., San Diego, Cal.	Feb., 1897	80,000	5.0	11	. . . .	A. D Norman
San Jose (Cal.) R. R. Co.	. . .	350,000	17.0	27	. . . .	Jas. Fin lay, Henry B. Alvord
Grant St. Elec. Ry. Co., Seattle, Wash.	. . .	125,000	6.5	11	c 12,862	W. J. Grambs
Seattle (Wash.) City Ry. Co.	. . .	1,000,000	5.0	27	. . . .	W. A. Underwood
Front St. Cable Ry. Co., Seattle, Wash.	. . .	. . . .	5.5	12	. . . .	O. D Colvin
So. Dakota Rapid Transit & Ry. Co., Sioux Falls, S. Dak.	A r., 1895	75,000	7.4	6	. . . .	F. H. Files
Streator (Ill.) Ry. Co.	. . .	160,000	6.3	8	. . . .	C. C. Barr
The Belt Ry. Co., Washington, D. C.	Sept., 1896	490,000	15.4	81	87,634	W. K. Schoepf
Eckington & Soldiers' Home Ry. Co., Washington, D. C.	Sept., 1896	199,800	17.4	93	104,608	W. K. Schoepf
Maryland & Washington Ry. Co., Washington, D. C.	. . .	430,000	2.3	. .	. . . .	W. K. Sc oepf
Watertown (N. Y.) & Brownsville St. R. R. Co.	Nov., 1895	160,000	6.3	17	24,979	J. A. Lawyer
Watertown (So. Dak.) & Lake Kampeska Ry. Co.	. . .	. . . .	6.5	1	. . . .	
Superior Rapid Transit Ry. Co., West Superior, Wis.	Jan., 1896	250,000	26.0	35	39.306	S. T. Norvell
Moundsville, Benwood & Wheeling (W. Va.) Ry. Co.	. . .	150,000	9.0	6	. . . .	Howard Hazlett

Funded Debt, total, $54,489,500. Funded Debt, Elevated Railways, $34,083,000. Funded Debt, Surface Hazlways, $20,406,500.

* Latest obtainable. *a.* Reorganization has now been practically effected. *b.* From Apr. 28, 1894, to Feb. 1, 1896. *c.* Six months.

Annual Report of the Westinghouse Electric & Manufacturing Company.

The following is an abstract of the report to the stockholders of this company dated June, 23, for the year ending Mar. 31, 1897:

Your board of directors present herewith the balance sheet showing the financial condition of your company as of Mar. 31, 1897.

Owing to the removal operations from the old into the new shops, your board of directors were unable to present a balance sheet for Mar. 31, 1896, based upon actual values of inventories.

The class of electrical business conducted by your company has been in a depressed condition during the past two years, owing to the almost complete interruption in the building of new railways and new power stations. Notwithstanding these unfavorable conditions and the heavy charges to current expense account, due to the

removal to the new works, and the making of new tools, patterns, etc., the company's earnings have exceeded the amount required for the dividends on the preferred stock, which have been promptly paid.

By comparing the present balance sheet with that for Mar. 31, 1895,* it will be seen that there has been made a reduction in the surplus account of $1,577,735.93, due to amounts written off in connection with the disbandment of the old factories, the sale of obsolete tools, machinery and stock, depreciation of inventory, bad debts, the adjustment and settlement of old accounts, and the book loss from the sale of stocks and bonds owned by the company, and also the book loss resulting from the sale, at the price mentioned below, of $3,000,000, par value, of "assenting stock."

SALE OF ASSENTING STOCK.

On June 4, 1896, your company authorized the increase of its capital stock from $10,000,000 to $15,000,000, and your board of directors effected a sale of $3,000,000, par value, of the new assenting stock thus authorized to the Security Investment Company, of Pittsburgh, which realized to the company $2,489,000, of which amount $1,260,000 was received in cash, $329,000 was represented by patents and property, and the remaining $900,000 in interest-bearing notes secured by collateral; $300,000 of such notes were payable July 5, 1897, and have been paid; $300,000 are payable July 5, 1898, and the remaining $300,000 July 5, 1899.

EXPENDITURES FOR PATENTS.

Pursuant to the terms of the contract with the General Electric Company, for the exchange of licenses under the patents of the two companies, of which you were notified by a circular letter dated Apr. 2, 1896, your company has purchased outright for $216,600 the Tesla patents for multiphase current motors, in order that both companies might manufacture apparatus covered by those patents without the payment of royalties, other than those provided for in the agreement between the two companies. For like reasons your company purchased, for $72,231.17, the entire capital stock of the R. D. Nuttall Company, which has a complete workshop for its purposes, and manufactures trolleys for the General Electric Company and your company, and gears and other railway supplies for the general market. The stock purchased is considered fully worth its par value of $118,000. Your company also purchased for $58,500, and the transfer of certain patents acquired through its agreement with the Security Investment Company, 12,433 shares of the Electro-Magnetic Traction Company, out of a total issue of 20,000 shares.

PATENTS.

The agreement between the General Electric Company and your company has been in force a little over a year, and the wisdom and value of the union of patents has been fully established. The terms of the contract between the General Electric Company and your company fix the respective values of the patents at 62½ per cent for the General Electric Company and 37½ per cent for your company. The patents owned by your company are carried at $4,689,080.89, or less than 37¼ per cent of the aggregate book value of the patents of both companies.

STOCKS, BONDS AND PROPERTIES.

These items appear on the books at cost. It was the expectation of your board of directors that a large part of the bonds and stocks of lighting companies on hand could be disposed of from time to time, but there has been no market for the sale of such securities during the past two years.

POWER TRANSMISSION.

About two years ago your company installed at Niagara Falls, for the Cataract Construction Company, three 5000 h. p. generators, and in January of this year was awarded by that company the contract for five additional generators of the same capacity, which are now under construction.

Your company has also just been awarded a contract for fifteen 5000 h. p. generators by the St. Lawrence Power Company, which is the largest single order yet given for power transmission apparatus.

Your company should derive great benefit from the execution of this contract, since no other company has yet attempted work of this size and importance. The securing of these contracts was, without doubt, due to the success of your apparatus at Niagara Falls, and to the most complete facilities which your company now has at its new works at East Pittsburgh for the manufacture of large electrical units.

RAILWAY DEVELOPMENT.

Your company has made marked progress in the development of apparatus for the operation of suburban and interurban trains on main railways, and it has installed at East Pittsburgh, on the tracks of the Penusylvania Railroad, experimental apparatus, where important experiments are constantly being carried on. We believe your company is now more fully equipped and has better facilities for work of this kind than any other concern.

The balance sheet of Mar. 31, 1897, is as follows:

* The balance sheet of Mar. 31, 1896, was not issued, "owing to the removal operations from the old into the new shops."

ASSETS.

Cash in banks		$330,193.89
Bills receivable		43,207.09
Accounts receivable		1,604,547.19
Material in stock and in course of manufacture (at cost of labor and material)		1,636,612.33
Amounts advanced leased companies		569,766.56
Bonds (par value $1,395,094.79)		1,352,655.31
Stocks (par value $10,470,611.02)		4,612,223.87
Real estate and buildings, Pittsburgh		455,115.71
New factory—Land and buildings	$1,290,732.85	
Less—First mortgage on land and buildings (final payment due Apr. 1, 1900)	$325,000.00	
First mortgage second purchase of land (due July 1, 1899)	59,300.00	384,300.00
Total		906,432.85
Machinery and tools		1,479,153.41
Miscellaneous		286,306.40
Charters, franchises and patents		4,689,080.89
		$17,965,295.50

LIABILITIES.

Accounts payable	$484,534.21
Bills payable, issued for merchandise	207,151.12
Discounted with collateral	1,399,506.89

CONTRACT AND CONTINGENT LIABILITIES.

Scrip dividend	194,560.00
Collateral trust bonds	590,000.00
U. S. E. L. Co.'s 6 per cent fifteen year bonds payable annually	350,000.00
(Bills receivable under discount, $907,155.33.)	

CAPITAL STOCK.

Preferred, 79,921.06 shares	$3,996,053.00	
Assenting, 163,902.52 "	8,195,126 00	
Common, 2,934 "	146,700.00	
		12,337,879.00
(In treasury 56,097.48 shares Assenting; and 78.94 " Preferred)		
Surplus		2,401,664.28
		$17.965,295.50

Gross Receipts in 1895 and 1896.

There are presented in the following table a comparison of the gross receipts of twenty-seven street railway properties earning

ROADS HAVING GROSS RECEIPTS FOR 1896 OF $1,000,000 OR OVER.

NAME OF COMPANY.	Gross Receipts 1895.	Gross Receipts 1896.	Per Cent. Increase.
Union Traction Co. (Philadelphia)	$9,491,991	$10,210,026	7.56
Metropolitan St. Ry. Co. (New York)	7,595,840	9,322,331	22.73
Manhattan Ry. Co	9,731,213	9,313,885	*4.28
West End St. Ry. Co	7,746,171	8,341,958	7.69
Chicago City Ry. Co	4,476,824	4,808,867	7.42
Brooklyn Heights R. R Co	4,129,863	4,604,392	11.49
West Chicago St. R. R. Co	4,201,477	4,018,948	*4.34
North Chicago St. R. R. Co	2,780,487	2,913,709	4.79
Consolidated Traction Co	2,507,557	2,800,582	11.68
The Third Ave. R. R. Co	2,655,154	2,680,448	.95
Twin City Rapid Transit Co	1,988,804	2,059,218	3.54
Consolidated Traction Co	1,728,659	1,963,529	13.58
Buffalo Ry. Co	1,714,163	1,867,061	8.92
Nassau Electric R. R. Co	1,214,237	1,765,868	45.43
Brooklyn Elevated R. R. Co	2,082,937	1,719,398	*17.45
United Traction & Electric Co	1,510,771	1,692,933	12.06
Cleveland Electric Ry. Co	1,503,620	1,634,841	8.72
National Ry. Co. of Chicago	1,403,957	1,522,273	8.42
Lynn & Boston R. R. Co	1,381,389	1,425,922	3.22
New Orleans Traction Co., Ltd	1,327,756	1,334,277	4.91
Baltimore Traction Co	1,179,191	1,269,514	7.66
Montreal St. Ry. Co	1,102,778	1,265,898	14.78
Louisville Ry. Co	1,288,172	1,234,526	*4.16
Baltimore City Pass. Ry. Co	1,058,305	1,060,418	1.99
Detroit Citizens' St. Ry. Co	1,055,465	1,040,545	*1.41
Capital Traction Co	1,063,767	1,034,458	*2.75
City & Suburban Ry. Co	751,720	1,014,592	34.97
Total	$78,672,268	$83,920,417	6.67

$1,000,000 or more in 1896; twenty-two properties earning from $500,000 to $1,000,000; fifty-two properties earning from $100,000 to $500,000; and fifty-six properties earning from $50,000 to $100,000.

In the first group, the average rate of increase in the earnings of 1896 over the earnings of 1895, is 6.67 per cent; in the second group the average rate of increase is 6.47 per cent; in the third group the average rate of increase is 12.14 per cent; and in the fourth group the average rate of increase is 9.18 per cent.

These tables form a convenient method of comparing the results of operation in this particular matter of gross receipts for different roads of the same class, and from the additional information contained in the body of this work, the comparative percentages of operating expenses to gross receipts, and other details of operation may be found.

ROADS HAVING GROSS RECEIPTS FOR 1896 OF $500,000 TO $1,000,000.

Name of Company.	Gross Receipts 1895.	Gross Receipts 1896.	Per Cent. Increase.
Toronto Ry. Co.	$992,801	$997,273	.45
New York & Harlem R. R. Co.	1,015,076	935,417	*7.85
North Hudson County Ry. Co.	871,273	906,985	4.09
Rochester Ry. Co.	873,445	855,694	*2.03
Second Ave. R. R.Co.	641,290	787,414	22.78
Kings County Elevated Ry. Co.	858,575	781,737	*8.95
Denver Consolidated Tramway Co.	721,266	752,290	4.30
Dry Dock,E. B'way & Battery R.R.Co.	748,443	728,879	*2.61
Br'klyn,Qu'ns Co.& Suburban R.R.Co.	638,731	725,366	13.57
The 42d St.,Manhattanville & St. Nicholas Ave. Ry. Co.	626,337	715,626	14.26
Columbus St. Ry. Co.	629,995	631,324	.21
Central Crosstown R. R. Co.	547,491	576,267	5.25
Lake Street Elevated R. R. Co.	517,305	573,669	10.89
The Albany Ry.	522,276	554,445	6.16
Hestonville,Mantua & Fairmount Pass. Ry. Co.	523,212	549,896	5.09
Metropolitan R. R. Co.	326,130	549,767	68.57
Brooklyn City & Newtown R. R. Co.	598,691	536,811	*10.33
Hartford St. Ry. Co.	409,372	531,388	29.79
Union Ry. Co. of New York City.	457,457	525,800	14.94
Springfield St. Ry. Co.	442,006	521,673	18.02
Troy City Ry. Co.	455,991	520,171	14.08
Wilkesbarre & Wyoming Valley Traction Co.	451,941	507,862	12.37
Total	$13,869,104	$14,765,754	6.47

* Decrease.

ROADS HAVING GROSS RECEIPTS FOR 1896 OF $100,000 TO $500,000.

Name of Company.	Gross Receipts 1895.	Gross Receipts 1896.	Per Cent. Increase.
Atlanta Consolidated St. Ry. Co.	$294,845	$497,290	68.85
Worcester Consolidated St. Ry. Co.	422,956	492,796	16.51
Pittsburgh, Allegheny & Manchester Traction Co.	449,661	478,295	6.37
Federal St. & Pleast. Vall. Pass. Ry.Co.	406,686	443,123	8.96
Richmond Ry. & Electric Co.	450,886	437,747	*2.91
New Orleans & Carrollton R. R. Co.	441,900	431,414	*2.37
Lowell & Suburban St. Ry. Co.	329,807	422,739	28.18
Pttsburgh & Birmingham Trac. Co.	305,582	412,288	34.91
Lowell, L'rence & Hav'rhill St. Ry. Co.	403,530	410,001	1.61
New York & Queens Co. Ry. Co.	304,103	358,870	18.01
Coney Island & Brooklyn R. R. Co.	383,367	344,907	*10.03
Globe St. Ry. Co.	269,786	323,521	19.92
Nashville St. Ry.	311,896	322,566	3.42
Bridgeport Traction Co.	279,559	321,260	14.91
Paterson Ry. Co.	298,689	319,085	6.83
Brockton St. Ry. Co.	266,892	306,865	14.98
The Newark & South Orange Ry. Co.	272,564	291,515	6.99
Fair Haven & Westville R. R. Co.	247,658	281,023	13.45
Portland R. R. Co.	220,220	251,425	14.17
Winchester Ave. R. R. Co.	233,246	251,314	7.75
Des Moines City Ry. Co.	241,168	239,511	*0.68
Allentown & Lehigh Valley Trac. Co.	222,834	238,453	7.01
Trenton Pass. Ry. Co.	222,761	228,356	2.51
Union St. Ry. Co.	196,480	224,144	14.08
Chicago Electric Transit Co.	141,524	223,141	57.68
Duluth St. Ry. Co.	213,605	219,927	2.96
New Haven St. Ry. Co.	187,631	219,490	16.98
Galveston City R. R. Co.	216,271	212,661	*1.67
The Ottawa Electric Ry. Co.	193,992	212,106	9.33
Chester Traction Co.	206,997	208,105	0.53
Pennsylvania Traction Co.	171,218	198,304	15.82
Pittsburgh & West End Pass. Ry. Co.	169,421	193,224	14.05
Holyoke St. Ry. Co.	112,547	173,540	54.21
Utica Belt Line St. R. R. Co.	160,284	170,256	6.22
Wheeling Ry. Co.	150,094	167,993	11.92
Erie Electric Motor Co.	144,559	159,142	10.08
Sacramento Electric, Gas & Ry. Co.	146,569	154,501	5.41
Columbia Ry. Co.	134,562	149,270	10.93
Manchester St. Ry. Co.	82,924	148,781	79.42
Worcester & Suburban St. Ry. Co.	135,810	144,635	6.49
Binghamton R. R. Co.	127,257	144,592	13.62
Waterbury Traction Co.	124,567	137,273	10.20
Fitchburg & Leominster St. Ry. Co.	110,275	128,187	16.24
Easton Transit Co.	117,626	126,259	7.34
Lehigh Traction Co.	119,588	124,565	4.16
Westchester Electric R. R. Co.	98,520	124,514	26.38
Camden, Glo'ster & Woodbury Ry. Co.	135,125	118,966	*11.96
Dartmouth & Westport St. Ry. Co.	112,709	111,142	*1.39
Johnstown Pass. Ry. Co.	94,926	110,339	16.23
Meriden Electric R. R. Co.	102,089	104,641	2.50
The Yonkers R. R. Co.	76,438	102,501	34.09
Quincy & Boston St. Ry. Co.	86,453	101,830	18.25
Total	$11,349,757	$12,727,393	12.14

ROADS HAVING GROSS RECEIPTS FOR 1896 OF $50,000 TO $100,000.

Name of Company.	Gross Receipts 1895.	Gross Receipts 1896.	Per Cent. Increase.
Haverhill & Amesbury St. Ry. Co.	$104,853	99,047	*5.53
Schuylkill Traction Co.	97,382	96,809	*0.59
Chicago General Ry. Co.	82,082	96,251	17.26
Norfolk Suburban St. Ry. Co.	58,114	94,967	63.41
Northampton St. Ry. Co.	83,504	94,802	13.53
London St. Ry. Co.	56,537	94,194	66.61
The Jamestown St. Ry. Co.	83,076	91,965	10.70
Altoona & Logan Valley Elec. Ry. Co.	83,292	90,264	8.37
Bay Cities Consolidated Ry. Co.	88,658	90,552	2.13
Newton St. Ry. Co.	81,823	86,464	5.67
Taunton St. Ry. Co.	74,508	85,897	15.29
Norwich St. Ry. Co.	85,210	84,715	*0.58
Sioux City Traction Co.	85,541	81,571	*4.64
Seattle Traction Co.	72,290	80,885	11.89
The Niag. Falls & Suspen. Bg. Ry. Co	66,319	77,100	16.25
Williamsport Passenger Ry. Co.	66,845	76,902	15.05
The Springfield (O.) Ry. Co	82,760	76,253	*7.88
Elmira & Horseheads Ry. Co.	72,023	73,626	2.22
Macon Consolidated St. R. R. Co.	69,190	73,419	6.05
Rockland & Abington St. Ry. Co.	67,815	71,466	5.38
Beaver Valley Traction Co.	59,930	69,346	15.71
Hoosac Valley St. Ry. Co.	30,785	68,422	122.24
Suburban Traction Co.	52,000	68,247	31.25
Newburyport & Amesbury H. Ry. Co.	68,426	67,614	*1.19
Rockland, Thomaston & Camden St. Ry. Co.	63,111	67,288	6.62
Rochester & Irondequoit R. R. Co.	61,933	67,284	8.64
Schuykill Valley Traction Co.	50,752	65,576	29.20
Gloucester St. Ry. Co.	63,224	64,777	2.46
The West Side St. R. R. Co.	54,107	64,044	18.36
City Pass. Ry. Co. of Altoona	56,527	62,884	11.24
Delaware Co. & Phila. Elec. Ry. Co.	31,984	61,498	92.28
Ithaca St. Ry. Co.	55,820	61,426	10.04
Shamokin & Mt. Carmel Elec. Ry.Co.	56,225	58,805	4.59
Wakefield & Stoneham St. Ry. Co.	52,548	58,213	10.78
Southwest Missouri Elec. Ry. Co.	42,438	58,170	37.06
Bangor St. Ry. Co.	56,790	58,071	2.25
York St. Ry. Co.	48,504	57,623	18.80
New Haven & Centerville St. Ry. Co.	46,498	57,488	23.63
Montgomery St. Ry. Co.	50,645	57,291	13.12
Derby St. Ry. Co.	61,332	55,853	*8.93
Lewiston & Auburn Horse R. R. Co.	36,099	55,758	5.44
Glens Falls, Sandy Hill & Ft. Edward St. R. R. Co.	50,173	54,567	8.75
Middletown & Goshen Traction Co.	45,141	54,003	19.63
Brightwood Ry. Co.	51,137	53,862	5.32
Nashua St. Ry.	26,840	53,640	99.85
Norwalk St. Ry. Co.	53,338	53,521	0.34
New London St. Ry. Co.	51,759	53,162	2.71
Charlotte Elec. Ry. Light & Power Co.	26,009	52,977	103.26
Kingston City R. R. Co.	50,230	52,682	4.88
City Electric Ry, Co.	52,848	52,500	*0.66
Schenectady Ry. Co.	44,750	52,122	16.47
Hartford & W. Hartf'd Horse R. R. Co.	42,425	51,959	22.47
South Middlesex St. Ry. Co.	41,995	51,009	21.46
Enterprise St. R. R. Co.	50,156	50,755	1.19
Concord St. Ry. Co.	51,965	50,650	*2.53
Norwalk Tramway Co.	43,315	50,161	15.80
Total	$3,343,372	$3,650,297	9.18

DIGEST OF CONTENTS.—JULY, 1897.

Abkürzung des Inhalts—Juli 1897.

"*Elektrischer Strassenbahn-Betrieb in Europa—II.*" [Seite 383]
In diesem Artikel erscheinen Beschreibungen der Strassenbahn-Systemen in Budapest, Belgrad, Wien, München, Paris und Bristol, sowie eine ausführliche Uebersicht, nebst Mappe, des Kleinbahnbetriebs in Belgien. Bei der Sammlung dieser Auskünfte, wurde besonders bestrebt, technische Mittheilungen über jenen Bahnen zu erhalten, welche elektrisch betriebt werden, sowie eine Uebersicht der finanziellen Erfolge welche der Einführung des elektrischen Betriebs folgten. Die Beschreibungen sind mit zahlreichen Zeichnungen und Photographieen illustrirt.
Diesem Artikel folgen Beschreibungen der Strassenbahnsystemen von Buenos Aires, Argentinien, Dunedin, Neu-Seeland, und Sydney, Australien.
"*Strassen- und sonstige Eisenbahnen in Siam*, von John Barrett, Gesandter der Vereinigten Staaten in Siam" . [Seite 399.]

Betrieb.

"*Reparaturwerkstätten der Brooklyn Heights Railroad Company.*" [Seite 401.]
Das umfangreiche System dieser Bahn, welche zwischen 2100 und 2200 Wagen besitzt, erfordert den Gebrauch einer grossartigen Reparatur-Werkstättenanlage, in welcher eine Anzahl von arbeitersparenden Vorrichtungen eingeführt worden sind, die der Wirksamkeit der Werkstätten wesentlich beitragen. Der Artikel beschreibt im allgemeinen die für die Reparatur aller elektrischen Apparaten, Untergestellen und Wagenkörpern angewandte Methode, so wie verschiedene Verbesserungen welche namentlich in der Ausstattung der Motoren eingeführt wurden. Es werden eine Anzahl von Werkzeuge für besonderen Gebrauch dargestellt, welche das Ergebniss jahrenlanger Erfahrungen der Bahn-Gesellschaft bilden. Unter denselben befinden sich Ringe für die Zusammenstellung von Kollektoren, eine Vorrichtung für die Entfernung der Kollektoren von der Achsenschiene, Klemmen für das Festhalten der Spülen während dem Aufwinden, ein Werkzeug für die Biegung von Schutzrahmen, ein elektrischer Ofen, und ein Verfahren um gebogene Achsen und Armaturdeichseln gerade zu machen.
"*Das System der Akron, Bedford & Cleveland Eisenbahn für Telephonsversendung*," von F. J. Sloat, Superintendent der Bahn. . . . . [Seite 405.]
Diese elektrische Bahn, welche sich auf eine Strecke von ungefähr 50 km. ausdehnt, hat seit einiger Zeit einen Telephondienst zwischen den Wagen und der Zentralstation eingerichtet. Sollte irgend ein Wagen eine Haltestelle zu spät erreichen, setzt sich der Wagenführer sogleich in Verbindung mit der Zentrale, und erhält die nöthige Befehle um sich entweder zu der nächste Haltestelle zu begeben, oder anzuhalten bis der nächste Wagen von der entgegengesetzten Richtung vorbeigefahren ist. Diese Diensteinrichtung, mit der Hilfe eines Oberabsenders, welcher die Fahrtzeit der Wagen controllirt, hat sich als besonders erfolgreich für die Vermeidung von Verspätigungen und Unfällen erwiesen.
"*Elektrische Strassenbahnen-Motoren. I. Formen von Feldmagneten*" von George T. Hanchett. . . . . [Siete 406.]
Dies ist der erste einer Reihe von Artikeln welche die gegenwärtige Formen von elektrischen Strassenbahnen-Motoren, deren relativen mechanischen und elektrischen Vor- und Nachtheile, die beste Methode für die Reparatur der Motoren, u. s. w. beschreiben. Der in der gegenwärtigen Ausgabe erscheinende Aufsatz beschreibt die verschiedene Formen von Feldmagneten welche bis heute verwendet wurden, erklärt wesshalb gewisse Formen anderen vorzuziehen sind, und beschreibt die für das Aufwickeln der Feldmagneten angewandten Methoden.
"*Die finanziellen Erfolge des elektrischen und Kabelbahn-Betriebs in den Vereinigten Staaten*" . . . . . [Seite 409.]
Dies is der dritte einer Reihe von Artikeln über dieses Subject, und behandelt die finanzielle Lage zweier wohlbekannten amerikanischen Strassenbahngesellschaften in Städten von resp. 75,000 und 100,000 Einwohnern. Erklärende Tabellen werden beigefügt.
"*Strassenbahnen in Italien*," von E. Lavalard, "Membre du Comité de Direction," General-Omnibus Gesellschaft, Paris. [Seite 412.]
Uebersicht der Ausdehnung der Kleinbahnen in Italien, nebst kurzer Beschreibung der gegenwärtigen Verhältnisse der Strassenbahnen in mehreren der grösseren Städten. Der Verfasser, während einer neulichen Reise durch Italien, überzeugte sich dass die Aussicht für die Einführung des elektrischen Betriebs auf manchen italienischen Strassenbahnen in der nächsten Zukunft eine sehr günstige war.
"*Die richtige Behandlung der Controlleuren*," von J. R. Cravath. [Seite 412.]
In diesem Briefe kritisirt der Schreiber eine durch N. H. Heft in der vorigen Nummer des Journals veröffentichten Angabe, nach welcher "wenn der Strom schnell zugelassen wird, die Ersparniss in Kraftverbrauch grösser ist als wenn die Zulassung des Stroms wenig schneller geschieht."
"*Der Zolltarif auf Mica*," von C. W. Jefferson . [Seite 413.]
"*Dauer der Räder, Zahnräder und Triebeln*," von M. R. McAdoo, Generaldirektor der Paterson (N. J.) Eisenbahngesellschaft. [Seite 414.]
"*Rechtswesen.*" . . . . . [Seite 415.]

Leitartikeln.

"*Verein der Strassenbahn-Rechnenmeistern in Amerika.*" [Seite 418.]
"*Unsere finanzielle Beilage über amerikanische Strassenbahngesellschaften*" . . . . . [Seite 418.]
"*Rechtsmässige Entscheidung in Indianapolis über verminderten Fahrpreisen* . . . . . [Seite 418]
"*Ein Vergleich der Brutto-Einnahmen verschiedener amerikanischen Strassenbahngesellschaften*" . . . [Seite 418.]
"*Der Nationale Elektrische Codex der Versicherungsregeln für die Drahtverwahrung* . . . . . [Seite 419.]
"*Die Geschäftsaussichten für das kommende Jahr*" . [Seite 419.]
"*Entwurf für elektrische Kraftstationen für Eisenbahnen.*" [Seite 420.]
Erörterung der Streitfrage welche neulich in dem STREET RAILWAY JOURNAL über die Kraftstat on der Chicagoer Stadtbahn stattfand.

Oberbau.

"*Einrichtung der Schalttafeln in Centralen*," von George Moffat. [Seite 421.]
Erörterung des Materials, aus welchem Schalttafeln gebaut werden sollten, der besten Lage für eine Schalttafel, u.s.w. Verschiedene Irrthümer, welche öfters in der Einrichtung der Schalttafeln begangen werden, sind beschrieben, und es werden einige werthvollen Eingebungen über das beste Verfahren für die Inspektion und Reinigung der Apparaten zugefügt.
"*Die Zentral-Londoner Unterpflasterbahn*" . . [Seite 423.]
Diese Bahn, welche letztes Jahr in Bau gesetzt wurde, besteht aus einem doppelten Tunnel, von denen jeder eine Längtrecke von 10½ km. beträgt; sie durchzieht den mittleren Geschäftstheil der Stadt, bei einer durchschnittlichen Tiefe von 19-22 m. Mehrere Seiten-Abzweigungen werden auch von der Hauptlinie ausstrahlen. Die Tunnels sind nach dem Greathead-System gebaut, und haben einen Durchmesser von 3.50 m. An den Stationen erweitert sich der Tunnel zu einem Durchmesser von 6.30 m., auf einer Strecke von 115 m. Die Steigungen innerhalb des Tunnels richten sich aufwärts bei der Näherung einer Station, und abwärts nach der Abfahrt, um den Anhalt und die Abfahrt der Züge zu erleichtern.
"*Der Leitungsträger des elektrischen Kraftübertragung zwischen den Niagarafällen und Buffalo*," von J. G. White. [Seite 425.]
Beschreibung des Leitungsträgers welcher die elektrische Kraft der Niagarafällen nach Buffalo übertragt. Es werden blosse Drähte verwendet, mit einer Spannung von 10,000 volts. Die Stangen sind je 23 m. von einander, auf Krümmungen entsprechend näher entfernt. Sie werden paarweise aufgestellt und zusammengekoppelt Die Isolatoren sind aus Porzellan verfertigt, und zu 40,000 volts in Salzwasser geprüft. Die Isolirungskraft per Porzellan, wie die Versuche erwiesen, hängt fast ausschliesslich von der Vollständigkeit ihrer Verglasung, und sehr wenig von ihrer Stärke ab. Der Leitungsträger hat eine Länge von über 40 km., wovon 1.2 km. unterirdisch geführt werden. Der Strom der unterirdischen Abtheilung wird durch bleibedeckten, mittels Gutta-Percha isolirten Kabeln zugeführt, welche durch Formstücke aus gebranntem Thon laufen. Die effective Wirksamkeit, wie sich mittels dem Wattmeter in dem Wechselstrom in Niagara und in dem 500 volt Gleichstrom in Buffalo erzeigte, erwies sich auf 79.6 prozent. Dies galt für einen längeren Zeitraum mit schwankender Ladung. Diese Wirksamkeit war der Verlust durch die verschiedener Wechselungen in den Umgestaltern einbegriffen. Die Kosten würden sich dreimal so hoch gestellt haben, und die Entwerthung viel höher gewesen sein, wäre der Leitungsträger unterirdisch gelegt worden.
"*Die Anwendung der Elektricität auf Dampfbahnen*," von P. H. Brangs, elektrischer Ingenieur der "Delaware, Lackawanna & Western R. R." . . . . . [Seite 427.]
Der Wettbewerb zwischen den elektrischen (Trolley) Strassenbahnen und den Dampfbahnen für den Vorortverkehr hat schliesslich in solcher Massen entwickelt dass in manchen Fällen der Betrieb der letzteren wesentlich abnahm, und in einzelnen Fällen die Dampfbahnen die Anzahl ihrer Züge vermehrten und ihre Fahrpreise reduzirten um den Verkehr beizubehalten. Der Verfasser ist von der Meinung dass der elektrische Betrieb auf den Dampfbahnengleisen mit Erfolg eingeführt werden könnte, ohne dadurch dem Dampfbetrieb zu schaden, und dass die Reparaturkosten der elektrischen Ausrüstung nicht mehr als dreissig prozent der Kosten des Dampfbetriebs erweisen würden. Es wird zugegeben dass eine Locomotive eine unbalancirte Maschine ist und in keiner anderen Weise gebaut werden kann. Die beweglichen Theile einer Dampfmaschine können sich entweder in einer senkrechten oder in einer horizontalen, jedoch nicht in beiden Richtungen schwingen. Versuche, welche

durch die New-Yorker Zentralen Eisenbahn durchgeführt wurden, erweisen Ergebnisse die sich so hoch wie 3½ kg. Kohle pro P. S. pro Stunde beliefen; doch waren die Verhältnisse unter welche diese Proben stattfanden von solcher Art, dass es sehr zweifelhaft ist ob die durchschnittliche tägliche Thätigkeit einer Schnellverkehrslokomotive ein Ergebniss von viel weniger als 18½ kg. Kohle pro P. S. pro Stunde, erweisen kann; 2.23 kg. für Vorortbetrieb, 2.72 kg. für Güterbetrieb, und 9.06 kg. pro P. S. pro Stunde für Weichenlokomotiven. Dagegen ist die durchschnittliche Wirksamkeit einer stehenden Dampfmaschine ungefähr 0.9½ kg. Kohle pro Stunde. Der Verfasser erklärt sich nicht für eine dritte ungeschützte Schiene; nach seiner eigenen Angabe, erhielt er einen Strom von 600 volt ohne dadurch wesentlich fortdauernd gelitten zu haben.

Wissenschaft. — Baukunst. — Erfindungen.

"*Drehgestelle für den elektrischen Verkehr*" . [Seite 430.]

Eine der bemerkenswerthesten Tendenzen in dem Gebiete des elektrischen Eisenbahnbetriebs während dem laufenden Jahre erwies sich in dem stets zunehmenden Gebrauch von Drehgestellen. Wiederholte Versuche in Californien und anderswo haben die frühere Theorie gründlich widerlegt, nach welcher ein einfaches Untergestell bei grossen Steigungen erforderlich war, um die nöthige Triebkraft zu sichern. Bei der Verwendung eines Drehgestells war es ermöglicht eine Steigung von 14½ prozent zu ersteigen. Die Art und Weise in welcher dies geschieht wird in dem Artikel beschrieben, sowie das zu diesem Zwecke angewandte Drehgestell. Es wird auch eine Beschreibung der Construction dieses Drehgestells gegeben, sowie Zeichnungen nach welchen, mit einem Radgrunde von 1.60 m., und einer Wagenbreite von 2.20 m., der Wagenboden auf einer Entfernung von 72 cm. von dem Schienenkopfe gehalten werden kann, und der Wagen doch über eine Krümmung von 10 m. Halbmesser fahren kann. Für Doppelwagen soll sich dieses Untergestell besonders eignen.

"*Kraftbremsen für elektrischen Strassenbahnwagen*," von G. E. Pratt. . . . . [Seite 431.]

"*Triplex Kraftpumpen.*" . . . . . [Seite 431.]

Beschreibung einer neuen Gattung von Kraftpumpen, welche neulich eingeführt wurden; sie sind mit drei Zylindern und Stempeln versehen.

"*Spezielles Drehgestell*" . . . . . [Seite 432.]

Beschreibung eines Drehgestells welches für Wagen mit einer Radgrundlänge von nicht über 1.20 m. bestimmt ist. Der kurze Radgrund machte es erforderlich die Motoren ausserhalb statt innerhalb der Achsen aufzuhängen. Dies erforderte die Anwendung von besonderen Langsträgern und Bremseinrichtungen. Das Untergestell ist besonders für Bahnen mit sehr kurzen Krümmungen und für den Schnellverkehr geeignet.

"*Neue Motoren für den schweren Betrieb*" . . . [Seite 433.]

Beschreibung einer Reihe von vier elektrischen Motoren, welche durch eine Maschinenfabrik neulich eingeführt wurden. Der grösste hat eine indizirte Pferdestärke von 200 P. S.

"*Ein umwandelbarer Höher- und Gleichvolt-Generator*" [Seite 435.]

"*Ein neuer Motor G. E. 52*" . . . . . [Seite 436.]

Ausführliche Beschreibung eines neuen Motores, von einer Kraft von ungefähr 28 P. S.

"*Anwendung von abgenutzten Metallstücken*" . [Seite 437.]

"*Neue sektionale elektrische Unterirdische Bahn*" . [Seite 438.]

"*Wagen für die Cincinnati & Miami Valley Traction Company.*" [Seite 439.]

"*Vier-valvige Compound Dampf Maschine*" . . [Seite 440.]

"*Elektrische Boote für Ausflüge*" . . . . [Seite 440.]

"*Der 'Patton' Motorwagen*" . . . . . [Seite 441.]

"*Oberleitungs Isolirungsmaterial*" . . . . [Seite 441.]

Table des Matières—Juillet 1897.

Construction de tramways électriques en Europe, II . [Page 383.]

Cet article contient des descriptions des réseaux de tramways de Budapest, Belgrade, Vienne, Munich, Paris et Bristol, avec une revue générale, accompagnée d'une carte, du système de chemins de fer vicinaux en Belgique. En obtenant ces renseignements, des efforts spéciaux ont été faits en vue de recevoir, en ce qui concerne les lignes installées avec la traction électrique, des détails de construction, ainsi qu'une revue de résultats financiers qui ont suivi l'introduction de l'électricité comme force motrice. Les descriptions sont abondamment illustrées par des reproductions de diagrammes et de photographies.

Cet article est suivi d'une description des systèmes de tramways de Buenos Ayres, dans la République Argentine, de Dunedin, Nouvelle Zélande, et de Sydney, Australie.

Tramways et chemins de fer à Siam, par John Barrett, Ministre des Etats Unis à Bangkok . . . . . [Page 400.]

Service.

Les ateliers de réparation de la "Brooklyn Heights Railroad Co." [Page 401.]

L'étendue considérable du système de cette compagnie, qui possède de 2100 à 2200 voitures, exige le maintien d'un vaste atelier de réparation, dans lequel ont été introduites plusieurs machines-outils qui contribuent matériellement à l'efficacité du travail. L'article décrit d'une manière générale les méthodes employées pour la réparation des divers appareils électriques, de trucks et de corps de voitures, ainsi que certains perfectionnements qui ont été introduits, particulièrement dans l'arrangement des moteurs. Il est donné des illustrations d'un certain nombre de ces machines, construites pour usages spéciaux en suite de la longue expérience acquise par la compagnie, et parmi lesquelles se trouvent un anneau d'assemblage pour commutateurs, un arrangement pour déplacer les commutateurs de l'arbre de l'essieu, des crochets pour retenir les fils en place lors de l'enroulement, un appareil pour courber les châssis des ramasseurs, un four électrique et une machine à redresser les essieux et tiges d'armatures.

Le système de contrôle des départs par téléphone en usage sur la ligne "d'Akron, Bedford & Cleveland," par F. J. J. Sloat, surintendant de la compagnie . . . . . [Page 405.]

Cette ligne de tramway électrique, dont le réseau s'étend sur environ 50 kilomètres de voie, a adopté un système de communication téléphonique entre ses voitures et les stations de force motrice. Lorsqu'une voiture se trouve en retard à un point de relais, le conducteur se met immédiatement en communication avec la station centrale, afin de recevoir ordre, soit de continuer jusqu'au prochain relais, soit d'attendre jusqu'à ce que la voiture suivante vienne à passer. Ce système, à l'aide d'un employé préposé au service des départs, qui contrôle la marche des voitures, a donné les meilleurs résultats en ce qui concerne l'empêchement de retards et d'accidents.

Moteurs de chemins de fer électriques.—I: Formes d'induits, par George T. Hanchett . . . . . [Page 406.]

Premier article d'une série d'études décrivant les formes actuelles de moteurs de chemins de fer électriques, leurs avantages et désavantages respectifs au point de vue mécanique et électrique, les meilleurs méthodes de réparation de moteurs, etc. Le présent article décrit les différentes formes d'induits qui ont été en usage, explique pourquoi certaines d'entre elles sont préférables à d'autres, et décrit les méthodes employées pour l'enroulement des induits.

Les résultats financiers de la traction électrique et funiculaire aux Etats-Unis . . . . . [Page 409.]

Ceci est le troisième d'une série d'articles sur ce sujet; le présent article s'occupe de la situation financière de deux compagnies bien connues de tramways dans des villes ayant une popnlation respective de 75,000 et 100,000 habitants. L'article est accompagné de tracés explicatifs.

Les tramways en Italie, par E. Lavalard, membre du comité de Direction de la Compagnie Générale des Omnibus à Paris. [Page 412.]

Revue du développement des chemins de fer d'intérêt local en Italie, contenant divers détails sur la condition actuelle des tramways dans quelques unes de grandes villes. L'auteur, dans le cours d'un récent voyage en Italie, a été frappé par les conditions favorables pour l'adoption de la traction électrique sur la plupart des lignes de tramways en Italie.

Sur la propre manière de faire usage du contrôleur, par J. R. Cravath . . . . . [Page 412.]

Dans cette lettre paraît une critique de l'assertion faite par N. H. Heft dans le numéro de Juin, que "lorsque le courant est envoyé vivement en mettant la voiture en mouvement, l'économie de force est plus grande que lorsque le courant est lancé moins rapidement."

Le tarif sur le mica, par C. W. Jefferson . . [Page 413.]

Durée des roues, des engrenages et des pignons, par M. R. McAdoo, Directeur Général de la "Paterson (N. J.) Railway Company" [Page 414.]

Jurisprudence. . . . . [Page 415.]

Articles de Fond.

L'Association des Comptables de Tramways d'Amérique. [Page 418.]

Notre Supplément Financier de Compagnies de Tramways Américaines . . . . . [Page 418.]

Décision de la cour d'Indianapolis au sujet d'un prix de passage réduit . . . . . [Page 418.]

Une comparaison des recettes brutes de certaines compagnies américaines de tramways . . . . . [Page 418.]

Le Code National Electrique de règles d'assurances pour la sûreté des fils électriques . . . . . [Page 419.]

Les indications de la reprise des affaires pendant l'année prochaine. [Page 419.]

Plan d'une station de force motrice pour chemin de fer électrique. [Page 420.]

Revue d'une récente discussion dans le STREET RAILWAY JOURNAL au sujet d'une station centrale de la "Chicago City Railway Company."

Construction.

Montage des tableaux de distribution dans les stations centrales, par George Moffat . . . . . [Page 421.]

Cet article consiste en une discussion du matériel devant servir à la construction des tableaux de distribution, du meilleur emplacement du tableau, etc. Il passe en revue certaines erreurs habituellement commises dans le montage des tableaux, et donne des conseils utils sur les meilleurs systèmes d'inspection et de nettoyage des appareils.

Le chemin de fer souterrain Central de Londres . [Page 423.]

Ce chemin de fer, qui fut commencé l'année dernière, est une

ligne à tunnel double, chaque tunnel ayant 10½ kilomètres de voie, et traverse le quartier central des affaires de la ville, à une profondeur moyenne de 19 à 22 mètres. Il y a aussi un certain nombre de lignes d'embranchement. Les tunnels sont construits d'après la méthode "Greathead," et ont 3.50 mètres de diamètre. Le tunnel s'élargit aux stations à un diamètre de 6 30 mètres sur une longueur de 115 mètres. Les pentes du tunnel s'élèvent à l'approche des stations et s'abaissent en s'en éloignant, afin de faciliter les arrêts et les départs des trains.

L'équipement se fera entièrement à l'électricité, et il sera fait usage de locomotives, vu que le diamètre restreint des tunnels ne livre pas suffisamment d'espace pour loger les moteurs sur les essieux de la voiture. Le système alternatif triphasé sera employé pour les feeders, et il sera fait usage 'un courant direct de 500 volts dans le tunnel pour les moteurs. La station centrale se composera de 6 générateurs triphasés de 850 kilowatts, avec un voltage initial de 5000 et une fréquence de 25. Il sera fait usage de trente-cinq locomotives du type "Gearless," chacune desquelles portera quatre moteurs. Les trains consisteront de sept voit res pouvant transporter 336 personnes en tout.

La ligne de transmission d'énergie électrique entre Niagara Falls et Buffalo, par J. G. White . . . . . [Page 425.]

Description faite par le constructeur de la ligne utilisée pour la transmission de l'énergie électrique de Niagara Falls à Buffalo. Il est fait usage de fil de fer découvert et le voltage est de 10,000. Les poteaux sont à 23 mètres de distance l'un de l'autre en ligne droite, et plus rapprochés en proportion sur le courbes. Ils sont posés deux à deux, et reliés au moyen de traverses. Les isolateurs sont en porcelaine, et éprouvés à 40,000 volts dans l'eau salée. La résistance isolatrice de la porcelaine dépend presque absolument de sa vitrification complète et fort peu de son épaisseur. La ligne a une longueur de plus de 40 kilomètres, dont une section de 1250 mètres est souterraine. Le courant de la section souterraine est conduit par des câbles à armature de plomb et isolés à la gutta-percha, posés dans des conduites en terre cuite. L'efficacité actuelle telle qu'indiquée par le wattmètre dans le circuit alternatif à basse tension aux Chûtes de Niagara, et par le circuit à courant direct de 500 volts à Buffalo a été de 79.6 pour cent, pour une période considérable et une charge variable. L'efficacité comprenait la perte dans les transformateurs montants, de ligne, descendants et rotatoires. Si la ligne avait été placée souterrainement, les dépenses auraient été trois fois plus grandes et la dépréciation bien supérieure.

Application de l'électricité aux lignes à vapeur, par P. H. Brangs, Ingénieur Electricien du "Delaware, Lackawanna & Western R. R." . . . . . [Page 427.]

La concurrence faite par les lignes à trôlet aux lignes à vapeur pour le trafic de banlieue a été si désastreuse aux dernières que dans un certain nombre de cas leurs recettes ont considérablement diminué, et qu'elle a forcé plusieurs d'entre elles à augmenter le nombre de leurs trains et à diminuer leurs prix dans le but de regagner la clientèle du public. L'auteur de l'article est convaincu qu'il serait possible d'introduire l'équipement électrique sur les voies des lignes à vapeur sans que le service ordinaire à vapeur ait à en souffrir, et que les frais de réparation de l'installation électrique ne se monteraient pas à plus de 30 pour cent de frais de réparation de l'équipement à vapeur. Il est admis que la locomotive est une machine qu'il n'est pas possible de faire balancer, et qui ne peut être construite d'une façon différente. Les parties mobiles d'une locomotive peuvent se balancer soit dans le sens vertical, soit dans le sens horizontal, mais non dans les deux directions. La compagnie du "New York Central Railroad" a fourni des résultats se montant jusqu'à 3½ kilogrammes de charbon par cheval vapeur par heure, mais les conditions sous lesquelles ces essais ont eu lieu sont de telle nature qu'il est très-difficile, sinon impossible, d'obtenir des résultats précis, et il est douteux que l'on parvienne à démontrer que la moyenne journalière des locomotives à grande vitesse soit inférieure a 1.81 kilogrammes de charbon par heure de cheval vapeur, s'élevant à 2.27 kilogrammes pour le service de marchandises, et à 9.06 kilogrammes par heure de cheval vapeur pour le service d'aiguillage. D'un autre côté, la consommation moyenne d'une locomotive au repos est environ de 0.91 kilogrammes par heure. L'auteur ne recommande pas l'emploi d'un troisième rail indépendant. Il assure qu'il a reçu lui-même un choc de 600 volts sans en être affecté d'une façon permanente.

Science — Génie — Inventions.

Trucks à pivot pour le service électrique . . . . [Page 430.]

L'une de tendences les plus remarquables dans le cours de l'année 1897 dans l'exploitation des chemins de fer électriques a été l'emploi constamment plus fréquent du truck à pivot. L'ancienne théorie d'après laquelle un seul truck etait indispensable afin d'assurer la traction nécessaire sur les voies à pentes élevées a été refutée par de nombreux essais faits en Californie et ailleurs, où les voitures peuvent gravir des pentes de 14½ pour cent. La méthode d'après laquelle c'est accompli est décrite dans cet article, qui donne aussi une description du truck employé à cet effet, les détails de sa construction et des diagrammes indiquant de quelle manière, avec un empattement de roue de 1 m. 60 et une largeur de caisse de 2 m. 20, le fond de la caisse peut être maintenu à 72 cm. de la tête du rail, et la voiture peut tourner une courbe de 10 mètres de rayon. Ce truck est spécialement destiné à un usage considérable pour voitures à impériales.

Pompes à triple expansion . . . . . [Page 431.]

Description d'une nouvelle série de pompes récemment mises sur le marché, avec trois cylindres et plongeurs.

Freins pour chemins de fer électriques, par G. E. Pratt [Page 431.]

Revue de quelques unes des raisons avancées pour l'adoption de freins automatiques sur les voitures électriques.

Truck à pivot spécial . . . . . [Page 432.]

Description d'un truck à pivot construit pour être utilisé sous une voiture dont l'empattement de la roue est limité à 1 m. 20. Le peu de longueur de l'empattement donna lieu à la nécessité de suspendre les moteurs en-dehors des essieux au lieu d'en-dedans, et à l'emploi de barres d'appui spéciales et d'un arrangement particulier de freinage. Ce truck est spécialement utile sur les lignes ayant de courbes très-prononcées et un service considérable.

Les nouveaux moteurs pour le service de grande vitesse. [Page 433.]

Description de quatre moteurs électriques construits par la même maison, le plus grand étant de 200 chevaux.

Un générateur de conversion à courant continu et survolteur. [Page 435.]

Un nouveau moteur G. E. 52 . . . . . [Page 436.]

Description détaillée d'un nouveau moteur ayant une force d'environ 28 chevaux.

Ce que deviennent les pièces de métal usées . . [Page 437.]

Nouveau chemin de fer électrique à caniveau en sections. [Page 438.]

Voitures pour la compagnie de traction de "Cincinnati & Miami Valley" . . . . . [Page 439]

Machine compound à quatre soupapes . . . [Page 440.]

Bateau électrique pour parties de campagne . . [Page 440.]

La voiture motrice "Patton" . . . . . [Page 441.]

Matière isolatrice pour conducteur aérien . . [Page 441.]

Lista de Materias—Julio 1897.

Operación de los tranvías elétricos en Europa. II. . [Pág. 383.]

Este artículo comprende descripciones de los sistemas de tranvías de Budapest, Belgrade, Viena, Munich, Paris y Bristol, así como una revista general, con mapa del sistema de ferrocarriles vecinales en Bélgica. Al obtener esa información, fué hecho un esfuerzo especial para segurar, en el caso de las líneas instaladas por la tracción eléctrica, muchos detalles técnicos de construcción, y también una revista de los resultados financieros que siguierón la introducción de la tracción eléctrica. Las descripciones son liberalmente ilustradas con reproducciones de diagramas y fotograbados.

Este artículo está seguido por descripciones de los sistemas de tranvías de Buenos Aires, Argentina; Dunedin, Nueva Zelanda; y de Sydney, Australia

Ferrocarriles y tranvías en Siam, por John Barrett, ministro de los Estados Unidos á Bangkok . . . . [Pág. 399.]

Operación.

Los talleres de reparación de la "Brooklyn Heights Railroad Co." [Pág. 401.]

El desarollo de la red de esta compañía, la cual posee entre 2100 y 2200 carruajes, exige talleres de reparación muy extensivos, y han sido introducidos muchos aparatos perfeccionados, que aumentan materialmente la eficiencia de los talleres. El artículo da una descripción general de los métodos empleados para la reparación de todos los aparatos eléctricos, carretones y carruajes, así como de ciertos mejoramientos que han sido introducidos, especialmente en la construcción de los motores. Varias máquinas diseñadas para usos especiales, como resultado de experiencias adquiridas por la compañía, son ilustradas, incluyendo anillos para juntar conmutadores, un concepto para remover los conmutadores de el eje, lañas para asir bobinas durante su arrollo, una máquina para encorvar bastidores de fenders, un horno eléctrico, y un concepto para enderezar ejes y armaduras encorvadas.

El sistema de despacho por medio del teléfono sobre el "Akron, Bedford & Cleveland Railroad," por F. J. J. Sloat, sobrestante de la compañía. . . . . [Pág. 405.]

Esta compañía eléctrica, cuya red mide cerca de 50 kilómetros de longitud, ha instalado un sistema teléfonico para comunicar entre los coches y las estaciones centrales. En caso que un coche arriba tardío á una encrucijada, el conductor puede comunicar inmediatamente con la estación central, y recibir instrucciones, sea que continue á la próxima encrucijada, ó que quedase hasta el próximo coche traspasa. Ese sistema, con el empleo de un despachero jefe, para constar el horario de los coches, ha sido muy eficaz en impedir retardos y casualidades.

Motores para tranvías eléctricos.—I: Formas de electro imán, por George T. Hanchett . . . . . [Pág. 406.]

Eso es el primo de una serie de artículos describiendo las formas actuales de motores de tranvías eléctricos, las ventajas y desventajas mecánicas y eléctricas de cada uno, los mejores métodos para reparar motores, etc. El artículo en el número presente describe las varias formas de motor electro-imán que son en uso, explicando la superioridad de ciertas formas sobre otras, y describe los métodos en uso para arrollar los inductores.

Los resultados financieros de la tracción eléctrica y de cable en los Estados Unidos . . . . . [Pág. 409.]

Eso es el tercero de una serie de artículos sobre ese sujeto. El

presente artículo trata de la situación financiera de dos compañías bien conocidas de tranvías en poblaciones de 75,000 y 100,000 habitantes. El artículo está ilustrado por medio de diagramas explicativos.

Tranvías en Italia, por E. Lavalard, "Membre du Comité de Direction" de la Compañía General de Omnibus de Paris. [Pág. 412.]

Relación del desarrollo de ferrocarriles de vía estrecha en Italia, con una breve revista de la condición actual de los tranvías en varias poblaciones de primer ordén. El autor, durante un viaje reciente en Italia, fué muy sorpreso por las condiciones favorables para la breve aplicación de la tracción eléctrica sobre muchas líneas de tranvías en Italia.

Sobre el propio modo de manejar contralores, por J. R. Cravath. [Pág. 412.]

En esta comunicación parece una crítica del artículo de N. H. Heft, en el número de Junio, afirmando que "cuando la corriente está lanzada bruscamente al mover el coche, la economía en consumo de potencia está mayor de que cuando no se hace tan rapidamente."

La tarifa sobre la mica, por C. W. Jefferson . . [Pág. 413.]

Duración de ruedas, engranajes y piñones, por M. R. McAdoo, Director General de la "Paterson (N. J.) Railway Company." [Pág. 414.]

Son dadas tablas de numerosas ruedas, piñones y engranajes de coches, en respeto de sus servicios actuales sobre la red de la compañía ferroviaria "Paterson Railway Company."

Jurisprudencia. . . . . [Pág. 415.]

Artículos de la Redacción.

Asociación de los Contadores de Tranvías de América. [Pág. 418.]

Nuestro suplemento financiero de compañías de tranvías en América. [Pág. 418.]

Decisión legal en Indianapolis en respecto de precios reducidos. [Pág. 418.]

Comparación de las recetas brutas de compañías de tranvías américanas . . . . . [Pág. 418.]

El Código National Eléctrico de reglas para la seguridad de los alambres . . . . . [Pág 419.]

Perspectiva de los negocios para el año próximo . [Pág. 419.]

Plano de una estación de fuerza motriz para ferrocarriles eléctricos. [Pág. 420.]

Revista de la controversia recientemente publicada en el STREET RAILWAY JOURNAL en respeto de la estación de fuerza motriz de la "Chicago City Railway Company."

Construcción.

Sobre el establecimiento de cuadros de distribución en estaciones centrales, por George Moffat . . . . [Pág. 421.]

Discusión del material más propicio para la construcción de cuadros de distribución, del mejor sitio del cuadro, etc. Son describidos algunos yerros comunmente cometidos en el establecimiento de cuadros de distribución, así como sugestiones de valor sobre los mejores métodos para inspeccionar y limpiar los cuadros.

El ferrocarril subterráneo de Central Londres . [Pág. 423.]

Este ferrocarril, cuya construcción fué comenzada el año precedente, consta de un tunel doble, cada uno de los tuneles midiendo 10½ kilómetros de longitud, y traviesa el districto central del negocio de Londres, á una profundidad media de 19 á 22 metros. Los tuneles son construidos según el sistema "Greathead," y tienen un diametro de 3½ metros. A las estaciones el diametro del tunel es de 6.30 metros sobre una distancia de 115 metros. Los pendientes dentro del tunel van ascendiendo en dirección de las estaciones, y descendiendo á la partida, para facilitar el alto y la salida de los trenes.

La instalación será toda eléctrica, y serán empleadas locomotoras, por tanto que el diametro estrecho de los tuneles no permite la colocación de los motores sobre los ejes del coche. El sistema alterno y trifásico será en uso para los feeders, y la corriente directa de 500 volts en los tuneles para los motores. La estación central constará de seis generadores trifásicos de 850 kilowatts cada uno con un voltaje inicial de 5000 y una frecuencia de 25. Serán empleadas treinticinco locomotoras del tipo "Gearless," proveedas con cuatro motores cada una. Los trenes serán compuestos de siete coches, con una capacidad total de 336 personas.

La línea de transmisión de potencia eléctrica entre Niagara Falls y Buffalo, por J. G. White . . . . . [Pág. 425.]

Eso es una descripción por el constructor de la línea para transmitir la potencia eléctrica desde Niagara Falls hasta Buffalo. Se hace uso de alambre descubierto y el voltaje es de 10,000. Los apoyos son colocados á una distancia de 23 metros en línea recta, y en proporción más arrimados en curva. Son colocados en pares, y juntados por ligaduras. Los aisladores son de porcelana, y son probados hasta 40,000 volts en salmuera. La fuerza aisladora de la porcelana fué demostrada depender casi totalmente de la perfección de su vitrificación, y muy poco de su espesor. La línea tiene una longitud de más de 40 kilómetros, y una sección de ella, midiendo 1250 metros, está subterránea. La corriente de la sección subterránea pasa á traves de cables cubiertos de plomo, con una envolvente aisladora de caucho. Los cables son establecidos en cañerías de tierra cocida. La eficiencia actual, como fué demostrado por el wattmetro en el circuito alternativo de baja tensión á Niagara, y por el circuito de corriente continua de 500 volts á Buffalo, fué de 79.6 por ciento, por un tiempo considerable y una carga variable. La eficiencia incluyó la pérdida en los transformadores de descensión, de línea, de ascensión, y de rotación. El costo hubiera sido tres veces superior con una línea subterránea, y la depreciación mucho mayor.

Aplicación de la eléctricidad á ferrocarriles de vapor, por P. E. Brangs, Ingeniero Electriciano de la compañía "Delaware, Lackawanna & Western Railroad" . . . [Pág. 427.]

La concurrencia de los tranvías de "trolley" para el tráfico suburbano ha sido tan desastrosa á los ferrocarriles de vapor, que en varios casos sus recetas han disminuido considerablemente, y en unos casos las compañías de vapor han establecido un servicio de trenes más frecuente, y reducido las tarifas en un esfuerzo de retener el tráfico. El autor cree que la instalación eléctrica podría ser adaptada con éxito sobre las vías de las compañías de vapor, sin intermeterse con el tráfico de vapor, y que los gastos para la reparación de la instalación eléctrica no serían más de los 30 por ciento de la reparación del sistema de vapor. Está concedido el facto que la locomotora es una máquina que no es balanzada, y que no puede construirse otramente. Las partes móviles de una locomotora de vapor pueden ser balanzadas, sea en un sentido vertical, ó un sentido horizontal, pero no en ambos. La compañía ferroviaria "New York Central Railroad" ha obtenido resultados hasta 3½ kilogramos de carbón por caballo y por hora, pero las condiciones soto las cuales esos ensayos fueron hechos son de tal modo que es muy difícil, sino imposible, de obtener resultados actuales, y es muy dudoso si el trabajo medio diario de locomotoras de gran velocidad puede demostrar resultados muy inferiores á 1.81 kilogramos de carbón por caballo por hora 2.27 kilogramos en tráfico urbano, 2.72 kilogramos para tráfico de mercancias, y 9.06 kilogramos por caballo por hora en máquinas de traslación. De otra parte la eficiencia media de máquinas fijas de gran tamaño es cerca de 0.91 kilogramos de carbón por hora. No recomenda el autor el uso de un tercero carril sin protección. Afirma que ha personalmente sostenido un choque de 600 volts sin afecto permanente.

Ciencia. — Ingeniería. — Invenciones.

Carretones giratorios para servicio eléctrico . . [Pág. 430.]

Se ha observado que la tendencia más notable en la práctica de ferrocarriles eléctricos durante el año corriente ha sido un aumento en el uso de carretones giratorios. La teoría antigua que fué preciso un solo carretón sobre pendientes fuertes, ha sido confutada por pruebas numerosas en California y otras partes, demostrando que con el uso de un carretón giratorio ascendán coches eléctricos á un pendiente de 14½ por ciento. El artículo describe el método por modo del cual eso es efectuado, así como el carretón que se emplea. La construcción del carretón está descrita, con diagramas demostrando que con una rueda de 1.60 metros y una anchura de coche de 2.20 metros, el fondo del coche puede ser mantenido dentro de 72 cm. de la cabeza del carril, y que aún el coche puede pasar una curva con un radio de 8 metros. Este carretón está particularmente adaptado para coches con imperial.

Frenos de fuerza para coches eléctricos, por G. E. Pratt. [Pág. 431.]

Revista de unas de las razones para la adopción de frenos de fuerza sobre coches eléctricos.

Bombas de fuerza "Triplex" . . . . . [Pág. 431.]

Descripción de una nueva clase de bombas de fuerza recientemente introducidas, con tres cilindros y émbolos.

Carretones giratorios . . . . . [Pág. 432.]

Descripción de un carretón giratorio diseñado por el uso de coches cuyas ruedas tienen una dimensión limitada á 1.25 metros. Fué preciso sospender los motores fuera de los ejes en lugar de hacía dentro. El empleo de barras de apoyo y de un aparejo de frenos especiales fué necesario. Este carretón está particularmente adaptado para tranvías con corvas muy estrechas y para servicio de gran velocidad y pesado.

Los nuevos motores para el servicio de gran velocidad. [Pág. 433.]

Descripción de cuatro motores construidos por la misma casa, la potencia del mayor siendo 200 caballos.

Generador de conversión á corriente continua y de voltaje elevado [Pág. 435.]

Un nuevo motor G. E. 52 . . . . . [Pág. 436.]

Descripción detallada de un nuevo motor con una potencia de cerca de 28 caballos.

Disposición de metal viejo . . . . . [Pág. 437.]

Nuevo ferrocarril eléctrico de cañería en secciones . [Pág. 438.]

Coches para la compañía de tracción de "Cincinnati & Miami Valley" . . . . . [Pág. 439.]

Máquina compound de cuatro valvulas . . . . [Pág. 440.]

Lancha eléctrica para excursiones . . . . [Pág. 440.]

El coche motor "Patton" . . . . . [Pag. 441.]

Material de aisladores para alambres aéreos. . . [Pág. 441.]

Financial Notes.

Baltimore, Md.—The Columbia & Maryland Railway Company has recorded two mortgages for $3,000,000 each as security for an issue of $6,000,000 in 5 per cent bonds, the proceeds of which are to be used to finish the electric railway between Baltimore and Washington, and to pay the indebtedness of the Catonsville Construction Company. The mortgage is dated Dec. 1, 1896, and is payable, one-half June 1, 1941, and the remainder June 1, 1947. It is understood that new contracts will be let for the completion of the line.

THE Baltimore City Passenger Railway Company, has declared a semi-annual dividend of 5 per cent, payable July 1.

Battle Creek, Mich.—The controlling interest in the Citizens' Street Railway Company, which has been held by E. E. Downs, a Kalamazoo capitalist, was sold recently to L. N. Downs and Dee Allen, of Battle Creek. F. J. Griswold becomes secretary and general manager of the company to succeed E. E. Downs.

Boston, Mass.—The Norfolk Suburban Street Railway Company has declared a regular semi-annual dividend of 3½ per cent, payable July 15, to stockholders of record June 30.

Brockton, Mass.—The Brockton Street Railway Company has declared a quarterly dividend of 1½ per cent.

Buffalo, N. Y.—The Buffalo Railway Company has declared a quarterly dividend of 1 per cent.

Charleston, W. Va.—Attorney C. B. Couch, receiver of the Charleston Street Railway Company, has applied to the Circuit Court, for authority to sell the property and franchise of the company at public sale. The claims against the company amount to about $45,000.

Chicago, Ill.—Receiver McKeon, of the Calumet Electric Street Railway Company has applied to the court for permission to borrow $200,000 on 6 per cent certificates, the same to be a first lien on the road after the $123,000 mortgage bonds. The money raised will be used to pay present debts, build a new power house, extend the tracks and pave streets.

JOHN A. ROCHE has been appointed receiver for the Suburban Construction Company.

Dallas, Tex.—The property of the Dallas Consolidated Traction Company has been sold to C. H. Alexander and I. S. Randel, of Dallas. The purchasers propose to make extensions and improvements at once.

Dayton, O.—It is rumored that The People's Railway Company and The City Railway Company, of Dayton, O., will be consolidated.

East Liverpool, O.—The East Liverpool Railway Company has recently issued bonds to the amount of $300,000 for the purpose of raising money to purchase new equipment.

Gettysburg, Pa.—The property and franchises of the Gettysburg Electric Railway Company were sold at public auction on June 10 for $50,000, to Horace A. Dean, of Philadelphia, president of the West End Trust Company, Max Riebenack and Luther S. Bent, president of the Maryland Steel Company.

Ithaca, N. Y.—The controlling interest in the Ithaca Street Railway Company, the Brush-Swan Electric Light Company, the Ithaca Transfer Company and the Cayuga Lake Electric Railway Company, formerly owned by Alfred Hand, of Scranton, Pa., has been sold to E. G. Wyckoff and H. Bergholtz, of Ithaca. Mr. Wyckoff has been elected president of these companies and Mr. Bergholtz will continue to act as treasurer and manager.

Jackson, Mich.—The transfer of the Jackson Street Railway, which has been under negotiation for several months past, has been practically completed. The purchaser is W. A. Bolan, of Lynn, Mass., as trustee for an Eastern company. The new company agrees to expend at least $40,000 at once in refitting the line, to put on six new summer cars and to extend the line to Vandercook's Lake, 4 miles south of Jackson.

Kalamazoo, Mich.—Eastern capitalists have recently purchased the rights and franchises of the Michigan Traction Company and have been over the proposed road connecting Battle Creek and Kalamazoo. It is likely the road will be built by them this year. All the franchises and rights of way have been obtained and engineers are now making a survey. The Gull Lake resort, which will be an important feature of the new line, is already in the hands of parties identified with the proposed road.

Marion, Ind.—The Indianapolis, Anderson & Marion Railway Company has issued $500,000 first mortgage 6 per cent bonds to the Farmers' Loan & Trust Company, of New York, to secure money for the construction of its lines.

Meadville, Pa.—The Meadville Traction Company has issued $300,000 bonds to secure money for the construction of its lines.

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Meridian, Miss.—The property and franchises of the Meridian Street Railway Company have been sold to John Kamper, of Enterprise, who will improve and extend the lines. New cars, a new engine and new rails will probably be purchased.

Milford, Mass.—The Railroad Commissioners have granted the Milford, Holliston & Framingham Street Railway Company the right to issue $60,000 stock to purchase and cancel the stock of the Milford & Hopedale Street Railway Company, to extend the line through Bellingham to Medway, and to issue $160,000 bonds.

New Philadelphia, O.—Negotiations are being made to consolidate the Tuscarawas Electric Railway which operates between Canal Dover and New Philadelphia, and the Tuscarawas Street Railway Company, whose line was built last year between New Philadelphia and Uhrichsville.

Newton, Mass.—The Newton & Boston Street Railway Company has petitioned for permission to increase its capital stock from $100,000 to $225,000 for the purpose of extending its lines in Newton and Needham.

New York, N. Y.—It is reported that the Metropolitan Street Railway Company is about to issue $11,500,000 in new bonds.

The directors of the Manhattan Railway Company have declared the regular quarterly dividend of 1 per cent.

The Metropolitan Traction Company has declared a dividend of 1¼ per cent, payable July 15.

Norfolk, Neb.—The Norfolk Street Railway has been sold at auction for $55.

Pittsburgh, Pa.—The Pittsburgh, Allegheny & Manchester Traction Company, of Pittsburgh, has decided to make a new mortgage of $250,000 at not over 5 per cent. At present only about

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See page 81.

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$150,000 of the bonds will be used, this being the amount required to fund the company's floating debt, which amounts to $162,000 and which is bearing interest at the rate of 6 per cent. The officers of the company already have practically arranged with a Pittsburgh trust company to float the present issue of the new 5s. The net earnings of the company in the year ended Apr. 30 were $155,000, against $126,000 in 1896.

ALEXANDER BROWN & SONS have agreed under certain conditions to purchase $4,000,000 of the bonds of the United Traction Company, which is a consolidation of the Second Avenue Traction Company, the Federal Street & Pleasant Valley Railway Company, and the Pittsburgh, Allegheny & Manchester Traction Company. The new company will issue $10,000,000 of 5 per cent bonds, $3,000,000 preferred stock and $7,000,000 common stock. In addition to the purchase of the bonds, Alexander Brown & Sons will probably take a large amount of the stock of the new company.

JUDGES WHITE AND FRAZER have appointed the Fidelity Title & Trust Company receiver of the McKeesport, Duquesne & Wilmerding Railway, with authority to operate it under order of Court.

Reading, Pa.—The stockholders of the East Reading Electric Railway Company have voted to increase their funded debt $25,000. The bonds will bear 5 per cent interest and upwards of $15,000 of the issue has already been subscribed for. The money will be used for the construction of an extension to Carsonia Park.

Savannah, Ga.—The consolidation of the Savannah street railways, which has been long delayed, has just been completed by the union of the Savannah Traction Company with the Savannah, Thunderbolt & Isle of Hope Railway Company.

Stillwater, Minn.—Stillwater citizens are endeavoring to raise a bonus of $2500 to be given to August Jesse, who contemplates buying and operating the Stillwater Electric Railway.

Washington, D. C.—The Capital Railway Company, of Washington, D. C., has decided to issue $300,000 in bonds for the purpose of providing funds for the construction of two branch lines.

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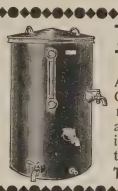
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The bonds are secured by a deed of trust given by the Washington Loan & Trust Company for the amount named. The officers of this company are: president, A. E. Randle, secretary and treasurer, Edw. H. Way. The company has also declared a dividend of sixty cents per share, payable July 1.

Waverly, N. Y.—The Waverly, Sayre & Athens Railway Company has consolidated with the Waverly Electric Light & Power Company, and a new company has been formed by the election of the following officers: president, A. C. Wade; vice-president, Percy L. Lang; secretary and treasurer, A. N. Broadhead. Many improvements will be made.

Winchester, Mass.—The Railroad Commissioners have approved an issue of $50,000 capital stock by the Arlington & Winchester Street Railway Company. Of this $35,000 is for roadbed and track, $9000 for overhead electric construction and $6000 for rolling stock. The length of the proposed road is 3 miles. Charles F. Woodward, of Wakefield, is president.

Worcester, Mass.—There was a conference recently between the directors of the Worcester & Suburban Street Railway Company and the owners of the Worcester & Blackstone Valley Street Railway Company, relative to the purchase or lease of the latter road by the former.

Cannot Consolidate.

Receivers Cowen and Murray, of the Baltimore & Ohio Railroad, say that a consolidation of the Baltimore & Ohio and the Baltimo e & Ohio Southwestern is an impossibility under present conditions. The former road is in the hands of the United States Court, while the Baltimore & Ohio Southwestern has a separate organization and is not in the hands of receivers. Consolidation could only be effected by both lines being on the same basis and by the consent of all the bondholders. The consolidation step has not even been considered by the Baltimore & Ohio people.

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ELECTRICAL ENGINEERING DEPARTMENT
University of Illinois

Street Railway Journal.

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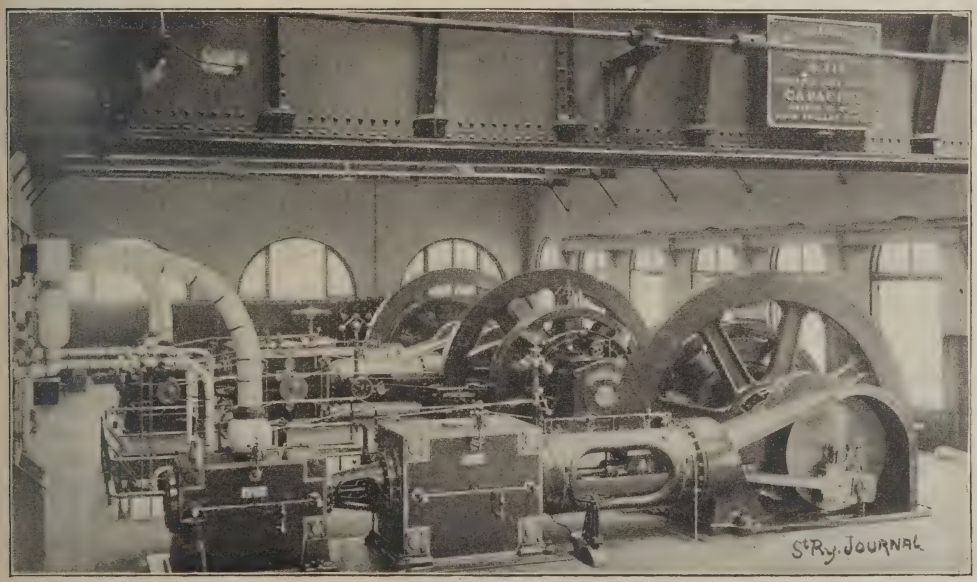
THE ELECTRIC TRANSPORTATION SYSTEM OF FAIRMOUNT PARK, PHILADELPHIA.

One of the most interesting and novel electric lines in this country is that recently installed within the confines of Fairmount Park, Philadelphia. This attractive park is the largest and most important of the public pleasure resorts in Philadelphia, and in fact is the largest public city park in the world and covers 2740 acres. It is attractively located on both sides of the Schuylkill River, which divides West Philadelphia from the older part of the city and is quite accessible from the latter, the entrance on Twenty-fifth and Spring Garden Streets being only about a mile in a direct line from the City Hall. The park way have always been defeated, owing to the fear that the construction of a transportation system would destroy or seriously injure the natural attractiveness of the park. The subject was again taken up, however, several years ago, and plans were prepared, showing how an electric line making a circuit in the park could be built without a great destruction of the natural scenery, and after much debate among the Park Commissioners a franchise for such a line was finally granted the Fairmount Park Transportation Company. The result is so at variance with the popular idea that a railroad line, and particularly a trolley



ENGINES AND GENERATORS—FAIRMOUNT PARK POWER STATION.

is noted for natural attractions and artificial improvements, as well as for its extent, in all of which it ranks among the first in the world among similar undertakings.

Although traversed by many fine carriage drives and walks, the very size of the park which, like the city, was laid out with exceedingly generous proportions, has made many portions of it inaccessible to all except sturdy pedestrians or those who could drive or ride to the points farthest distant from the entrances. In this way many of the most beautiful localities within its borders have been practically unknown to the large mass of citizens; but the proposals which have been made from time to time heretofore to open these portions to visitors by means of a railroad, is necessarily conspicuous and must detract in a park from the natural scenery, that a description of the methods by which the results are reached will be of interest.

On reaching the park the visitor's first surprise is to find the cars standing in the edge of the lawn with almost nothing suggesting a railway in sight. While the usual overhead work is in place it is not conspicuous, owning to the openness of its surroundings, while on the ground only two rail heads are seen stretching away through the grass. The space between the rails is completely filled in and sown with grass. The element of danger is eliminated by avoiding, from one end of the park to the other, every grade crossing of even a foot path. The line dips sharply under

many of the carriage ways; it winds along valleys, clings to the hillsides, follows up and down ravines, and is as utterly unobtrusive as two lines of iron could be on the landscape. Conforming so closely to the contour of the land there are few embankments or cuttings that are even noticeable features in the landscape until one is close upon them. Even the power station and car house are hidden from sight as will be described later.

The line has a length of 8½ miles, along which stations are constructed at distances of about three-quarters of a mile apart, and at these stations only are passengers allowed to enter or leave the cars. The road being in the form of a loop, the cars run in one direction only. For short distances at the southern and eastern ends the tracks lie parallel, but for the remainder of the distance they are widely separated. The whole line is enclosed by a wire fence of twisted steel. The track is laid with 90 lb. T rail laid on yellow pine ties 6 ins. × 8 ins. × 8 ft. in size and spaced 2 ft. centers. The rails are bonded with the Brown plastic bond. All switches are of standard steam railroad pattern. As all banks and cuts are seeded with grass they are of a different slope than is usual. Those on banks and cuts less than 10 ft. deep are proportioned as one to three, and on cuts or banks more than 10 ft. in depth the proportion is one to two. The track and special work was supplied by Wm. Wharton, Jr. & Company.

In preventing grade crossings over drives and pathways, the company has constructed a number of viaducts, stone arches and iron bridges, the total number of which is twenty, including a bridge over the Schuylkill River. The character of these structures is as follows. three stone arches across the double track line are 32 ft. wide × 102 ft., 75 ft. and 106 ft. long; three are 16 ft. wide × 60 ft., 55 ft. and 52 ft. long; four are 10 ft. wide × 17 ft. long; one is 16 ft. wide × 17 ft. long. There is also one double track girder bridge with 85 ft. span, one single track girder bridge with 50 ft. span, four viaducts with a combined length of 960 ft. and one bridge over the Schuylkill River 1227 ft. long. This latter has a double track for the railway, a 40 ft. wide carriage drive, and a 12 ft. wide sidewalk. The height from the drive to low water is 80 ft. This bridge has four river arched spans each 208 ft. long.

SIDE AND END VIEWS OF CAR HOUSE.

TYPICAL PASSENGER STATION—FAIRMOUNT PARK.

The rolling stock consists of sixty cars, ten of which are closed motor cars. Of the fifty open cars twenty are fitted with motors and the remainder are trailers. All the cars are of unusual width, being 7 ft. 10 ins. in the clear at the seats. The gage is 5 ft. 2¼ ins. The closed cars have 32 ft. bodies and are 42 ft. over all. They are 8 ft. 9½ ins. wide at the posts. The sills run through to the end of the platforms, which are 4 ft. 6 ins. wide and are flush with the car floor. These cars seat forty-eight passengers in cross seats which are 35 ins. long and have a 21 in. aisle between them. This broad aisle with the great width of the flush platform makes entrance and egress very easy and rapid. The seats are stationary, placed back to

back and have spring cane seats and cane backs. There are wood grills on the top of the seat backs. The cars are lighted with three 3-light clusters and a light on each platform. Each car is fitted with Wittingham electric heaters and International registers.

the clear, ample room is given those entering or leaving a seat. The spaces are the same as those in the Broadway cars in New York City, and in the case of a crowd there is ample standing room for a row of people in front of those who are sitting. There are eight reversible seats

VIEWS IN FAIRMOUNT PARK, SHOWING TRANSPORTATION SYSTEM.

The open cars were also specially designed for the service and differ essentially from other cars of a similar type. In length they measure 47 ft. over the crown pieces or 38 ft. at the corner posts. The width over the posts is 8 ft. 10 ins. This gives a long seat which accommodates six persons comfortably. As the seats are spaced 3 ft. in and four with stationary backs, giving a seating capacity of seventy-two. The seats and seat backs are of cherry and maple strips. The trimmings of all the cars are of solid bronze. The open cars are fitted with the round end seat panels. These doubly curved metal panels not only permit the curtains to come down to the floor without

catching and without friction, but they give more room at the seat opening, making access much easier. This has had much to do with the ease with which the road has handled the large crowds without accidents of any kind. In one day during the present season it has carried as high as 87,000 passengers. Ash grab handles are fitted to the posts. There are three 3-light clusters in the roof, giving a very brilliant illumination at night. The cars were designed and manufactured by the J. G. Brill Company.

The cars are mounted upon 27-B trucks, a modified form of the "Perfect truck" of the same firm. These trucks are equalized, and have a swing motion which is cushioned by means of springs within the swinging links. This feature makes them very easy and steady on curves even when going at a high rate of speed. A long elliptic spring on each side is so arranged as to take the place of the equalizer. The general design of the truck is seen in the engraving of the closed car. They give a short wheel base, bring the body of the car low and do not kick up under the action of brakes. This road tests the riding qualities of the cars most severely as it is full of curves, many of them of quite short radius. Under these conditions the trucks are riding with remarkable ease and smoothness.

STANDARD OPEN AND CLOSED CARS.

The electrical equipment consists of four motors to a car and electric brakes acting on all axles, on the trailer cars as well as motor cars. The cars are equipped with G. E. 1000 motors and controllers, specially manufactured for the Fairmount Park Transportation Company, controlling both motors and brakes. The operation of the road is protected with the Hall block signal system.

EXTERIOR VIEW OF POWER STATION.

The overhead construction work of this line is one of the most substantial in the country and is of a peculiar nature, owing to the heavy traffic and the location of the road through a series of rock and clay cuts, over high earth embankments and through and over stone and iron viaducts.

Over 60 per cent of the poles are set in solid rock and about 15 per cent are of special lengths and construction, varying all the way from a 28 ft. pole, weighing 750 lbs., to a pole 65 ft. long, weighing 2800 lbs. There are three standard weights of poles on the line—on straight track a 7 in. × 6 in. × 5 in., 28 ft. pole, weighing 750 lbs.; for pull-offs and special strains a 1000 lb. pole, of same dimensions, and for special strains, at the end of the line, an 8 in. × 7 in. × 6 in., 28 ft. pole, weighing 1800 lbs. The poles are set in concrete 6 ft. deep, in 2 ft. diameter holes. On straight track, poles are spaced 100 ft. apart, and on curves 50 ft. apart.

The span wires are $\frac{7}{16}$ in. diameter steel cable, insulated from poles by special heavy Macallan turnbuckles. The trolley wire is attached to the span wire through a special cap and cone insulator. The trolley wire is a No.

0000, and it is held in the insulators by soldered ears weighing a little over double the standard weight ear used on No. 00 construction work. The wire is spliced with heavy copper sleeves. All feeder taps are provided with 600 amp. single switches, heavy line brakes and General Electric Company's lightning arresters. On double track, the trolley wires are cross connected every 1000 ft. Under bridges, of which there are a large number, the trolley wire is secured in heavy yellow pine troughs with standard cap and cone barn hangers. All curve work is of exceptionally heavy construction, owing to the use of heavy No. 0000 trolley wire and the constant traffic.

SOUTH ELEVATION OF POWER STATION.

The feeders are underground and are laid in 2½ in. Williamsport creosoted wooden ducts. Roebling paper covered feeders are used. This feeder system runs across a number of valleys containing streams of water and many of the manholes are 20 ft. deep. The contractors for the overhead and underground systems were Pepper & Register. Mayer & Englund supplied the overhead appliances.

The car house measures 110 ft. × 425 ft. and is shown on page 460. As will be seen, it is in a ravine and is almost entirely concealed by trees. The building itself is sunk 10 ft. in the ground so that the roof is but little above the surrounding surface. At the end where the building looks out toward the river a tremendous bank of earth has been raised, 30 ft. or 40 ft. high upon the outside. It contains perhaps 20,000 cu. yds. and not only is a safeguard against the possible escape of a car if it should break through the wall of the building, but completely hides the structure from the river. This building also contains rooms for offices and will have space for shops, etc. It is a handsome brick structure quite as creditable as many of those already erected for ornamental purposes within the park.

ENTRANCE TO ONE OF THE ARCHES.

A short distance below the car house is situated the engine and boiler house. This building was designed by Axel H. Engstrom and Edw. B. Ives and is also much below the surrounding level. The stack is only as high as the roof of the house itself, and from a little distance the building is entirely hidden from sight by the tree covered banks.

The engine room is 156 ft. × 55 ft. in size, and the boiler room of the same length and 36 ft. wide. A spur from the adjacent railroad is carried close to the south wall of the boiler room and passes over coal vaults, the coal being dumped into the vaults by means of chutes. The station has sufficient storage capacity for one month's supply of coal.

At present there are installed three tandem compound condensing Corliss engines, furnished by Robert Wetherill & Company. There is room in the station for two more engines. The engine foundations are of brick and of unusually large proportions. Each foundation rests upon one of the two concrete beds shown by dotted lines in the plan. This bed of concrete is 24 ins. in thickness. The engines have cylinders 20 ins. and 36 ins. × 48 ins. in size, and each makes 90 r. p. m. The flywheel is 20 ft. in diameter and weighs 40 tons. It is made in sections, an arm being cast with each rim section. The rim segments are tied together by heavy wrought iron links. Each engine is directly connected to a 500 k. w. generator, furnished by the General Electric Company.

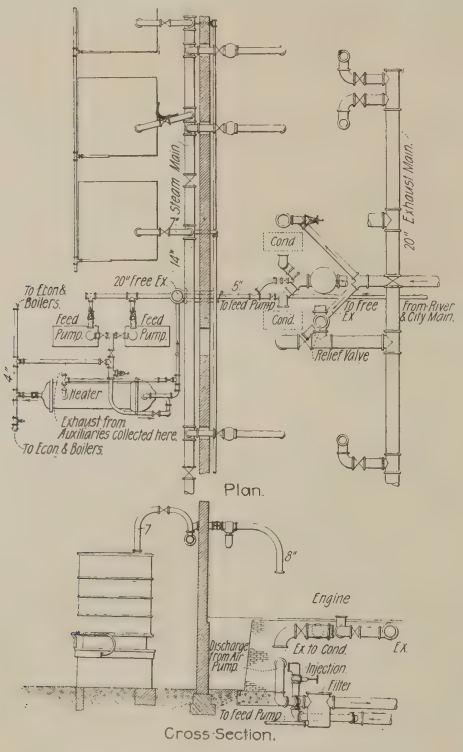
The boiler room at the present time contains six Berry boilers, built by Wetherill & Company, and space has been provided for the installation of two more. Each boiler is of the vertical type, occupies a floor space of 11 ft. × 11 ft. in size, and is rated at 250 h. p. The gases from the boilers pass to an overhead smoke flue leading to two sets of economizers, from which the waste gases are exhausted by a pair of exhaust fans discharging into a short steel stack 7 ft. in diameter. The economizers are so connected to the flues that one set receives the waste gases from the boilers at one end of the boiler room, while the other receives the waste gases from the other boilers. All of the waste gases, however, may be passed through either economizer. A single fan, 10 ft. in diameter and 4 ft. wide, driven by a direct connected engine, exhausts each economizer, and both fans discharge into a common stack. The fans and economizers were furnished by the American Economizer Company. The economizers have 256 pipes each. The sections are eight pipes wide and each pipe is 4¼ ins. in diameter and 9 ft. 4 ins. long. Each economizer has a heating surface of 2944 ft.

The arrangement of the steam piping is shown on the next page. A 7 in. steam pipe from each boiler rises, and bending in the form of a semi-circle, drops into a 14 in. main in the boiler room. The valve is located in the highest part of the feeder, so that condensation cannot collect on either side of it. An 8 in. pipe leading from the top of the main passes the wall and over to the engine, dropping to the throttle valve. Each supply pipe to the engine is provided with a valve close to the wall, and also with a separator.

The steam main in the boiler room is divided into

three sections by two gate valves and each valve is provided with a by-pass. The boiler room steam main and each separator from the steam pipe to the engines has 1½ in. drip pipes all connecting with a 3 in. drip main, which is connected to an automatic pump and receiver, returning the water to the boilers. The exhaust steam from the engines passes into a 20 in. exhaust main located under the floor of the engine room, as shown by Fig. 3. This main is divided into two sections by a 20. in. valve and each section has a pipe leading to a twin vertical air pump made by the George F. Blake Manufacturing Company, connected to a jet condenser. A branch from the exhaust pipe to the condenser 16 ins. in size, and fitted with a relief valve, unites with the free exhaust from the other half of the system to form a 20 in. pipe leading to the atmosphere.

The steam cylinders of the air pump are 12 ins. in



PLAN AND CROSS SECTION OF STATION PIPING.

diameter, and the bucket of the air pump, which is single acting, is 25 ins. in diameter. Each has a stroke of 18 ins. The injection water is taken from the adjacent Schuylkill River through a 16 in. pipe. These mains pass to the condensers in a trench between the two concrete beds underneath the engine foundations. The discharge from both condensers is 16 ins. in size, and leads back to the river.

All of the auxiliaries of the plant, such as the air pumps from the condensers, drip and feed pumps, fans, engines, etc., are supplied by branches from an auxiliary steam main supported from the wall of the engine room. The exhaust steam from all of these auxiliaries is collected into a 6 in. pipe and passed through a Berryman feedwater heater with 1000 sq. ft. of heating surface from which the surplus exhaust steam passes into the free exhaust pipe from the main engines. The heater, however, may be bypassed if desired. The boiler feedwater may be taken either from the river or from the discharge from the condensers. The water, which is taken from the discharge from the condensers, is passed through a filter made to remove the oil in order that it may not enter the boilers.

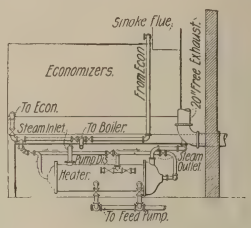
The boiler feed pumps are two in number and the water is forced by them through the feedwater heater where it is raised to about 200 degs. temperature, and from the heater either directly to the boilers or through the fuel economizers as desired. The fuel economizer may also be by-passed if desired.

The following is a report of a test made Feb. 9, by Axel H. Engstrom, chief engineer of the company, of one engine and two boilers of the station.

This test was conducted to determine the economy of engines and boilers, and for this reason condenser pumps, feed pumps, fan engines, etc., were furnished with steam from a separate boiler.

The feedwater for the boilers which were being tested was measured by a Worthington water meter.

The electrical measuring instruments were calibrated before and after the test by the Weston Electrical Instrument Company, four voltmeters, two amperemeters and one Thomson recording wattmeter being used.



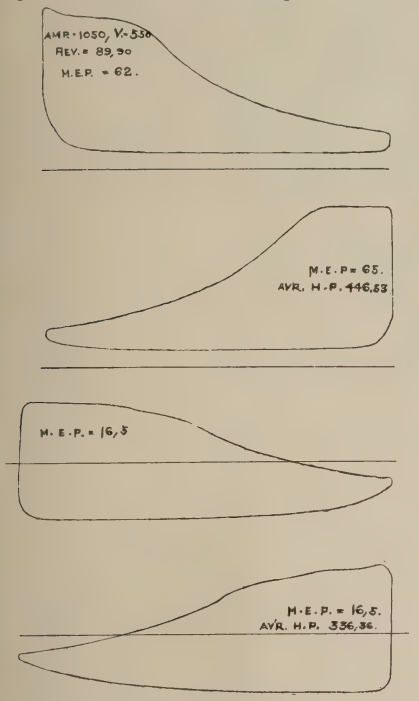
PIPING AROUND HEATER.

The indicator cards shown were taken of average load for five hours. The load was applied to the generators by means of a water rheostat of ample capacity. Live steam was not used in the receiver.

TEST MADE FEB. 9, 1897. DURATION OF TEST, TEN HOURS.

Total kilowatt hours	4,859.6	
Average output per hour in kilowatts	485.96	
Total electrical horse power hours	6,511	
Average current density in amperes	884.2	
Average potential pressure in volts	549.6	
Total indicated horse power hours	7,868.9	
Average indicated horse power hours	786.89	
Pounds of steam per indicated horse power per hour	14.42	
Combined effort of engine and generator as a unit	84%	
Total amount of water evaporated	113,511	lbs.
Water evaporated per pound of coal	9.79	"
Water evaporated per pound combustible	11.27	"
Total amount of coal burned	11,589	"
Coal burned per indicated horse power hour	1.473	"
Coal burned per electrical horse power hour	1.743	"
Coal burned per kilowatt hour	2.332	"
Water evaporated from and at 212° per pound coal	11.76	"
Temperature of water at hot well	96.51°	
Temperature of water leaving heater	174.02°	
Temperature ot water entering boilers	216.1°	
Temperature of gases leaving boilers	402.5°	
Temperature of gases entering economizer	350°	
Temperature of gases leaving economizer	230°	
Steam pressure in boilers	140	lbs.
Steam pressure in horse power cylinder	134	"
Steam pressure in receiver	14.5	"
Vacuum in inches	25.5	"
Average draught at boiler	0.15	in.
Average draught at fan	0.19	"
Revolutions per minute of fan wheel	17	
Percentage of combustible in one pound of coal	86.83	
Moisture in coal	1.17%	
Percentage of ash in coal	12 %	
Type of engines	Tandem compound condensing.	
Manufacturer of engines	Robert Wetherill & Company.	
Rated horse power	750 h. p.	
Speed at rated power	90 revolutions.	
Cylinder dimensions	20 ins. × 30 ins. × 48 ins.	
Speed of engines during test	89 revolutions.	

No. of engines tested . . . . . One.
Type of boilers . . . . . Berry.
Manufacturer of boilers . . . . . Robert Wetherill & Company.
Rated horse power . . . . . 250 h. p.
Boilers in use . . . . . Two.
Horse power developed per boiler . 187.68 h. p.



NOTE:—When live steam is used in receiver, the consumption of steam per horse power per hour has been found to be 13.8 lbs.

STEAM ENGINE INDICATOR DIAGRAMS DURING TEST.

The cost up to date for the 8½ miles of line is estimated at $2,000,000, including $500,000 paid for the franchise. To earn returns on this investment a large traffic is, of course, necessary, as the fares are limited to five cents per passenger, independent of the length of ride. The traffic so far has been enormous, and points to a most successful financial return upon the investment. Thirty five hundred passengers have been carried in one day, the maximum load in the station on this day being 3400 amps. while the running expenses were $300

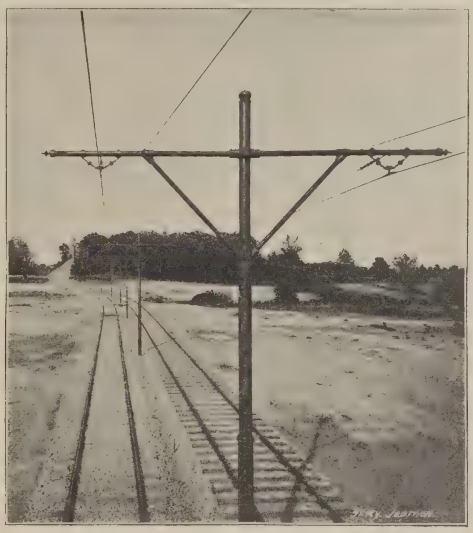
The officers of the Fairmount Park Transportation Company are: president, James Rawle; vice-president, John W. Henderson; secretary and treasurer, Ellsworth H. Hultz; chief engineer, Axel H. Engstrom.

Electric Mail Service in Maine.

The Rockland (Me.), Thomaston & Camden Street Railway is the first electric railway in Maine to carry the U. S. mails. A separate compartment has been fitted up in a car expressly for the mail service; mails are collected and distributed along the line of the road. The car is 28 ft. long over all, and is equipped with a Taylor single truck, which has a 6 ft. 6 in. wheel base, 33 in. wheels and two G. E. 1000 motors. The car is capable of running at a very high rate of speed.

Substantial Railway Construction.

The accompanying engravings show a section of heavy double track construction recently installed by the



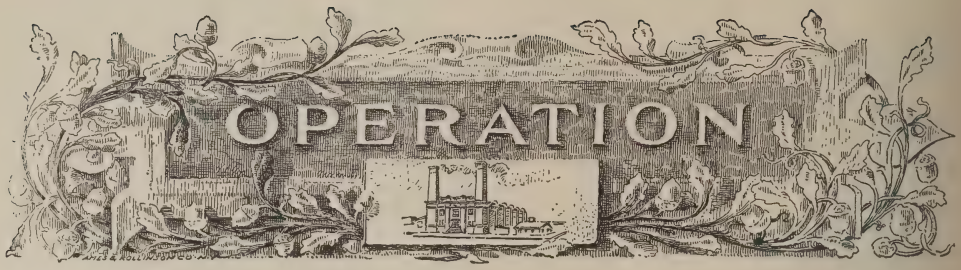
END VIEW OF POLE LINE.

Maryland & Washington Railway Company as part of the proposed through electric line between the cities of Washington and Baltimore. The section shown is in the District of Columbia and the overhead equipment includes No. 0000 trolley wire and double bracket poles, weighing about 1000 lbs. each.

The franchise required the completion of the line by a certain date, but owing to certain delays the contract for the overhead equipment was not given out until thirteen days before the limiting date. In spite of the fact, however, that bare trolley wire of the size selected had probably never been employed before and was not on the

SIDE VIEW OF POLE LINE.

market, the contractors, J. G. White & Company, completed the line in the required time. The wire, which was made to order, was rolled by the American Electrical Works. Morris & Tasker poles and Macallen insulators were used.

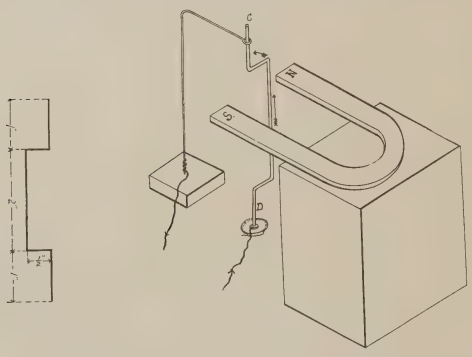


Electric Railway Motors.

By George T. Hanchett.

II.—Armature Winding Diagrams.

The following experiment will be of great assistance in understanding an armature winding. Bend a wire of stout copper as shown in Fig. 1 and sharpen the ends. Obtain a small dish—a table butter dish will answer—and mount the wire supported by a stand as shown in Fig. 2. Connect the stand to one terminal of a battery and connect the other terminal of the battery to a globule of mercury placed in the dish, thus making a circuit through the wire. If this is properly done the wire will be delicately poised and easily revolved about the axis, C D. Procure a wooden block and on it mount a magnet, arranging its poles to surround the wire as shown in the figure. We will then have a two-pole field and a single conductor so poised that if currents are properly directed through it, it may be revolved by the influence of the magnetism. Let

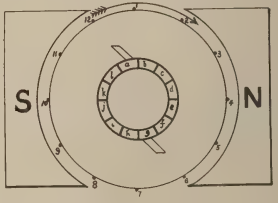


FIGS. 1 AND 2.—EXPERIMENTAL CONDUCTOR.

us suppose that the wire is opposite a north pole and that current is sent through it in an upward direction. The wire will rotate in the direction shown by the curved arrow till it reaches the south pole when it will be found that if the rotation is to proceed, the current in the wire will have to be reversed, By appropriately reversing the circuit as the wire proceeds, it may be made to revolve continuously and if we could make the wire do its own reversing we should have an electric motor.

Now, if instead of using a single wire we take a cylinder of wood or any convenient material and cover its periphery with wires closely laid together and parallel to the axis, it is obvious that if we place such a cylinder in a field having two or more poles and so connect these wires that the current will always flow in the proper direction in them as they pass under their respective poles, the joint action of all of these wires will produce a very much stronger rotative effort. If we make the cylinder on which these wires are placed of iron, the magnetic flux will be concentrated on the wires and will make the turning moment or torque still greater. This is the principle of every direct current armature.

The experiment has shown that every active wire in such an armature must have its current reversed as it passes from pole to pole, and therefore these wires must be suitably connected to a system of sliding contacts traveling under brushes which feed current to the armature. This will enable the necessary reversal to be automatically ac-



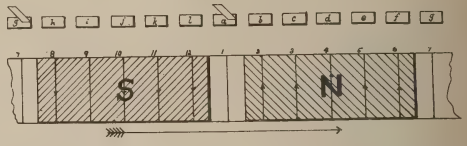
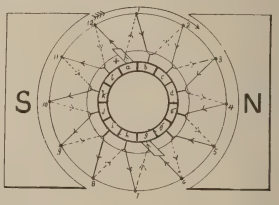


FIG. 3.—CURRENT DIRECTION IN WIRES UNDER POLE PIECES.



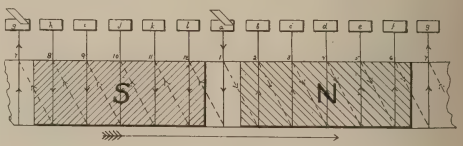


FIG. 4.—SIMPLE BIPOLAR RING WINDING.

complished, and is also a means of supplying current to the revolving member.

It is further evident that for maximum effect all of the wires in front of the north poles must carry current, say, up, and all in front of the south poles must carry current correspondingly down, no matter how fast the armature is revolving. Thus the polar faces divide the armature into alternate and equal sections of up and down currents. If therefore we can devise a system of wires

and contacts such that as the armature revolves under the brushes it will present sections of its surface to the polar faces which always carry currents in the proper direction, the problem of designing a winding will have been solved.

It is evidently necessary for such a winding to be perfectly symmetrical, for having designed the winding so that the flow of current is correct for one position of the commutator under the brushes, it must be always the same, no matter how the armature be turned.

If we should attempt to trace an armature winding by an examination of the armature itself or by mere description we should find it a puzzling, if not an impossible job. Some form of diagram must be used and in this series the following will be adopted. We will consider the cylindrical surface of the armature with its wires to be stripped off and laid out flat in much the same way as the bark from a birch tree would be stripped. (See Fig. 3.) To further render the matter clear such parts of the armature as are covered by the pole pieces will be designated by shaded rectangles. The cross hatching on the north pole will be parallel to the slanting cross bar of the letter N. In addition to the developed diagram there is added an end view of each winding which shows the end connections more clearly. It is but justice to say that this method, which is without doubt one of the clearest of any, is due to Prof. Sylvanus P. Thompson.

Before commencing a study of these diagrams it is well to say that the wires have been reduced to an absurdly small number for practical use, but by thus avoiding a multiplicity of lines the principle of the winding is more readily seen. It is conventional to call the straight wires on the surface of the armature directly under the influence of the polar faces, conductors, and the wires connecting these together, connectors. The conductors are active wires and the connectors are the dead wires and should be as short as possible. Now consulting Fig. 3, we have a problem the solution of which has been reached in many different ways. It is briefly how to connect the conductors to each other and to the commutator bars so that the current distribution shown by the arrows will always obtain

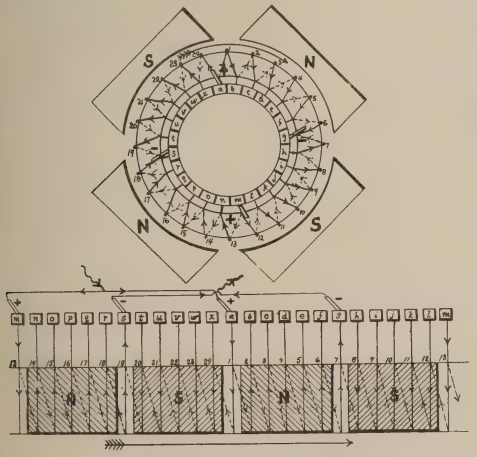


FIG. 5.—FOUR POLE RING WINDING.

whatever the position of the commutator under the brushes.

The simplest solution is shown in Fig. 4. Here the connector connects opposite ends of adjacent conductors and leads are brought down at equal intervals to the commutator bars. Tracing the current out from brush to brush, this will be seen to be correct and as the system is symmetrical any movement under the brushes will simply change the direction of the current in each wire as it passes from pole to pole and thus prevent any change in the current distribution under the polar faces. It will at once be questioned whether the connector carrying an equal and opposite amount of current should not neutralize the rotative effect of the conductor. This would certainly be the case if the connector were under the influence of the pole piece, but this influence it avoids by passing

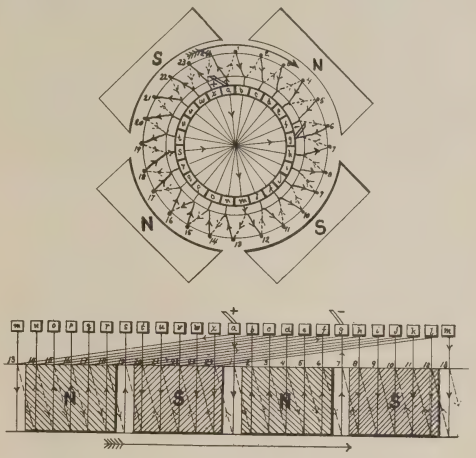


FIG. 6.—FOUR POLE RING WINDING CROSS-CONNECTED.

through a hole in the center of the core, which is really a ring of iron. The winding will now be recognized as the ring winding which is the simplest of all the windings.

Consulting the developed diagram, it is easy to see that it might be extended to four, six, eight or more poles by simply providing brushes to take off and feed the current at the proper intervals. The four pole extension is shown in Fig. 5 as it has been used to some extent in railway work. Multiple connection, as will be seen, solves the problem of properly feeding the brushes.

It is well to call attention to an important general principle here. Between adjacent bars of the commutator on this winding is connected an active coil, and this is universally true of all windings used in railway work, for on it depends the principle of commutation, which is most important in the study of sparkless running.

A multiplicity of brushes is to be avoided in railway motors. Two are, of course, necessary, and a number of devices exist to eliminate the need of more. The only device that could be applied to the winding just shown is that of cross connection. This is simply connecting opposite bars together, thus enabling one brush to feed at the two necessary places, and the other brush to take the current off at the proper places. A diagram of this method is shown in Fig. 6. This arrangement tends to divide the current in unequal amounts between the sections of the armature, for the cross connector has a sensible resistance, and sections fed by means of it receive less current than those fed directly. The advantage gained by the simplicity of two brushes is partially offset by the necessity of a larger commutator, for the brushes carry double current and, of course, need a proportionally larger bar.

Ring windings have been very popular in railway work, but are not modern practice. The active conductors are usually at a considerable distance from the axle, and this inherently long moment arm gives a strong torque. They are simple and easy to repair, and a single coil can burn out and be removed and replaced without in any way disturbing its mates.

The principal makes of motors using this winding were the Short system, that was designed by Prof. S. H. Short and manufactured by the Brush Company, and the W. P. 30 and 50 motors of the General Electric Company.

Financial Results of Cable & Electric Railway Operation in the United States.

IV. Two systems in manufacturing cities of 60,000 and 90,000 inhabitants.

The diagrams and tables represent the development of two neighboring street railway systems, one of which, Case III, serves a single city of about 90,000 inhabitants, and the other, Case IV, a city of about 35,000 inhabitants with its suburbs, the whole area served having a population of nearly 60,000. The former is one of the busiest manufacturing centers of the East, having a valuable water power which has given it pre-eminence in certain special lines. It has over 300 manufacturing establishments, employing a capital of $36,000,000, and the annual value of its products exceeds $30,000,000. The street railway system serves no suburbs, so that it has been forced to depend solely upon internal traffic for its revenue.

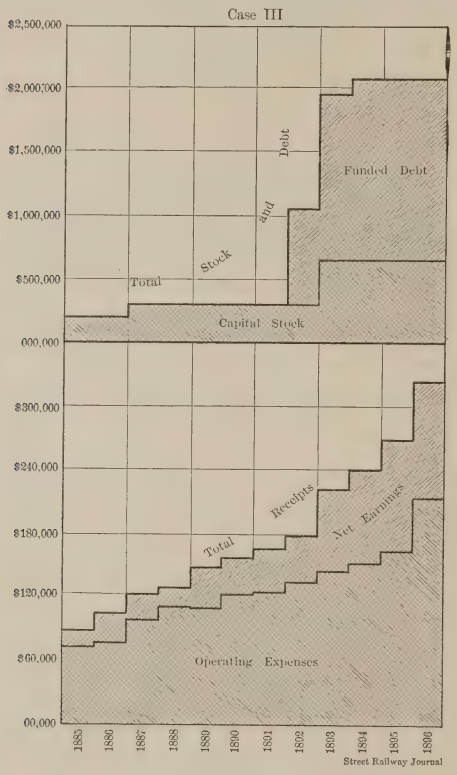


FIG. 1.

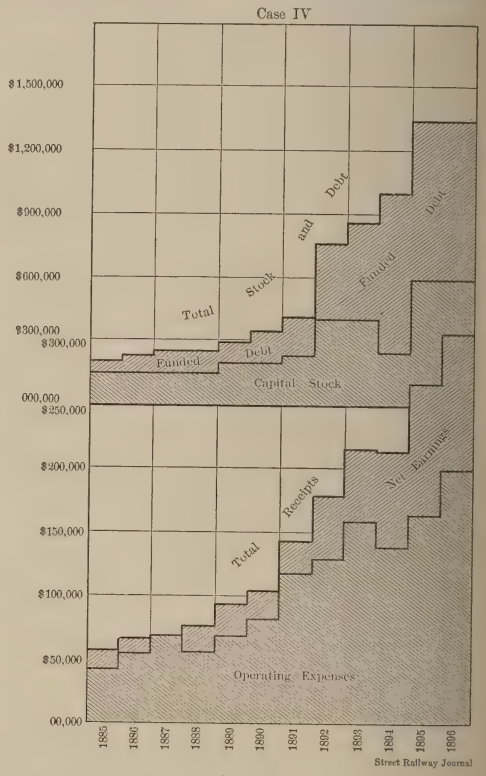


FIG. 2.

The central city of Case IV is also a busy manufacturing center, the value of whose product amounts to over $20,000,000 per annum, and whose factory employes number about 12,000.

In 1889 the two cities had about the same track mileage and neither had begun to expand under the influence of better motive powers. In that year the system in the larger city was earning 50 per cent more, both in gross and net, than the system in the smaller city. In 1896, however, the influence of the added suburban mileage of Case IV brought its gross and net earnings almost up to those of Case III, in spite of the large increases of the latter from year to year, due to the development of internal traffic only.

Here is an interesting thing. About 20 miles of city track and 23 miles of suburban track, costing about $32,500 per mile of track on an average, or $1,396,106 in toto, is earning practically as much, gross and net, as 28 miles of city track costing $78,000 per mile or $2,166,993 in toto. Surely no stronger evidence of the financial benefit to city railway systems of suburban extensions is needed if we can regard these two cases as at all typical of what is found elsewhere.

If the operating curves are examined further interesting facts are disclosed. The total receipts per mile of track have always been (and naturally so) much heavier in the larger city than in the smaller. The percentage of operating expenses to total receipts has been about the same in each, with some variation both ways, and the net earnings per mile have therefore been less in the smaller

	Gross Receipts per Car Mile.		Operating Expenses Per Car Mile.	
	Case III.	Case IV.	Case III.	Case IV.
1885	$ .274	$ .379	$ .229	$ .281
1886	.302	.309	.224	.251
1887	.295	.254	.240	.249
1888	.298	.245	.253	.180
1889	.309	.257	.229	.189
1890	.315	.250	.246	.195
1891	.304	.272	.230	.224
1892	.322	.256	.245	.185
1893	.305	.229	.198	.168
1894	.262	.246	.166	.159
1895	.272	.254	.167	.157
1896	.260	.238	.172	.155

city in most years. Prior to the adoption of electricity, the system in the smaller city was considerably less profitable than in the larger as gaged by percentage return on investment, but since the adoption of electricity the reverse has been true. The preceding table shows the comparative receipts and expenses of the two systems per car mile since 1885:

It will be seen that both the total receipts and the operating expenses of Case IV have been less per car mile except in the two or three earlier years, than those of Case III. It will also be seen that with electric traction the receipts per car mile have, for the present at least, fallen off, though slowly, while the expenses have fallen off very largely. American experience shows that while the public always responds generously to the better service given by its street railways with electric traction, there is always a period of falling off in receipts per car mile at first.

In Case III, the total receipts per mile of track steadily increased during the period of horse railway operation to somewhat over $10,000 per mile. Then came a falling off as the mileage was suddenly increased, but in the following three years receipts per mile began again to climb up and were in 1896 at their maximum. This is particularly interesting in this case, as during the last four years the increase in mileage has been very small and this increase in receipts per mile indicates constant development of traffic on existing mileage. Street railways in America have been extending so rapidly during the last five years that it is difficult to always get a true gage on the natural increase of traffic due to increase in population

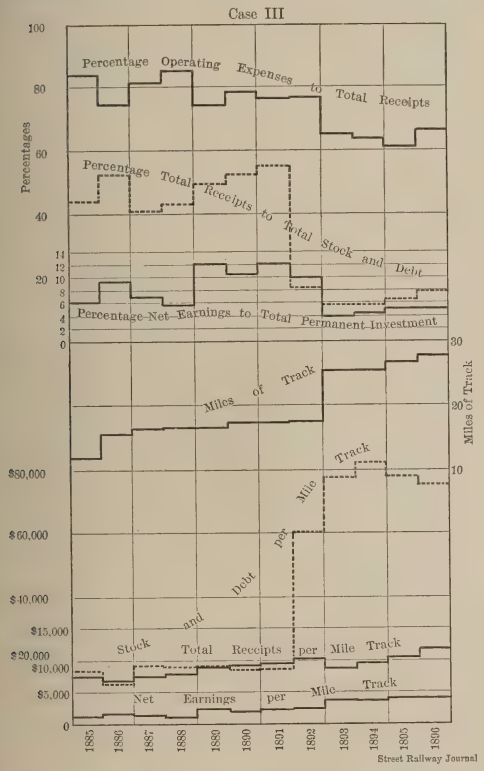

Case III
Percentage Operating Expenses to Total Receipts
Percentage Total Receipts to Total Stock and Debt
Percentage Net Earnings to Total Permanent Investment
Miles of Track
Stock and Debt per Mile Track
Total Receipts per Mile Track
Net Earnings per Mile Track
Percentages
Miles of Track
1885 1886 1887 1888 1889 1890 1891 1892 1893 1894 1895 1896
Street Railway Journal

FIG. 3.

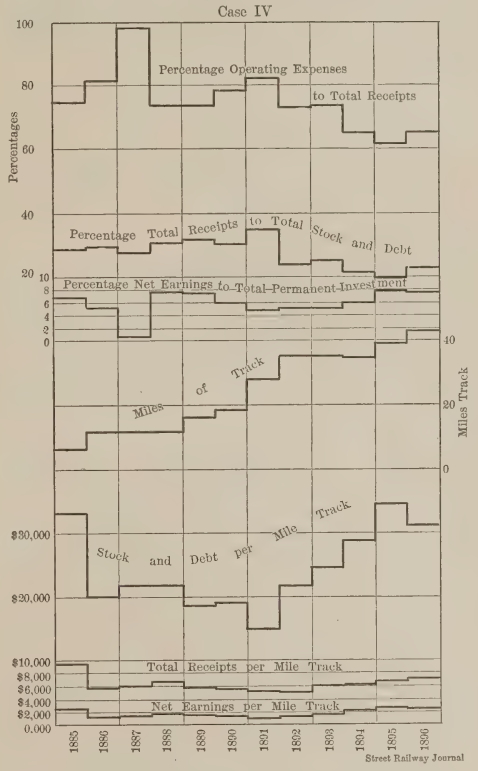

Case IV
Percentage Operating Expenses to Total Receipts
Percentage Total Receipts to Total Stock and Debt
Percentage Net Earnings to Total Permanent Investment
Miles of Track
Stock and Debt per Mile Track
Total Receipts per Mile Track
Net Earnings per Mile Track
Percentages
Miles of Track
1885 1886 1887 1888 1889 1890 1891 1892 1893 1894 1895 1896
Street Railway Journal

FIG. 4.

ITEM.	CASE III.			CASE IV.		
	1885.	1891.	1896.	1885.	1889.	1896.
Capital stock	$200,000	$300,000	$650,000	$150,000	$194,935	$596,000
Funded debt	. . .	. . .	1,425,000	50,000	100,000	750,000
Total capitalization	200,000	300,000	2,075,000	200,000	294,935	1,346,000
Total permanent investment	234,413	328,591	2,166,993	217,544	324,160	1,396,106
Miles of track	11.90	17.38	27.71	6.05	15.96	42.98
Total receipts	88,102	165.099	323,521	57,410	93,080	306,865
Operating expenses	73,628	125,400	214,208	42,659	68,504	200,150
Net earnings	14,475	39,699	109,313	14,751	24,576	106,715
Capitalization per mile track	16,807	17,261	74,883	33,058	18,478	31,317
Cost of road and equipment per mile track	19,699	18,906	78,202	35,957	20,311	32,480
Total receipts per mile track	7,403	9,499	11,675	9,489	5,832	7,141
Net earnings per mile track	1,216	2,284	3,945	2,438	1,539	2,483
P. c. operating expenses to total receipts	83.6	76.0	66.2	74.4	73.6	65.2
P. c. net earn'gs to total perma't investm't	6.2	12.1	5.0	6.8	7.6	7.6

and general growth of the riding habit, but here is a case which throws some light on this question.

In Case IV, there was little variation in receipts per mile up to 1895, but they now seem to be on an ascending scale in spite of considerable increases in mileage, and this would seem to prove that the wisdom of these mileage increases is justified by results, particularly as the net

earnings per mile have also been much larger during the last three years than ever before.

Summarizing the results of electrical equipment and increase of mileage in Case III, it appears that, since the horse railway days in 1891, the mileage has been increased about 60 per cent, the receipts 96 per cent, the expenses 71 per cent, the earnings from operation 175 per cent and the capitalization per mile of track 334 per cent. The percentage return on "investment" has fallen from 12.1 to 5, but before laying much weight upon this fall it would be well to have further information as to what constitutes an item of "investment" amounting to nearly $80,000 per mile of track in a city of this size.

In Case IV, the percentage increase in mileage has been about 169 per cent, in total receipts 230 per cent, in operating expenses 192 per cent, in earnings from operation 334 per cent and in capitalization per mile of track about 60 per cent—an entirely legitimate increase, and in fact, a remarkably small one.

Electric Traction.*

NOTES ON THE APPLICATION OF ELECTRIC MOTIVE POWER TO RAILWAY SERVICE, WITH ILLUSTRATIONS FROM THE PRACTICE OF THE METROPOLITAN ELEVATED ROAD OF CHICAGO.

By M. H. Gerry, Jr.

The conditions of passenger rapid transit on elevated and suburban roads differ somewhat from common railway practice. Regular stops are made at frequent intervals; the distance between stations on elevated roads, for example, averaging about 2000 ft. The interval between trains is small, and the time of stops very short. The traffic is irregular, is heavy at certain hours, and is apt to increase and decrease at a rapid rate. To make the fast running time desired, the speed must increase up to the point where the brakes are applied; thus the maximum of speed is high compared with the mean speed. There is little or no opportunity for maintaining the speed, and the running time depends almost entirely upon the rate of accelerating and retarding of the train.

With a given number of stops per mile, the amount of power required will increase very rapidly with the speed beyond a certain point, and the cost per car mile will not furnish a reliable basis of comparison for the motive power of different roads unless the conditions are the same. A slight difference in the average speed, or in distance between stations may cause a considerable change in the amount of power required.

There are in operation at the present time several noteworthy examples of the application of electric motive power to the heavier classes of railway service. The most important of these installations are the Lake Street and the Metropolitan Elevated roads of Chicago, the Baltimore Tunnel Line of the Baltimore & Ohio, and the Nantasket and Berlin lines of the New York, New Haven & Hartford Railroad. From the experience gained on these roads, there is no longer a question in regard to the ability of properly designed electric motors to operate trains of the heaviest weights in service, and at any speed permissible under practical railroad conditions. In the future, matters of efficiency and general utility must determine the desirability of electric power for any particular railway service.

Certain operating conditions have a special bearing on the efficiency of this form of motive power; the most important being the frequency of the train service. If traffic is such that a large number of trains must be operated on a division, the electric power will have an advantage in point of economy, over steam locomotives; and if the trains are few, the reverse will be the case. This condition holds good independently of the weight of the trains or of the speed attained. The length of the line is in itself no bar to the successful operation of an electric railway system, as by using alternating current apparatus, the power stations may be located favorably, and at long distances apart.

The distribution of the current to the trains, while it presents many practical difficulties in detail, is not so serious a problem as it was thought to be at one time. Of the three systems of overhead conductor, conduit and third rail, the last has given the best results, and is advisable wherever the conditions are such that it can be installed. For roads operating on their own right of way, there is really no serious objections to the third rail, and all of the difficulties encountered at crossings, switches and in yards can be overcome by methods already in use on the roads named above, or by other devices that have been proposed. It is not to be expected that all details of such a system are in an entirely satisfactory and final form, but they are practically operative at present and being constantly improved as difficulties develop in service. The experience already gained also justifies the statement that a reliable overhead or conduit system for heavy service can be constructed if the conditions favor the use of such methods.

*Abstract of paper presented at the meeting of the American Institute of Electrical Engineers, July 27, 1897.

The Metropolitan Elevated Railroad.

This system, now in its second year of operation, is the largest road in existence employing exclusively electric power for a heavy passenger service.

The structure has four tracks, from Market Street west to Marshfield Avenue, at which point three double track lines diverge. The northerly branch divides again near Robey Street into two double track branches. From Market Street to each of the terminals, the distance is about 6 miles. (See map, Fig. 1.)

Current is conveyed to the trains by the third rail system; the "trolley rail" being placed 20½ ins. outside, and 6¼ ins. above the running rail. It is of the common "T" section, bonded with leaf copper bonds, and divided into sections to provide for expansion. The insulation for the third rail, on all but a small section of the road, consists of hardwood blocks, mounted on small iron chairs fastened to the ties. On a recent extension an improved form of insulation made of stoneware has been tried with success. The electric leakage is small at all times. In dry weather it is entirely negligible and in wet weather is never more than a few amperes. It is greatest after a dry season, when the first shower is washing the accumulated iron dust from the insulating blocks. Steel rails are used for feeder, and copper only to make connections. The feeder system is divided into six sections, which are tied together at junction points through circuit breakers placed in the interlocking towers.

The rolling stock consists of motor cars, passenger cars, and a few coal and flat cars. The motor cars measure 47 ft. in length and weigh about 62,000 lbs. when loaded to their maximum capacity. They are mounted on rigid bolster locomotive type trucks, having 33 in. steel tired wheels. The truck centers are 33 ft. 6 ins. apart and the truck wheel base 5 ft. 6 ins. One truck of each motor car is equipped with two motors, each nominally rated at 2000 lbs. drawbar pull. The motors are operated by series parallel controllers, situated in the cabs at each end of the car. Rheostats of the packed ribbon type, used in connection with the controllers, are placed underneath the car. A circuit breaker placed in each cab is used both as a safety device and as a main switch for opening the circuit between the trolley device and the controller. A main fuse box is also provided, and placed in one of the cabs as an additional safety device, but experience has shown that failures of the circuit breaker to act are so rare, that the former piece of apparatus might well be omitted. Circuit breakers have proven very satisfactory for this service, as they cost little for maintenance, are reliable as safety devices, and by their quick action reduce to a minimum the damage to apparatus from grounding and short circuiting.

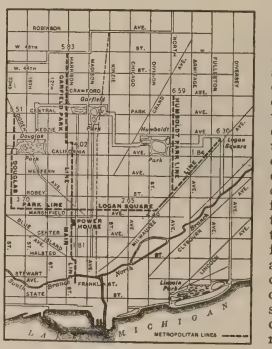


FIG. 1.

The cars are warmed by electric heaters arranged in three circuits, two of which take about 7 amps. each and the remaining circuit about 4 amps. All of the heaters are required only in the coldest weather, and are turned on and off by the trainmen. By cutting out all or part of the heaters for a short time when the traffic is heaviest, the peak of the load can be reduced and the heaters used to improve the load factor.

The air brakes are of the direct or "straight" air type with an additional re-enforce cylinder. The air is compressed to 60 lbs. by a vertical pump, driven by a motor of about 3 h. p. The pump motors have automatic control, regulated by the air pressure and also hand control from each end of car. The pump with its motor and automatic controller is placed in one of the cabs.

The passenger cars are 47 ft. in length and of the standard pattern, in use on all elevated roads. They are mounted on swinging bolster trucks, having 30 in. wheels and when loaded to maximum capacity weigh about 46,000 lbs. Two, three and four-car trains are in service at different hours, corresponding with the traffic. About 1200 trains are handled daily and under very close headway out of Franklin Street terminal.

The power house is supplied with water tube boilers, mechanical chain stokers, coal and ash handling machinery, forced draft, automatic oiling system and all modern appliances. The boilers are fourteen in number and work at 165 lbs. pressure. There are four vertical cross-compound engines, direct connected to the electric generators. The condensing water is taken from the Chicago River by tunnel, and water for the boilers from the city mains. There are four electric generators, two of 1500 k. w. and two of 800 k. w. capacity. The switchboard is placed on a gallery and is provided with the usual instruments, including recording wattmeters for each generator. There are six feeder panels corresponding to the divisions of the feeder system.

THE POWER ABSORBED BY TRAINS.

In an electric railway system, the mechanical energy supplied at the engine shaft may be divided, for purposes of discussion, into two general classes. First, that finally absorbed or utilized in propelling the train, and secondly the energy lost in transformation and transmission, including losses in generators, line, rheostats and motors.

The first division or class, that is, the energy to propel a railway train, may be divided again into three parts: first, that required to overcome inertia and accelerate the train to its maximum speed after each stop. Secondly, the energy required on account of ascending grades. Thirdly, that required to overcome train resistance, including friction, air resistance, etc. If the stations are far apart, the energy required to accelerate the train may be neglected without serious error, but for a service where trains make frequent stops, and

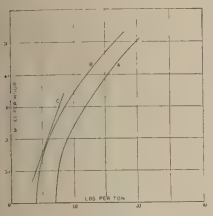


FIG. 2.

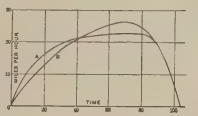


FIG. 5.

the maximum speed is high, compared with the mean speed, it becomes of importance, and may easily be the greatest of all losses. The amount of energy required for train acceleration, obviously depends upon the number of stops, the train weight and the maximum speed. Knowing these quantities, it can be readily determined from the common mechanical formula for kinetic energy, $U = \frac{w\, v^2}{64.4}$

The horizontal effort or drawbar pull required to produce a certain acceleration in a given time may be obtained from the mechanical formula, $f = \frac{w\, v}{32.2t}$.

The work done in ascending grades is the product of the train weight and the vertical distance the train is lifted. The horizontal effort required to take a train up a grade is equal to the product of the train weight by the per cent of grade.

Train resistance, as used in this paper, includes all retarding forces other than those due to inertia and grades. Formulas for determining this quantity are empirical and are based upon experimental results, where the conditions have varied widely. D. K. Clark, in *Railway Machinery*, recommends a formula which, reduced to tons of 2000 lbs., becomes $R = 7.1 + \frac{v^2}{192}$. Another formula in use is $R = 4 + \frac{v^2}{200}$, where $R =$ resistance in pounds per ton of train weight, $v =$ speed in miles per hour. These two formulas have been plotted in Fig. 2, and are marked respectively *A* and *B*. From measurements taken on the Metropolitan Elevated, the curve

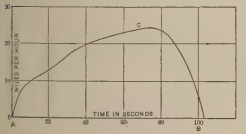


FIG. 3.

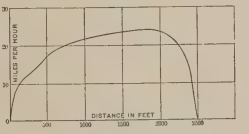


FIG. 4.

C has been determined and is used in the following discussions.

In Figs. 3 and 4, are shown actual speed curves on a time and distance base, for a train running between stations, 2500 ft. apart. For the purposes of discussion, consider the train weight as 100 tons, and in the first case assume it to be on an ascending grade of one-half of 1 per cent. From the curves, the speed at the time brakes are applied is 24 miles per hour, and the kinetic energy at that speed, for the train, is 3,800,000 ft. lbs. The time consumed up to the point where brakes are applied is 77 seconds, and the energy to overcome the .5 per cent grade while the train is passing over the first 1900 ft. is equal to 1,900,000 ft. lbs. The energy to overcome train resistance for the same distance is equal to 1,045,000 ft. lbs. Summed up, the energy would be as follows :

For accelerating the train	3,800,000 ft. lbs.
For the grade	1,900,000 "
For train resistance	1,045,000 "
Total energy required	6,745,000 "

This represents the total energy that must be supplied to the train from the time of starting, up to the moment the brakes are applied. From this point, the acceleration is negative, and the kinetic energy of the train is absorbed by train resistance, the grade and the brakes. The amount taken up by the brakes is 2,900,000 ft. lbs.

The above case is for the train on a .5 per cent ascending grade. For the train on a level the figures would be as follows :

For accelerating the train	3,800,000 ft. lbs.
For train resistance	1,045,000 "
Total energy required	4,845,000 "

The amount absorbed by the brakes in this case will be 3,500,000 ft. lbs.

For the same train and speed conditions for a .5 per cent descending grade, the figures are :

For accelerating the train	3,800,000 ft. lbs.
For train resistance	1,045,000 "
Total energy required	4,845,000 "
Supplied by descending grade	1,900,000 "
Total external energy required	2,945,000 "

The total energy absorbed by the brakes in stopping the train in this case is equal to 4,100,000 lbs.

The foot pounds per ton mile in each of the cases cited are as follows.

On an ascending grade	142,000 ft. lbs.
On a level	102,000 "
On descending grade	62,000 "

The average speed taken from the curves in the cases cited is 16.5 miles per hour, not including stops. Allowing twelve seconds for a stop, it is 15 miles per hour.

The average rate of using energy or the power, allowing time for stops, is as follows :

On a .5 per cent ascending grade	106.5 h. p.
On a level	76.5 "
On a .5 per cent descending grade	46.5 "

The power may also be divided as follows :

For accelerating the trait	60 h. p.
For ascending grade	30 "
For train resistance	16.5 "

These figures do not, of course, include losses in applying the power, and only represent the energy which must be applied at the rails to produce the results in the special cases named above. The conditions vary widely at times on the same road, but the above examples may serve to show how great is the percentage of power required to accelerate the trains when the stops are frequent.

In a speed curve with a time base, such as Fig. 3, the area enclosed is proportional to the distance traveled. That part of the area enclosed by the curve from *B* to *C*, a perpendicular from the point *C*, and the base line, depends on the form of the braking curve and hence on the efficiency of the brakes. The area enclosed by the curve from *A* to *C*, the perpendicular and the base line, depends on the form of the accelerating curve. The distance between stations being fixed, the area enclosed must be constant and independent of the form of the curves. The shape of the curve may be altered, however, in two general ways, first, by changing its form so as to still enclose the same area, with the same length of base, and secondly, by altering the form of the curve and changing the length of the base. This latter change will alter the time between stations, while either of the changes may or may not affect the amount of power used, this depending principally on the maximum speed attained. In Fig. 5, the curves *A* and *B* represent equal distances passed over in equal times, but the energy required for curve *A* is materially less than for curve *B*. The amount of power required in any case will depend largely upon the form of the speed curve, that is, upon the rates of accelerating and retarding of the train, and it is always desirable to keep the maximum speed as low as possible. Motors efficient at high speed are sometimes wasteful of energy because of insufficient torque, at starting and at low speeds, to produce a good form of acceleration curve.

The train weight may be considered as made up of two parts—the live, or paying load, and the dead load, which includes the weight of rolling stock, motors, etc. As the amount of power required by the train varies almost directly as the weight, it is desirable to have the non-paying or dead load as small as possible. In order that there may be sufficient traction, a separate locomotive must weigh between four and five times the maximum drawbar pull required by the train, all of which is dead load, in addition to that of the cars. It has been stated that a rapid acceleration is desirable if there are many stops, but as each pound of increased maximum drawbar pull from a locomotive must add 4 lbs. to 5 lbs. to the dead weight of the train, a point is soon reached where no further advantage is obtained by increasing weight on the drivers and drawbar pull. The weight admissible on the locomotive driving wheels, on account of track and structure, also limits the amount of traction, hence the drawbar pull and rate of train acceleration. Thus, for a service combining high speed and many stops, there are advantages in a form of motor which may be so placed as to utilize a part of the car weight and live load, for purposes of traction. The cars should weigh as little as possible so as to reduce the total dead weight of the train, for it is well known that the ton-miles of paying load form only a small percentage of the total ton-miles moved. On elevated roads it is probably below 6 per cent on the average and on some roads, below 1 per cent.

It is hoped that these remarks may direct attention to the question of economy in the use of power or to what may be called train efficiency, in contradistinction from the efficiency of the apparatus used in the generation and transmission of the power to the car axles.

THE MOTORS AND CONTROLLING APPARATUS.

In electric motors, the relations between speed, horizontal effort (or torque), current, voltage, and efficiency are all fixed, and may be readily determined for any particular motor. For most practical purposes it is best to represent these relations graphically. At *A*, in Fig. 6, the relation between current flowing and the static horizontal effort produced, is shown for the standard motors in use on Metropolitan Elevated road. Curve *B*, in the same figure, represents the horizontal effort produced when the motor is running with 500 volts at the terminals and at the speeds shown by *C*. The horizontal distance between *A* and *B*, represents the loss in horizontal effort due to friction and core losses. Curve *D*, in the same figure, gives the speeds which the motor would attain under the conditions named if there were no internal resistance, and the horizontal distance between the latter curve and *C*, represents the loss in speed due to such resistance. Thus the losses in a series motor may be divided into two classes, those that lessen the torque and those that reduce the speed. In Figs. 7 and 8, the relations between current, speed and horizontal effort are plotted for the same motor at 250 and 125 volts. The static horizontal effort is the same in all cases, but the running horizontal effort is slightly greater for the same current at the lower voltages, because the losses which affect it are less at the lower speed. At the same time the percentage of loss due to internal resistance becomes greater, as it depends upon the current flowing, while the total input of energy varies with the electrical pressure as well; hence, the reduced efficiency at the lower voltages. Curves of efficiency, in relation to the current, are plotted in Fig. 9, for the same voltages. In Fig. 10, the efficiency is plotted to the speed, and it will be seen that the curves fall off rapidly above or below a certain narrow range of speed over which the efficiency is high, at any one voltage. There is a considerable range of current and horizontal effort, over which the efficiency is high, as can be seen from Fig. 9, but it corresponds to only a small speed variation. The relations of speed to horizontal effort are given in Fig. 11. The maximum working range of the motor is from 350 to 4000 lbs. horizontal effort, and the total speed variation on this range at 500 volts will be about 14 miles, and at 250 volts, about 10 miles. The range of speed obtained in service at any one voltage is practically about one-half this amount, and if 250 and 500 volts be considered as the pressures at the motor, in series and parallel combination, then the total range of speed, without further alteration of the voltage by resistance in circuit, will be about 12 miles over a total speed range of 34 miles. For each combination of motors in series parallel, there is a certain range of speed over which the efficiency is equal to that of the motors; but at all other speeds, resistance must be introduced in circuit and the efficiency is reduced.

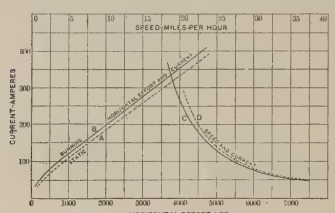


FIG. 6.

The weight of the armature and other revolving parts is a feature of importance in motors designed for a high speed service, requiring frequent stops. These parts should be as light, and the rotative speed as low as possible. The armatures of the Metropolitan motors weigh approximately 1400 lbs., and are 18½ ins. in diameter. At 800 r. p. m., corresponding to 25 miles per hour, the kinetic energy in each armature is equal to 43,000 ft. lbs. Thus, for a two motor equipment, 86,000 ft. lbs. of energy are dissipated each time the car is stopped from a speed of 25 miles per hour. This amount of energy will vary with the square of the maximum speed, and if stops are frequent it becomes an appreciable loss.

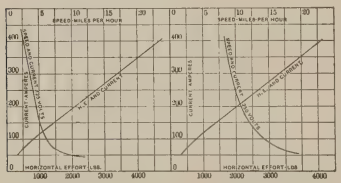


FIG. 8. FIG. 7.

The average load a motor is capable of sustaining is fixed by the permissible increase in temperature. The amount of such increase will depend on the average load, the efficiency of the motor and the extent and character of the heat radiating surfaces. The actual load on a railway motor differs at times, very widely, from the average load, and ability to withstand these fluctuations will depend in part on the heat storage capacity of the motor. The metal acts, to a considerable extent, as a reserve of heat, receiving it when the motor is doing its heaviest work and giving it up at lighter loads.

The amount of heat radiated in a given time varies greatly with the speed of the car and the temperatures. With the air at 60 degs. F., and under average working conditions, a Metropolitan motor will radiate heat at about 650 British heat units per minute. This is equal to 15 h. p., corresponding about to 60 h. p. of loading. But these motors will readily withstand for a considerable period of time a loading of three times this amount. Most of the

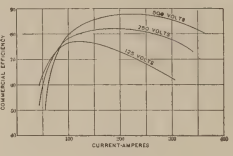


FIG. 9.

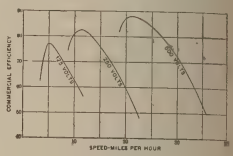


FIG. 10.

heat produced by this additional loading must be stored in the metal of the armature and frame. A considerable part of the heat is generated in the armature, but its thermal capacity being nearly 150 heat units per degree, a large amount of heat energy can be stored before the temperature reaches the danger point. Slow speed armatures in general have more metal in them, and are thus better able to stand a variable load.

The speed of a series railway motor at any given impressed e. m. f. is fixed by the total resistance of the train. The horizontal effort developed must just equal the resistance, or the velocity will change; therefore, if it be desired to maintain a constant speed, or to vary the velocity in any manner not corresponding to the fixed relations of speed and torque for the particular motor and voltage, it will be necessary to alter the impressed e. m. f., or to commutate the fields. To obtain this variable e. m. f. at the motor terminals from the constant e. m. f. of the line, many arrangements have been proposed, but only two are in use to any extent. They are by rheostat in the main circuit, and by grouping two or more motors in series and parallel combinations. Practically the two methods are combined, and are now in nearly general use. The rheostatic method wastes the energy represented by the reduction in voltage, and the series parallel arrangement provides two or more voltages at the motors without preliminary loss. The controllers in use on the Metropolitan are two combination series parallel, and have three steps on the rheostat for each voltage. The losses in this apparatus vary from 10 per cent to 20 per cent, depending upon the skill with which it is handled. With care this can be kept down to 10 per cent, making no allowance for the reduced efficiency of the motors at the lower voltages. The series parallel system has decided advantages over all other methods thus far tried in practice, but it lacks flexibility, and ultimately may not prove to be the best for heavy railway work and especially for high speed service.

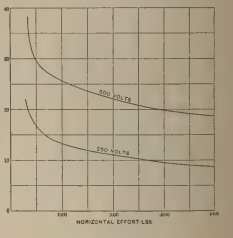


FIG. 11.

The selection of the proper motors and controlling apparatus for a given service deserves more attention than it has generally received. The horse power and maximum speed have too often been the determining quantities. A rating based on horse power is now understood to be of little value, and the maximum speed of which a motor is capable may be of still less account as representing its performance with a train. Quite generally, motors have been speeded too high, the result being insufficient starting torque, a poor commercial efficiency and less average speed than a better selected motor would have developed.

THE GENERATORS AND FEEDER.

The load line of an electric railway is subject to two kinds of fluctuations; first, those sudden changes caused by the starting together of a number of trains, and secondly, the more gradual change due to the variation of traffic at different hours of the day. On roads operating but few cars, the fluctuations due to the first cause are of considerable amount, but on large systems with many cars the changes in loading from starting up of trains are very slight—hardly noticeable, in fact—and this is especially the case if the feeders are tied together and form a network. There still exists, however, the change in the load line corresponding with the traffic. A railway load line differs from that of a lighting station in having two nearly equal "peaks" or points of maxima, one in the morning and one in the evening. These variations are best taken care of by cutting in and out units, while the momentary changes can usually be cared for by a slight overloading of the machinery. Engines and generators for railway purposes have a good efficiency over quite a wide range and generally stand overloads very well. In Fig. 12, are shown seven load curves from the power station of the Metropolitan Elevated. The curves correspond to the days of the week and indicate the average power taken, but do not show momentary fluctuations, caused by the movement of trains. The chief characteristics of these curves are the two decided "peaks" occurring daily with great regularity. The peaks vary as to amount

and time, with the season of the year, and to some extent with the weather, but are always present in a marked degree. Street railway systems with many lines extending to different parts of a city, usually show a station load with less decided and broader peaks. This is due in part to the habits and occupations of the patrons of the various lines which determine the hours of maximum traffic.

The load curves of the Metropolitan have proven to be a very sensitive index to the traffic. A delay on the competing cable lines or increase of travel from any cause is at once noticeable in the power house. The greater station loading is due not so much to the increased weight in passengers carried, as to the longer stops necessary to discharge and to take on passengers; thus requiring a higher speed to keep the trains on time.

The feeder system has an effect upon the form of load curves as well as upon the total amount of energy required. The highest percentage of loss will occur at the moment of greatest loading, but this rarely takes place at the same time on different sections, and an advantage is obtained by connecting the lines together to form a network as far as possible. Feeders are usually divided into sections as a matter of safety and convenience. The best economy of copper and of power, and the most favorable load lines are obtained when the number of such sections are as few as consistent with the safety and flexibility of the system. When feeder sections are connected, the best practice calls for a fuse or circuit breaker in this circuit. The permissible percentage of loss between the power house and the trains is partly a commercial question, depending on the cost of power and interest on the feeder investment. Transformers, rotary converters, boosters, batteries and

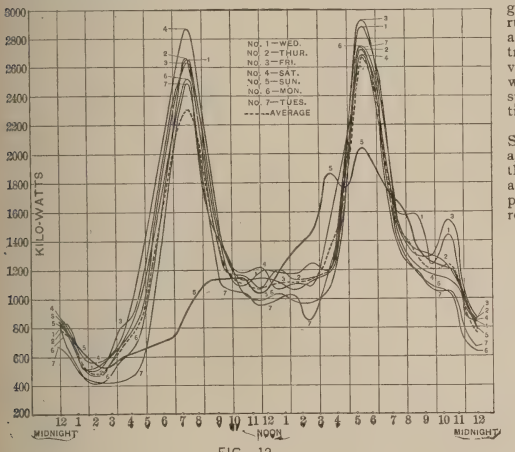


FIG. 12.

similar apparatus forming a part of the feeder system, should be considered with special reference to cost, operating expense, all day efficiency and effect on the load factor of the generating station.

THE EFFICIENCY OF TRANSMISSION.

The energy dissipated between the engine and the car axles may be divided into three parts—that lost in the electrical generators, the losses in the transmission lines (including transformers, rotaries, etc.) and the losses in the car controlling apparatus and motors.

The amount of loss in the generators will depend upon their efficiency and average loading. Modern railway generators have good efficiency above half load, and in stations designed with reference to the load line, there is but little difficulty in keeping the machinery above three-quarters at all times. In the table below are given the efficiencies for a number of direct connected machines of modern design.

TYPE OF MACHINE.	COMMERCIAL EFFICIENCY.			
	Full load.	¾ load.	½ load.	¼ load.
D. C. generator, 700 K. W	94	93	92	—
D. C. generator, 750 K. W.	93.5	92.5	91	85
D. C. generator, 800 K. W	96	95	92	—
D. C. generator, 1,500 K. W.	94.5	94	93	—
A. C. generator, 750 K. W.	94	93	91	—
A. C. generator, 600 K. W	93.5	92	87	82
A. C. generator, 700 K. W.	94	92	90	83
A. C. generator, 650 K. W	93.5	91.5	89.5	—
Rotary transformsr, 650 K. W.	94	92	90	—
Rotary transformer, 600 K. W.	95.5	92.5	90	84

With machines of this type and size, the all day efficiency ought to be about 92 per cent. A sub-station provided with rotaries and static transformers working under a good average loading, should have an efficiency of about 89 per cent; a loss of 8 per cent in the rotaries and 3 per cent in the transformers. The sub-station apparatus is at its highest efficiency at the time of greatest loading, when the feeder lines are at the lowest efficiency, and thus have a favorable effect on the load line.

The losses on railway feeders vary from 10 to 25 per cent. Often there is sufficient copper if rightly distributed and tied together to reduce this at least one-half. Such a change would also improve the load factor and increase the efficiency of the station. The losses in the motors and car apparatus have already been referred to in this paper, but actual data and tests are here introduced in evidence.

From a large number of tests made on the trains of the Metropolitan Elevated road, the following have been selected as illus-

No. of trip	1	2	3	4	5	6	7	8
No. of cars in train	4	4	4	3	3	2	2	4
Total time of trip	28′26″	29′03″	28′30″	28′37″	27′26″	25′30″	23′48″	32′44″
Total time of stops	2–19	2–05	2–42	1–47	1–16	0–54	1–22	1–41
Time running	26–07	26–58	25–58	26–50	26–10	24–36	22–26	31–03
Average speed (including stops)	13.3	13.0	13.2	13–88	14.4	14.9	15.9	11.53
Average speed (not including stops)	14.4	14.0	14.5	14–7	15.1	15.3	16.8	12.2
Average current (including stops)	138.3	142.6	138 6	130.2	129 5	90.1	106.6	101.1
Average current (not including stops)	148.7	153.2	151.8	137.4	135.6	92.5	112.4	106.4
Average volts (at the train)	504	498	503	512	516	521	529	509
Efficiency from generators to car axles	51	50.5	52	50	51	51.5	50	47.3
Kilowatt hours per car mile (at the train)	1.32	1.36	1.32	1.69	1.62	1.58	1.76	1.11
Kilowatt hours per car mile (at the station,	1.44	1.52	1.44	1.81	1.68	1.67	1.69	1.21

trating this part of the subject. The trips are numbered from one to eight, and in the table below the data for each trip are given, together with the general results obtained. All of these runs were made on a dry track, in moderate weather and under average working conditions. The total electrical energy at the train was measured by Thomson recording wattmeters and the voltage and current by Weston instruments. The velocity record was taken from a Boyer speed recorder and the stops and average speed from a double set of stop-watches. The pressure at the station was measured by a recording voltmeter.

Trip No. 1 was made from Franklin Street over the Logan Square line with a four-car train, heavily loaded, making an average runniug time of 13.27 miles per hour. The maximum grade on this line, going west, is 0.75 per cent ascending for about 2350 ft., and descending for about 1950 ft. Other grades do not exceed 0.03 per cent and only extend short distances. The amount of energy required or absorbed by the train is as follows:

Total energy for accelerating the train	30,940,000 ft. lbs.
" " " train resistance	14,110,000 "
" " " grade	3,400,000 "
" " required for propelling the train	48,450,000 "
Per cent of energy for accelerating	63.9
" " " " train resistance	29.1
" " " " grade	7.0
Time of trip, including stops	28 min. 26 sec.
Average horse power required for propelling train	51.5
" amperes of current	138.25
" volts at train	504
" watts at train	69,678.
Electrical horse power transmitted to the train	93.4
Average volts at the station	545
" watts " " "	75,346
Electrical horse power at the station	101
Efficiency from electrical generators to car axles	51%

Assuming the commercial efficiency of the generators as 93 per cent, the total power required at the engine shaft, to propel this train, is 108.5 h. p.

Trip No. 2 was made with a four-car train, under similar conditions to trip No. 1.

Trip No. 3 was made under similar conditions to trips 1 and 2, and the data and results are given in the table.

Trips No. 4 and 5 were made with heavily loaded three-car trains and the results are set forth in the table. Both the speed and commercial efficiency of apparatus are higher than in the case of the four-car trains.

Trips No. 6 and 7 are with two car trains and show a higher speed than attained in the case of the three and four-car trains. The greater amount of power consumed in trip 7 is due, mainly, to the increased speed over trip 6.

Trip No. 8 was made with four loaded cars and the motors operating only in series. Both the speed and current are less than for similar trips with the motors operating in series and multiple. The percentage of power saved is greater than that of the reduction in speed, but this is due, not to a better efficiency of the apparatus at lower speeds, but to the fact that the amount of power required to propel a train making many stops, decreases more rapidly than the average speed.

The amount of power lost in the machinery and line, as indicated by the commercial efficiency of the apparatus given in the table, might seem at first thought to be large, but considering the transformation and the distance of transmission, it is certainly not excessive.

Electrical energy can be produced in the vicinity of Chicago, with cheap coal, under the conditions of a railroad load at less than half a cent per kilowatt hour, and in the form of mechanical energy at the car axles, costing about one cent per kilowatt hour, it is several per cent cheaper than it can be generated by steam locomotives. Add to this the actual saving in energy from a more rapid acceleration and from reduced train weight and the total direct advantage for the electrical system is obtained as far as economy in power is concerned.

The Cost of Steam Power.*

BY HORATIO A. FOSTER.

In this age of electricity, when so much is being done in the way of developing its applications, and especially in its application to the transmission and distribution of power, perhaps no one item causes so much controversy as the cost of steam and other familiar forms of power. It seems to have been taken for granted for years that anyone and everyone knows the cost of developing power by steam, and in almost all cases when a person stating such costs is pinned down to facts, it has been found that he is either guessing or quoting those he supposes are authorities. It is to be presumed that statements of actual tests for cost might have been published, but the writer has, in a somewhat extended search, run across but one such statement that might be considered reliable, and that was a test for something under one hundred days, and that practically confined to the warm season of the year, and not, therefore, of the greatest value.

Other estimates have been made from extended experience and carefully revised theory, and in fact, little can be added to tables published during the past few years by some of our most eminent and best qualified engineers, in the way of carefully prepared estimates of what should perhaps be called the average cost of producing steam power under various conditions as to amount of power and the type of machinery employed.

It must be said, though, that almost all these estimates have been made for powers of large size and where little variation of load takes place, and while such estimates are of great value for use in discussion of the subjects, the writer has found them somewhat unsafe to use unless their results are applied in connection with extended experience, for, while the results considered as averages are probably correct for ordinary conditions, they cannot, of course, be expected to include extraordinary conditions, and the results of this investigation seem to show that individual cases vary so much that it is not fair, and may be misleading to state average costs.

It seems a pity that the cost of power is most often quoted for one horse power for one year, and so freely assumed that there is an average cost of power on which one can base estimates in the cost of manufacture; for the writer will endeavor to show, as this paper progresses, as others have done, first, that any general statement of the cost of power per horse power per annum is incorrect, for the reason that such a statement does not ordinarily take into account the number of hours run per diem, or the number of days per year, and even in that class of plants supposed to run, say, 308 days per annum, it is seldom one can be found that runs a full year, and no two run the same length of time; and second, that no such statement of an average cost of power is of any value whatever, unless it be for plants employed in similar work, and under exactly similar conditions, and even then the amount of power developed is such a factor for varying the unit cost that it is, in the opinion of the writer, quite fair to say that there is no average unit cost for steam power that is safe for general application, and it is thought that a somewhat careful study of the tables and computations accompanying this paper will help to a clearer understanding of the reasons therefor.

Although in the great majority of instances office accounts are so kept as to give no real basis upon which to compute the cost of power, and in most off-hand estimates, the rated capacity, and not the average power developed, has been used as a divisor, there can be no doubt that in some of the older industries, say, in the great flour mills and the large Eastern cotton factories, where prices of manufactured goods have been tending downwardly for so many years, and very close accounts of unit cost have necessarily been kept, and, as in all other departments the power has been very carefully looked after, in such cases it is very likely that careful comparisons will show the cost of power to be more or less uniform when used under similar conditions, but reference to the tables will show this to be more widely at variance than is commonly thought.

It will be the endeavor of the writer to show by tabulated data as far as possible, the condition of the plants tested, without going any more into detail than seems necessary for a clear understanding.

In order that the value of the results may be determined, it is necessary to give some description of the methods pursued in obtaining them, and, as they were as far as possible the same throughout, a general description will do for all except the special cases.

In order that the greatest value might be obtained, it has always been the opinion of the writer that no results for a period short of twelve consecutive months should be used, and in all but one case, which was for eleven months, a year has been taken as the smallest unit of time.

In a general way, the unit of time having been settled, where possible a unit of output was selected, after a careful and somewhat extended study of the special business in all its conditions, on which averages could be constructed and which could be turned into horse power after determining its rate.

Indicator tests were always made both for determining the rates of power and the ratio of power to the unit of output; for instance, in a flour mill it is only necessary to apply indicators to the engine cylinder for a certain period of time, not less than twenty-four hours, and to count the actual output in barrels, to determine a fairly accurate ratio of horse power per barrel of production, after which it is a simple matter to determine the average for a year from a total production and the actual time during which the mill was running and the output recorded; or in an arc lighting station, if an indicator test is made of the engine for the entire time per day, during which lamps are burned, and the number of lamps running during the same period be recorded, then also it is easy to determine the ratio of power to lamps, whence by computation from the records kept of the number of lamps burning and the time in hours during which they were lighted for a year, the lights can be reduced to horse power, and if accurate and well classified records of expenditure are kept, the annual and hourly cost of power is determinable to a close degree of accuracy. Of course, wide variations in the amount of power used will often change the ratio, but care has been taken in these tests, not to base them on periods of changing power consumption, and it is therefore thought that the results are within the ordinary limits of accuracy.

For the sake of uniformity, as well as to reduce the

TABLE IV.—Unit Costs for 20 to 24 Hour Power.

Number of Plant.	Average Horse-Power Developed.	COSTS. Per Horse-Power, Year.	Per Horse-Power, Day.	Per Horse-Power, Hour.
1	296.7	$53.37	$.1797	$.00749
2	210.9	48.17	.1662	.00693
3	58.8	131.12	.3592	.01613
6	70.4	122.45	.3355	.01641
9	1352.0	62.44	.1711	.00713
10	36 7	233.95	.6409	.02811
11	42.4	149.58	.4098	.01768
14	20.9	151.54	.4152	.01868

TABLE V.—Unit Costs for 9 to 12 Hour Power.

Number of Plant.	Average Horse-Power Developed.	COSTS. Per Horse-Power, Year.	Per Horse-Power, Day.	Per Horse-Power, Hour.
4	12.4	$173.33	$.4801	$.05648
5	21.5	108.27	.3000	.02918
7	1345.5	32.70	.0896	.00820
8	129.3	38 55	.1084	.00871
15	32.9	28.39	.0860	.00832
16	166.7	19.66	.0628	.00639
17	1174.8	15.69	.0513	.00531
18	926.0	20.50	.0669	.00691
19	2422.0	22.40	.0732	.00757
20	1909.7	20.03	.0655	.00677
21	1278 7	16.72	.0571	.0. 590
22	1010.8	23 44	.0767	.00794

TABLE VI.—Unit Costs for 3 Hour Power aud for 15½ Hour Power.

Hours Run.	Number of Plant.	Average Horse-Power Developed.	COSTS. Per Horse-Power, Year.	Per Horse-Power, Day.	Per Horse-Power, Hour.
3	12	173	$31.29	$.1000	$.03333
15½	13	53	76.45	.2473	.01596

TABLE VII.—Comparison of Power and Expenses. 20 to 24 Hours.

No. of Plant.	Rated Capacity, H. P.	Average Used H. P.	Per cent. Used of Capacity.	EXPENSE PER H. P. HOUR. Operating.	Fixed.	Per cent. Operating of Total.	Per cent. Fixed of Total.
1	380	296.7	78	$.00640	$.00109	85	15
2	250	210.9	85	.00580	.00113	84	16
3	205	58.8	47	.01195	.00417	74	26
6	220	70.4	32	.01361	.00278	83	17
9	2195	1352.0	62	.00377	.00336	53	47
10	110	36.7	33	.01650	.01161	58	42
11	110	42.4	39	.00986	.00722	57	43
14	65	20.9	32	.01520	.00356	81	19

*Abstract of paper read before the American Institute of Electrical Engineers, July 26-28, 1897.

TABLE VIII.—Comparison of Power and Expenses. 9 Hours to 12 Hours.

No. of Plant.	Rated Capacity, H. P.	Average Used H. P.	Per cent Used of Capacity.	Expense per h. p. Hour.			
				Operating.	Fixed.	Per cent. Operating of Total.	Per cent. Fixed of Total.
4	105	12.4	31	$.04820	$.00828	86	14
5	65	21.5	33	.02440	.00478	84	16
7	2500	1345.5	54	.00585	.00235	71	29
8	165	128.3	78	.00664	.00207	76	24
15	80	32.9	41	.00661	.00171	79	21
16	200	166.7	84	.00494	.00145	77	23
17	1200	1174 8	98	.00345	.00186	65	35
18	1000	926.0	93	.00396	.00295	57	43
19	2500	2422.0	97	.00530	.00227	71	29
20	2000	1909.7	95	.00453	.00224	67	33
21	1400	1278.7	91	.00370	.00220	63	37
22	1200	1010,8	84	.00532	.00262	67	33

TABLE IX.—Comparison of Power and Expenses. 3 Hours and 15½ Hours.

No. of Plant.	Hours Run.	Rated Capacity H. P.	Average Used H. P.	Per cent. Used of Capacity.	Expenses per h. p. Hour.			
					Operating.	Fixed.	Per cent. Operating of Total.	Per cent. Fixed of Total.
12	3	300	173	58	.02415	.00918	72	28
13	15½	165	53	32	.01190	.00406	75	25

TABLE X.—Coal Reduced to $3.00 per 2,000 lbs. Slow Speed. Non-Condensing.

Number of Plant.	Hours Run.	Average Power.	EXPENSES.		
			Operating.	Fixed.	Total.
1	24	296.7	$.00821	$.00109	$.00930
3	23	58.8	.01343	.00417	.01760
5	9	21.5	.02865	.00478	.03343
8	12	129.3	.00692	.00207	.00899
16	10	166.7	.00591	.00145	.00736
12	3	173.	.02789	.00918	.03707
Averages..	.....	.....	$.01517	$.00379	$.01896

TABLE XI.—Coal Reduced to $3.00 per 2,000 lbs. High Speed. Automatic Non-Condensing.

Number of Plant.	Hours Run.	Average Power.	EXPENSES.		
			Operating.	Fixed.	Total.
14	24	20.9	$.01802	$.00350	$.02152
4	9	12.4	.05686	.00828	.06514
15	10	32.9	.00824	.00171	.00995
13	15	53	.01446	.00406	.01852
Averages..	.....	.....	$.02439	$ 00439	$.02878

TABLE XII.—Coal Reduced to $3.00 per 2,000 lbs. Slow Speed. Condensing.

Number of Plant.	Hours Run.	Aver ge Power.	EXPENSES.		
			Operating.	Fixed.	Total.
2	24	210.9	$.00785	$.00113	$.00898

items of account to as small a number as was considered consistent with clear understanding, a list of cost accounts was determined on, that in most ways agrees with work previously done in this line, and which it was thought could be most easily met by the most ordinary bookkeeping.

The list is as follows:

Operating Expenses.

Fuel.
Wages.
Supplies.
Repairs.
Water.
Incidentals. including lighting and removal of ashes.

Fixed Charges.

Interest on cost of plant.
Depreciation on value of plant.
Insurance.
Taxes.

In considering the value to be given to each item, many things had to be discussed in order that proper separation of expenditure due to items other than for power could be made, as for instance, the item of fuel; in many cases buildings have had to be heated, either by exhaust or live steam; steam has been used for hot tables, as in the case of newspaper offices, and for dry rooms, for lumber, etc., as is the case of a furniture factory. In all such cases the study of the plant, consultation with the engineer in charge and the management, coupled with the experience of the writer, has ensured the determination of an amount satisfactory to all concerned as being the nearest correct obtainable under the ordinary conditions of practice.

In the item coming under the head of fixed charges, a somewhat different treatment obtained, as so little attention is given these items by the ordinary business management that in most instances not only the value of the plant, but the items going to make up the fixed charges had to be determined by the writer from his experience, together with such information as could be gotten from the people in charge. While insurance and taxes were, of course, determinable from the books, interest was rated in almost all cases at 5 per cent; and depreciation at rates varying from 2½ to 10 per cent for building, and 5 to 15 per cent on steam plant, all according to type of material in use, its condition, the manner in which it was handled, etc. In but few cases were either of these items considered in the estimates of cost by the owners. It must be remembered in this connection, that fixed charges go on all the time, twenty-four hours per day for 365 days, and that the unit cost is the same if computed by the year, but does not have the same relative value when computed by the number of hours the power was actually in use. In passing, it may be well to say that the number of firms in good business standing that are entirely at sea regarding the actual cost or present value of power plant is, to say the least, astonishing.

One item taken into consideration in all the tests, and one seldom considered at all in the ordinary statements of the cost of power, is the value of the building or part of the building devoted to the use of the power plant. In some few cases buildings were set apart for this purpose, and where the value was known it was, of course, easy to fill out the item; but in cases where the power plant was in the same building with the other portion of the plant, it became necessary to set off the value from the rest, and this was most often done by determining the renting value of the room used, which can usually be done with small chance of error, and then to capitalize the rent as the value of that part of the building devoted to power purposes.

In one item used in these tests, the writer apparently differs from most other estimators of the cost of power, and that is in the use of the indicated horse power rather than brake horse power for the divisor, and his reasons for using it are as follows: viz., indicated horse power can nearly always be determined to a degree of accuracy only limited by the usual errors of instruments and their users, generally conceded to be small; while brake tests can seldom be made in practice, and the net power is therefore most often determined by assuming a certain percentage of engine and shafting efficiency which under general conditions is quite incapable of proof, and the errors of which must be added to those of the indicator test. The writer therefore prefers to eliminate this chance of error, and should any one desire to change the figures here displayed to brake horse power, it is only necessary to make the single computation due to any engine efficiency that he may wish to assume.

Referring now to plants tested, those on which reports were made were not selected in order to show the very considerable variation in results that are given, but for availability and for variety of types and of business.

The plants on which tests were made for unit cost of power were twenty-two in number as follows:

Two electric lighting stations.
One grain elevator.
Three water works pumping stations.
Two flouring mills.
Six cotton mills.

TABLE XIII.—Coal Reduced to $3.00 per 2,000 lbs. Combined. Compound Condensing and Automatic Non-Condensing.

Number of Plant.	Hours Run.	Average Power.	EXPENSES.		
			Operating.	Fixed.	Total.
6	23	70.4	$.01573	$.00273	$ 01851

TABLE XIV.—Coal Reduced to $3.00 per 2,000 lbs. Pumping Engines, Compound Condensing.

Number of Plant.	Hours Run.	Average Power.	EXPENSES.		
			Operating	Fixed.	Total.
9	24	1352.	$.00455	$ 00336	$.00791
10	24	36.7	.01887	.01161	.03048
11	24	42.4	.01149	.00722	.01871
verages..	... .	....	.01174	00739	.01913

TABLE XV.—Coal Reduced to $3.00 per 2,000 lbs. Slow Speed Compound Condensing.

Number of Plant.	Hours Run.	Average Power.	EXPENSES.		
			Operating.	Fixed.	Total.
7	11	1345.5	$.00901	$.00235	$.01136
18	10	926.0	.00447	.00295	.00742
21	10	1278.7	.00414	.00220	.00634
22	10	1010.8	.00522	.00262	.00784
Averages..	. . ..	....	.00571	.00253	.00824

TABLE XVI.—Coal Reduced to $3.00 per 2,000 lbs. Slow Speed Triple Compound Condensing.

Number of Plant.	Hours Run.	Average Power.	EXPENSES.		
			Operating.	Fixed.	Total.
17	10	1174.8	$ 00318	$.00186	$.00504

TABLE XVII.—Coal Reduced to $3.00 per 2,000 lbs. Combined, Compound Condensing and Simple Condensing.

Number of Plant.	Hours Run.	Average Power.	EXPENSES.		
			Operating.	Fixed.	Total.
19	10	2422.	$.00460	$.00227	$ 00687
20	10	1909.7	.00527	.00224	.00751
Averages..	.....	.....	$.00494	$.00225	$.00719

TABLE XXIII.—Cost of power. from table in *Engineering Magazine*, by Dr. Emery. Coal reduced to $3.00 per 2,000 lbs. 3,080 hours.

	Net Horse Power.	Cost per H. P. per Hour.
Ordinary non-condensing	10	$.02579
Automatic cut-off, non-condensing	75	.01396
Automatic cut-off, condensing	150	.01060
Compound condensing	250	.00856
Triple compound condensing	500	.00727

Four newspaper and printing offices.
One department store.
One furniture manufactory.
One bakery.
One glazed and fancy paper manufacturing company.

The criticism may be offered that not enough plants were tested in any one business to determine an average cost of power in that business, and a careful inspection of the accompanying tables will show that comparisons of cost of power between unlike types of business are of little value, and if still further comparisons be made, it will be found that conditions vary so much in the same type of business as to show that any statement of an average cost of power even there is quite misleading and that therefore tests of even a single plant of any of the different classes of business is of value only so far as it determines the cost for that plant alone, and demonstrates the fact, of which the writer has become thoroughly convinced, that each plant must be tested as if it were the only one of the type in existence.

In rated capacity the plants vary from 40 h. p. to 2500 and in value per rated horse power from $23 to $89 in steam power plants, or as high as $368 in water works pumping stations.

While the type of boiler used leans largely to the plain, old-fashioned return tubular, with the exception of the cotton mills, the types of engines are almost as varied as the number of plants.

In fuel, soft coal or slack of soft coal largely predominates, and a considerable use of mixtures of the latter with dust from the yards and hard coal slack will also be noticed, which is largely due to efforts to reduce the smoke nuisance.

[Full data and details of operating expenses and fixed charges are given for each of the twenty-two individual plants in tables not reproduced in this abstract.—EDS]

In Tables IV to IX the results from the different plants have been separated and classified according to the hours per diem during which they are run, making the broad distinction of twenty to twenty-four hour runs and nine to twelve hour power. There are, however, two plants that, owing to wide difference of running time could not be brought under these headings, and they have therefore been placed by themselves in table VI and IX. In considering the plants under these general divisions, it must still be borne in mind that while they are classed under the same heading in hours per diem, they are by no means all run the same number of days per year, and therefore the total hours per annum during which the plant was run become the only correct basis on which to compute the cost for comparison.

While the above twenty-two plants are the only ones on which tests available for this paper were carried out, many others were examined during the time, and while it may be said that in most plants fairly accurate tests may be made, some are found in which it is next to impossible to arrive at anything like accurate results.

Until one makes a business of examining power plants with an idea of learning the unit cost of power, it is impossible to judge adequately of the varying conditions obtaining and, therefore, of the fact that any possible statement of an average cost is misleading.

It has been the writer's experience that one of the greatest factors for varying the cost of steam power in a given plant is to be found in the fire room.

In but few plants is this part of the expense found to receive the attention it should have to obtain the best results; and as a whole, the men employed at the work of firing are of a class that seldom runs to brains, and unless pushed to it by the management, the engineer is prone to exercise only a nominal supervision over the department. When a fireman on one shift can use nearly twice as much coal doing the same work as the fireman on the other shift, as was found in one case, it is time the engineer was disposed of or new methods arranged.

In plants developing a low amount of power, say, less than 100 h. p., as a large majority of them do, the labor item, due to varying conditions of the business, becomes a very important factor, and one in which great saving can be made by rearrangement of power supply.

In order to make this paper of greater value, the writer has thought it well to add the results of estimates by other investigators, and, as coal is the only item that varies to a great extent in unit price, it has been thought best to bring that item to the same price per ton, and, as the ton used in the neighborhood where most of the tests were made is 2000 lbs., all weights and prices have been reduced to a cost of $3 per 2000 lbs., delivered.

Tables X to XVII, inclusive, are the results of the tests by the writer, classified by types of plant, and reduced to coal at $3 per 2000 lbs. Table X shows the costs for slow speed, non-condensing engines, irrespective of the size or number of hours run per diem. Although an average is taken of these, it is, of course, of little value, as the costs vary, not only by reason of the amount of power developed, but from the number of hours run per diem, and the variety of each of these conditions is such that each item could as well be placed by itself.

TABLE XVIII.—Emery's Tables Reduced to Indicated Horse-Power and Coal at $3.00 per 2,000 lbs. 3,080 Hours Run.

Style of Engine.	OPERATING EXPENSE.				FIXED CHARGES		Total.	Total Cost.
	Coal.	Labor.	Repairs and Supplies.	Total.	Insurance, Taxes & Renewals	Interest.		
A	$19.70	$4.41	$2 73	$26.84	$2.72	$5.90	$8.62	$35 46
B	17 34	4.04	2.28	23.66	2.82	6.13	8 95	32.61
C	15.54	3.84	2.73	22.11	2 52	5.49	8.01	30.12
D	14.35	3.68	2.73	20.76	2.78	6.03	8 81	29.57
E	13 15	3.51	2.73	19.39	2.32	5.04	7 36	26.75
F	11.94	3.31	2 28	17.53	2 46	5.35	7.81	25.34
G	11.05	3.35	2.73	18.13	2.39	5.16	7 57	25.60
H	10 76	3.14	2.28	16.18	2.50	5.43	7.93	24.11
I	10 15	3.10	2.73	15.98	2.53	5.49	8.02	24.00
J	9 56	2.98	2.28	14.82	2.82	6.11	8.93	23 75
K	8 96	2.90	2.28	14.14	3.02	6.56	9.58	23 72
L	7.50	3.36	2.28	13.14	2.98	6.45	9.43	22.57

TABLE XIX.—Emery's Tables Reduced to Indicated Horse Power and Coal at $3.00 per 2,000 lbs. 7,300 Hours Run.

Style of Engine.	OPERATING EXPENSE.				FIXED CHARGES		Total.	Total Cost.
	Coal.	Labor.	Repairs and Supplies.	Total.	Insurance, Taxes & Renewals.	Interest.		
A	$44.70	$10.45	$6.47	$61.62	$2.72	$5.90	$8.62	$70.24
B	39.20	9.57	5.38	54.15	2 83	6.13	8.96	63.11
C	35 20	9.11	6 47	50.78	2.53	5.49	8.02	58.80
D	32.50	8.72	6.47	47.69	2.78	6.02	8.80	56.49
E	29.70	8.34	6.47	44 51	2.32	$5.04	7.36	51.87
F	27.10	7.84	5.38	40.32	2.46	5.35	7.81	48.13
G	27.10	7.93	6.47	41.50	2.39	5.17	7.56	49.06
H	24.30	7.45	5.38	37.13	2.50	5.44	7.94	45.07
I	22.90	7.35	6.47	36.72	2.53	$5.49	8.02	44.74
J	21.64	7.07	5.38	34.09	2.81	6.14	8 95	43.04
K	20.30	6.85	5.38	32.53	3.02	6.57	9.59	42.12
L	16.93	7.98	5.38	30.29	2.98	6.44	9.42	39.71

TABLE XX.—Cost per Horse Power Hour, from Emery's Tables. 3,080 Hours Run.

Style of Engine.	Operating Expenses.	Fixed Charges.	Total Cost.
A	$.00870	$.00280	$.01150
B	.00769	.00291	.01060
C	.00719	.00361	.00680
D	.00675	.00286	.00961
E	.00630	.00239	.00869
F	.00570	.00254	.00824
G	.00587	.00246	.00833
H	.00526	.00258	.00784
I	.00520	.00261	.00781
J	.00482	.00290	.00772
K	.00460	.00311	.00771
L	.00428	.00307	.00735

TABLE XXI.—Cost per Horse Power Hour, from Emery's Tables. 7,300 Hours Run.

Style of Engine.	Operating Expenses.	Fixed Charges.	Total Cost.
A	.00845	.00122	.00967
B	.00741	.00123	.00864
C	.00695	.00110	.00805
D	.00652	.00121	.00773
E	.00610	.00101	.00711
F	.00551	.00107	.00658
G	.00568	.00103	.00671
H	.00508	.00109	.00617
I	.00502	.00110	.00612
J	.00466	.00123	.00589
K	.00445	.00131	.00576
L	.00414	.00129	.00543

Table XI shows results for high speed, automatic engines, which are also assembled irrespective of time of running or power developed, and show very uneven costs.

Tables XII and XIII include but one plant each, and are, therefore, of little use for comparison, excepting as showing the general variation of cost.

Table XIV shows like results for three pumping stations, and one gets a very good idea of the vast difference in unit cost of power when developed in widely varying quantities; the first plant, developing 1352 h. p., and the other two less than 50 h. p. each, the difference in cost between the highest and the lowest being as $.007 is to $.03048.

In Table XV is shown the cost for four large plants using slow speed, compound condensing engines. This type of plant is perhaps the most common of modern plants in use for large quantities of power, and is one on which perhaps the most and best estimates have been made, and therefore most easily compared with other tables.

Table XVI shows the result in one plant using a large triple compound engine of special type, and one of the items tending to low cost in this instance, is that but half the engineer's time is chargeable to this particular plant; another being the low fixed charge owing to very close buying by the management. The cost of power here will be seen to be less than generally estimated.

Table XVII shows the results in two mixed plants of large size, both cotton mills. In both cases about half the plant consists of the best type of compound condensing engines, while the remainder is made up of the old-fashioned double Corliss part condensing type, the exhaust from one end of each cylinder being generally used for purposes of heating about the mills. In passing, it may be well to say that most of the modern cotton mill plants use steam for heating direct from the boiler through pressure reducing valves, and not from any part of the exhaust of the engines.

COMPARISONS.

Of modern investigations of the cost of power, none stand higher than those of Dr. C. E. Emery in a paper before the American Institute of Electrical Engineers, Mar. 21, 1893. I have therefore thought it well to include here such parts of the tables as will afford a chance for comparison with the work of the writer and that of others. The investigation by Dr. Emery in this particular case was confined to the large unit of 500 net h. p. and its application must be limited to that amount as any departure will be found to vary the results.

KEY TO TABLES XVIII, XIX, XX AND XXI.

Style of Engine.

A. Simple high speed non-condensing.
B. Simple low speed non-condensing.
C. Compound high speed non-condensing.
D. Special triple compound high speed non-condensing.
E. Simple high speed condensing.
F. Simple low speed condensing.
G. Compound high speed condensing.
H. Compound low speed condensing.
I. Special triple compound high speed condensing.
J. Triple compound low speed condensing.
K. Triple compound low speed condensing.
L. Ditto, for probable maximum results.

As Dr. Emery's computations are made on net power and with coal at 2240 lbs. per ton, it has been necessary to reduce his figures to indicated horse power and coal at 2000 lbs. per ton, the results being found in Tables XVIII and XIX following. Where necessary to bring the items of expense under the same heads, changes have been made in his tables so that direct comparison of items may be made.

Table XVIII shows itemized costs or ten hour power per annum and in Tables XX and XXI the totals have been reduced to cost per hour per horse power in order to conform with the argument of the writer that the only correct safe statement is cost per hour and not per annum.

TABLE XXIX.—Comparison of Different Estimates. Large, Compound Condensing Engines.

	Cost per H. P. per hour.
Emery, A. I. E. E., for 3080 hours, table XX	$.00784
Emery, A. I. E. E., for 7090 hours, table XXI	.00617
Emery, *Eng. Magazine*, 3080 hours	.00856
Webber, 650 h. p., 3080 hours, table XXIV	.00720
Webber, 1050 h. p., 3080 hours, table XXIII	.00646
Hale, 2985 hours, table XXV	.00557
Main, 3080 hours, table XXVIII	.00637
Foster, average, 3080 hours, table XV	.00824
Average of all	$.00705

CONCLUSIONS.

The writer has attempted in various ways, to group the foregoing tables for comparison with each other, but gave

up the attempt as hopeless, with the exception of the class of large compound condensing engines used so generally in the large mills of the East; Table XXIX shows the comparison of costs per hour as developed in the various tables in this class of engine, and although, as previously stated by the writer, the average is hardly to be depended on for use in careful estimates, an average has been computed of the costs by different estimaters and is seen to be $.00705 per horse power per hour. The especial point the writer desires to bring out, is the widely varying costs here shown; take for instance Mr. Hale's of $.00557 as compared with Dr. Emery's of $.00856 or for

TABLE XXX.—Comparison of Cost of Power per Annum. By Various Types of Engines. Coal at $3.00 per 2,000 lbs.

Type of Engine and Number of Plant.		Power Developed.	Cost per H. P. per Annum.			
			Operating Expense.	Fixed Charge.	3,080 Hours.	8,750 Hours.
Slow Speed Non-Condensing	1	297	$71.92	$ .81	....	$79.73
" " "	3	59	117.55	13.82	....	151.37
" " "	5	22	88.24	17.80	106.04	....
" " "	8	129	21.31	9.41	30.72	....
" " "	16	187	18.20	4.47	22.67	....
" " "	12	173	85.90	8.63	94.53	....
" " " Emery	B	556	23.66	8.05	32.61	....
" " " "	B	556	64.91	8.06	....	73.87
" " " Main.....XXVIII.		1,000	19.37	6.49	25.86	....
High Speed Non-Condensing	14	21	157.86	28.42	....	186.28
" " "	4	22	175.13	25.40	200.53	....
" " "	15	33	25.38	5.83	31.21	....
" " "	13	53	44.54	19.51	64.05	....
" " " Emery Eng. Mag.		10	73.15	6.00	79.16	....
" " " " " "		75	36.50	6.50	43.00	....
" " " " " "		542	26.84	8.62	35.46	....
" " " " " "		542	74.02	8.82	....	82.64
Combination, Slow Comp. Cond. High Speed Non-Cond.	6	70	137.79	20.76	....	158.55
Combination, Slow Speed Comp Cond. and Dbl. Cond.	19 20	2,422 1,910	14 17 16.33	6.73 6.63	20.90 22.96	....
Compound High Speed Non-Cond. Emery	C	542	22.21	8 01	30.12	....
" " " " "	C	542	60.88	8.02	....	68.90
Compound High Speed Condensing. Emery	G	542	18.03	7.57	25.60	....
" " " " "	G	542	49.76	7.56	....	57.32
Triple Comp. High Speed Non-Cond. Emery.	D	542	20.73	8 81	29.57	....
" " " " "	D	542	57.12	8.80	....	65.92
Triple Comp. High Speed Condensing. "	I	542	15 93	8.02	24.00	....
" " " " "	I	542	43.98	8.02	....	52.00
Slow Speed Condensing	2	211	68.87	7.83	....	76.75
" " " Emery	F	556	17 53	7.81	25.34	....
" " " "	F	556	48.27	7.81	....	56.08
" " " Main.....XXVIII.		1,000	16.82	6.36	23.18	....
High Speed Condensing. Emery	E	542	19.33	7.36	26.75	....
" " " "	E	542	53.44	7.36	....	60.80
" " " " Eng. Mag.		150	26.65	6.00	32.65	....
Slow Speed Compound Condensing	7	1,346	27.75	9.42	37.17	....
" " " "	18	926	13.77	8.77	22.54	....
" " " "	21	1 279	12.75	6 23	18.98	....
" " " "	22	1 021	16.08	7.74	23.82	....
" " " " Emery	H	556	16.18	7 93	24.11	....
" " " " "	H	556	44.50	7.94	....	52.44
" " " " Emery Eng. Mag.		250	19.96	6.40	26.36	....
" " " " Webber....XXIII.		1,050	13 31	6.62	19 93	....
" " " " .....XXIV.		650	15 68	6.78	22 46	....
" " " " Hale.....XXV.		....	10.75	6 21	16.96	....
" " " " Main.....XXVIII.		1,000	13.40	6.36	19 76	....
Slow Speed Triple Comp. Condensing	17	1,175	9.73	5.50	15.29	....
" " " " " Emery	J	556	14.82	8.93	23.75	....
" " " " " "	J	556	40.82	8.95	....	49.77
" " " " " "	L	556	13.14	9.43	22.57	....
" " " " " "	L	556	36.27	9 42	....	45.69
" " " " " Eng. Mag.		500	15.19	7.20	22.39	....
Water Works Pumps, Compound Cond.	9	1,352	30.86	29.41	....	69.27
" " " " "	10	37	165.30	96.70	....	261.00
" " " " "	11	42	100.65	63 20	....	103 85
" " " Triple "	XXVI	560	47 30	11.64	....	58.94

the writer's of $.00824, the last two are seen to exceed the first by about 50 per cent, a variation which the writer argues does not permit of stating average costs for general use. And finally, in order that the report may be of more practical value, the results have in Table XXX been assembled and reduced to cost per horse power per annum, for ten hours per day for 308 days, and for 24 hours per day for 365 days.

The first column gives the type of engines, with the number of the plant from the tables; next the amount of power developed, as showing the size of the plant; then operating and fixed expense; and in the last two columns, the total cost per annum for 3080 hours and 8760 hours.

This table allows a direct comparison of different plants and different authorities.

THE Mystic Valley Street Railway Company, of Stoneham, Mass., has applied for permission to extend its lines so as to connect with the Arlington & Winchester Street Railway. Chas. F. Woodward, 53 State Street, Boston, is president of the company.

Large Terminal Station in Boston.

The important consolidation of several of the principal trunk lines entering Boston from the South and West has resulted in the decision to erect a large terminal station at the southern end of the city close to the old Federal Street station of the New York & New England Railroad. The station will be used by the Boston & Albany Railroad and by the New York, New Haven & Hartford Railroad and is particularly interesting from an electric railway standpoint from the fact that provision will be made for the entrance there of the electric cars of the latter company's suburban service. The plans have been prepared and contracts let by the Boston Terminal Company, composed of the officers of the two main railroad companies interested. An idea of the extent of the station can be derived from the statement that the contract for the engineering equipment, which was awarded to Westinghouse, Church, Kerr & Company, amounts to about $500,000.

A radical departure from former precedents has been made by providing for tracks upon two floor levels instead of one. The upper level will be devoted to the usual steam railway stub track terminal station for the main line, or through trains, which go beyond commutation points, and also for such suburban trains as it may seem desirable to keep on that level. The lower level will be used exclusively for suburban trains which may be run by electricity or any other motive power which avoids the nuisance and difficulty incident to smoke, steam and gas. The upper floor will have twenty-eight stub tracks, capable of holding about 350 passenger cars. The lower floor will have two loops, which connect with the main tracks at points about half a mile from the station.

The engineering equipment comprises signaling and switching, power house equipme t, electric arc and incandescent lighting, elevators and lifts for passenger, freight and baggage service, heating and ventilation, ice making for car and restaurant use, etc., refrigeration for restaurant, kitchen and storage boxes, cooling water supply for head house, car heating in train shed, storage and express yards, air brake testing, fire protection, disposal of drainage from waterproof structure, frost protection for roof conductors and steam and hot water supply for head house.

The power house equipment will consist of ten boilers, fitted with economizers and mechanical draft and about 1500 h. p. of Westinghouse compound engines direct connected to Westinghouse multipolar generators. The plant will be operated condensing, using salt condensing water, from Fort Point Channel about 100 ft. distant, except when the steam is required for heating.

The electric arc and incandescent lighting is laid out with special reference to the character of the service, leading to the employment of a somewhat larger number of distributing centers than is customary in isolated plants, with very complete methods of switching, in order to meet the demands of the lighting and motor circuits, also to aid in economizing power. In addition to the usual wiring conduits, extra ones are added for miscellaneous wiring for other purposes and also for telephone service within the property. The elevators and lifts for passenger, freight and baggage service comprise nineteen electric elevators.

Heating and ventilation will be carried out on a very extensive scale owing to the exposed nature of the building and will be performed by a combination of the direct and indirect method, with hot blast and tempered air furnished by fans driven by electric motors, while the ventilation is assisted by exhaust fans also driven by electric motors, with separate exhaust systems for the sanitaries. The ice making apparatus comprises a 20 ton ice plant to make "Diamond" ice on the Plate system, and the refrigerating plant is of the usual form installed by Westinghouse, Church, Kerr & Company.

The heating system covers about 40 acres of tracks, and is adapted for heating cars by steam in all locations where they may be detached from the engines. For air brake testing compressed air will be carried to the twenty-eight stub tracks in the train shed and to nearly as many more in other sections of the yard, with the proper appliances for testing the air brakes on cars preparatory to sending out trains. The disposal of drainage from the waterproofed structures involves somewhat unusual considerations, due to the fact that a large portion of the subway structure is 10 ft. or 15 ft. below tide water, necessitating extensive water-proofing. The grade of the suburban tracks necessarily throws its watershed towards the head house and provision is made for taking the storm water of this incline and possible seepage through waterproofing to a sump which is provided with electrical pumping apparatus adapted to automatically keep the water below a certain dangerous level.

As a whole, the Boston Southern Terminal was designed by George B. Francis, C. E., resident engineer, and the chief engineers of the New York, New Haven & Hartford, Boston & Albany, New York & New England and Old Colony Railroads, while the president, Chas. P. Clark, and the Board of Trustees have given their personal attention and supervision not only to the general features, but to many of the details.

LETTERS AND HINTS FROM PRACTICAL MEN.

Proper Handling of Controllers.

GENERAL ELECTRIC COMPANY,
SCHENECTADY, N. Y., July 14, 1897.

EDITORS STREET RAILWAY JOURNAL:

In the last number of the STREET RAILWAY JOURNAL, on page 412, I notice a letter from J. R. Cravath, of Chicago, Ill., in which he attempts to question the statements regarding the acceleration of motor cars made by N. H. Heft in his article on the electrical work recently performed by the New York, New Haven & Hartford Railroad, which appeared in your June number.

Mr. Cravath takes exceptions to the statement made by Mr. Heft that "when the current is turned on quickly and used generously in moving the car, the economy in power consumption is greater than when the rate of acceleration is less rapid," and also asks, "How can results be deduced as to the economy of different methods of controller handling on a run where no stops are made and where the speed, as shown by the curves given, at no time even approaches a stop?"

I would like to say that the results observed by Colonel Heft are quite consistent with those that we have obtained from repeated actual tests. It is quite plain that where a car or train of cars is to run a certain distance in a certain time, the more rapid the acceleration at the beginning of the run the lower the maximum speed.

The work performed in moving a train consists in two parts: (1) that of overcoming train resistances and (2) the storing of energy in the moving mass. For rapid transit work where maximum speeds of 20 to 50 miles are attained, this latter part is much the larger of the two. The energy stored up in the moving car is equal to the $\frac{\text{Mass} \times (\text{Velocity})^2}{2}$, from which it is plain that the lower the maximum speed during the run the lower the energy input. Hence the more rapid the rate of acceleration the more economical the use of power.

It is clear also that the gearing should be properly proportioned to give just the maximum speed required during the run. A higher gearing will be uneconomical since too long a time would be required to get up speed between steps of the controller, and a considerable loss of power running on resistance would result while a lower gearing would not permit schedule time.

With the gears and motors properly proportioned to the work to be done, that is, to the particular running time and distance between stops, it will be found that the watt hours per ton mile will be a minimum when the controller is so handled as to work the motors up to the slipping point of the wheels during the period of acceleration. The economy of power consumption thus attained is more pronounced where, as on elevated and suburban roads, schedule speeds of 14 miles per hour and over are obtained and the distances between stops are from 1500 ft. to 3000 ft. and is less so for lower speeds and longer runs.

Referring to the second part of Mr. Cravath's criticism, namely, where he asks "How can results be deduced as to the economy of different methods of controller handling and acceleration on a run where no stops are made and where the speed, as shown by the curves given, at no time even approaches a stop?" I would say in this connection that the laws of controller handling may be studied from speed curves having base lines of, say, 10 miles an hour as well as from those having base lines of zero miles an hour. According to Newton's first law—"A material point under no forces, or under balanced forces, remains in a state of rest or of uniform motion in a right line," and his second law, "If the forces acting on a material point are unbalanced, an acceleration of motion is produced, proportional to the resultant force and in its direction"—we have a car, whether running uniformly at 10 miles an hour or standing at rest, requiring nearly the same amount of energy and method of applying power to increase its velocity a given amount. There is, of course, a comparatively slight difference due to static resistance at the start and the increase of train resistance with the speed.

From this it is apparent that Mr. Heft could as readily determine the law of economy of controller handling, acceleration and power consumption from a "run where no stops were made" over his entire line as he could where there were stops. The curves in Mr. Heft's article indicate that while the speed of the car never reached zero, the amperes frequently did, showing that the controller was manipulated to secure accelerations from initial velocities.

L. H. PARKER.

WALKER COMPANY,
CLEVELAND, O., July 16, 1897.

EDITORS STREET RAILWAY JOURNAL:

I have your letter asking me to give my opinion as to the most economical results to be obtained in the use of power in starting cars or trains of cars by means of electric motors, i. e., whether it is more economical to turn the current on rapidly so as to bring about a quick acceleration by means of the generous use of current, or whether it is more economical to handle the controller carefully to use less maximum current and more gradual acceleration. I do not believe that there is enough difference in the consumption of energy between the two methods to make much difference in economy. Of course it is much better if possible to secure a more nearly uniform load on the power station, and it would be much easier on the electric equipment, throughout, to accelerate slowly. Where many stops are to be made, it is necessary, of course, to have a rapid acceleration in order that the schedule will be fast. I have asked my assistant, S. T. Dodd, to lay out curves of acceleration, both rapid and slow, and to calculate the results of each, for the sake of comparison, and I herewith send you the results which he obtained.

S. H. SHORT.

[The following is Mr. Dodd's discussion of the problem.—EDS.]

PROPER HANDLING OF CONTROLLERS.

The criticism by J. R. Cravath in the July number of the STREET RAILWAY JOURNAL, under the above title, raises a question which under one form or another has met every street railway man and has appeared in various articles in nearly every periodical dealing with electric railway work.

Instead of dealing with the question in a purely experimental manner, it may be of interest to discuss it upon a theoretical basis. Given a car of a certain weight, let us suppose it is started first with a heavy current and rapid acceleration, then with a less current and slower acceleration, and discuss upon the basis of the torque and speed curves of the motors, the relative amounts of energy necessary to carry the car over the same distance in the two cases. In order to make the results bear more directly upon Colonel Heft's statement, to which Mr. Cravath takes exception, we will suppose that we have a car such as is used on the Nantasket Beach line. In Colonel Heft's article in the June number of the STREET RAILWAY JOURNAL, he gives the weight of motor car No. 2524 and load at 34 tons. This car is equipped with two G. E. 2000 motors, of which the curves are given on page 338 of the same number.

In the first case we will suppose such a car started at 240 amps. per motor and that this current is kept constant by cutting out resistance and connecting the motors in parallel with each other, as is usual with series parallel controllers, until on the last notch of the controller. Of course, in order to keep the current absolutely constant, we would need to have a controller with an infinite number of steps, but it will save complicating our calculations, and at the same time show the tendency of results in practical cases to make such a supposition.

The first thing to be known is the amount of current necessary to maintain the car at a uniform speed on the level. On looking at diagram "A" in the article already quoted, we see that at points

where the grade is shown to be about level, the car takes about 120 amps.

On looking at the curves of the G. E. 2000 motors (Fig. 3), we see that 60 amps. per motor is equivalent to a tractive effort of about 275 lbs., that is, about 550 lbs. per car. As this quantity is about the

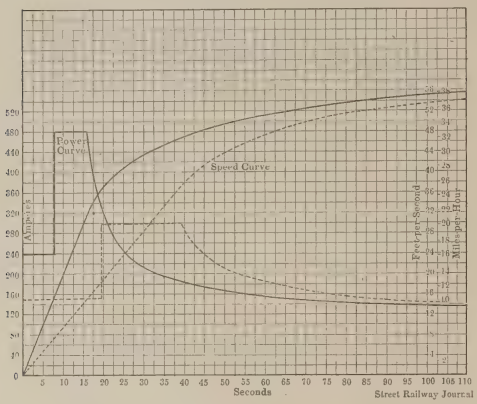


FIG. 1.

size that we might expect for the friction load of such a car, we will assume the current consumption upon the level at 120 amps. If, now, 240 amps. are flowing through each motor, the curve shows a total tractive effort of 2400 lbs. per motor. The acceleration of the car then, according to the usual formula, will be

$$f = 32.2 \times \frac{T - T_f}{W}$$

where T is equal to the total tractive effort; T_f is equal to the friction load (in this case 550 lbs.), W is equal to the weight of the car, 68,000 lbs.

The solution of this equation gives an acceleration of 2.01 ft. per second, the maximum speed at 240 amps. is 22 miles per hour. Therefore, the car would attain this speed, that is, the controller would be entirely cut out in

$$\frac{22 \times 5280}{2.01 \times 3600} = 15.8 \text{ seconds.}$$

After the controller is cut out, the motors continue to speed up and the current falls off; the acceleration for any particular current can be calculated again as above, and the speed curve plotted for this case is shown in full lines in Fig. 1.

The power consumption is shown in full lines in the power curve upon the same diagram. The current at first is 240 amps. According to our supposition this is maintained constant by cutting out the rheostat until the motors are in series with the rheostat all cut out. This operation occupies 8 seconds. The motors are now put in parallel with sufficient resistance to maintain the current at 480 amperes. This rheostat is now cut out by steps until the resistance is entirely cut out. From this point the current drops corresponding to the speed of the motors, and after a sufficient time the current approaches 120 amps. while the speed approaches the neighborhood of 40 miles per hour.

Now, for a slower start, we will suppose the current is maintained in the same way at 150 amps. per motor. The pull shown by the curve of the motor will then be 1280 lbs. per motor, giving us an acceleration of .954 ft. per second. It will be noted that the maximum amount of power is less in this case, but the time of application is greater, 19.6 seconds being occupied until the motors are in series, and 39.2 seconds until they are in parallel with the rheostat all out. However, in the limit the speed again approaches 40 miles an hour, and the limiting value of the current is 120 amps. This is the point that is brought out in the tests of Mr. Knox, which have been quoted, viz., that a quick use of the controller and rapid acceleration calls for sudden and violent fluctuations of current, both in the motors and the power house. After all, this is nothing more than might be expected, for it is elementary physics that it requires more *power* (not necessarily *energy*) to accelerate a certain weight quickly than slowly. As I understand it, however,

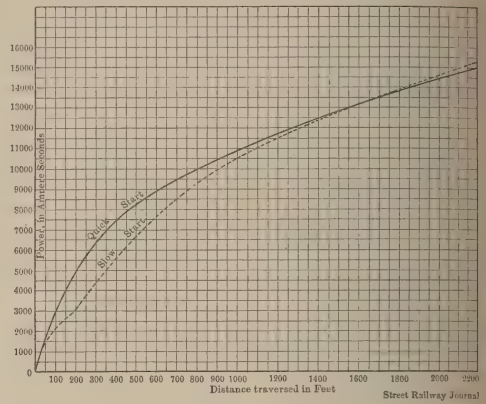


FIG. 2.

the point made by Colonel Heft is that the total energy is less for a given distance with a rapid acceleration than with a slow. To investigate this we will have to carry the work still further.

If, corresponding to any time, we draw a vertical line to meet the speed curve, the area enclosed between the vertical line and this curve will represent the distance traversed in feet. The area enclosed by the power curve and the same line, represents the power consumption in ampere seconds. From this data, a curve,

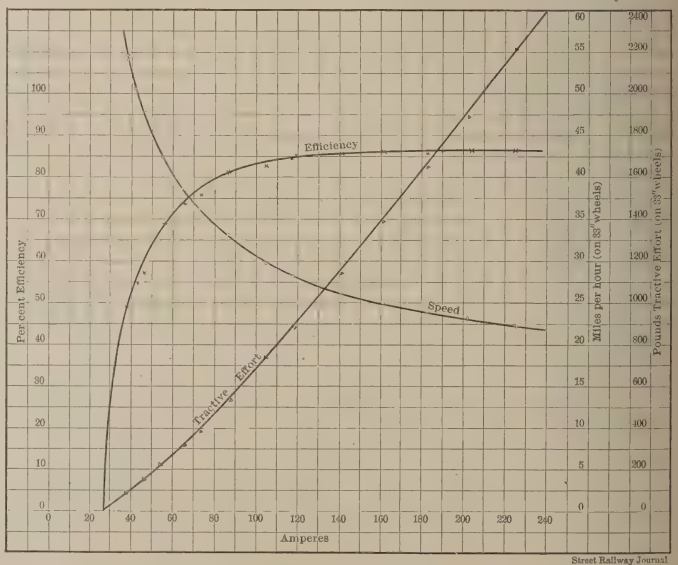


FIG. 3.

showing the energy necessary to carry the car over a certain distance can be plotted. This I have done in Fig. 2. The distances are given in the horizontal lines, while the energy used in ampere seconds is plotted upon the vertical. This energy can be reduced to watt hours by multiplying by $\frac{500}{3600} = .139$. The full lines and dotted lines show the power consumption for the rapid start and slow start, respectively. Comparing these curves, we find more

similarity between them than between the power curves shown in Fig. 1. They show that at first the expenditure of energy in a given distance is greater for a high acceleration than for a low; e. g., in traversing 400 ft. from the start, using 240 amps. per motor, we expend a total amount of energy of 6400 ampere seconds, that is 890 watt hours; while if the start is made with 150 amps. per motor, we expend 5600 ampere seconds, that is 780 watt hours. This difference however, becomes less as the distance increases, and after the car has traversed about 1500 ft. the curves come together. This means that due to the expenditure of energy at the start the car comes so much more rapidly to a high speed, that the economy of running at the high speed and low current makes up for the energy spent in making the start. In fact the curves crossing tend to show the truth of Colonel Heft's statement, "The economy in power consumption is greater than when the rate of acceleration is less rapid." However, the difference between the two curves is so slight that it would require the working out of a more general example before a general statement could be made. But we can get at the same result in this way; we can lay out another curve, having the speed as the horizontal distance, so that the curves will show the power expended in reaching certain speeds. I have not done this, but an inspection of Fig. 1 will show that in every case the curve of slow start would be the higher; that is, it would consume more energy to reach a certain speed with a slow than with a quick start. Since the speeds at distances over 2000 ft. tend to converge, it would appear probable that the curves of Fig. 2 are correct in showing the smaller expenditure of energy necessary to carry the car over distances greater than 2000 ft. with a rapid acceleration than with a slow.

These results will probably be a surprise to many, in view of the well-known fact of the increased power necessary for high accelerations. I have attempted in this article, however, to look at the question from the standpoint of total energy consumed, instead of power. At the same time, it is probable, especially in interurban roads with few and heavy trains, it would be found that the economy of engines and generators at steady loads would more than make up for any loss due to starting cars with moderate accelerations.

Transfer Tickets in Paris.

CIE. FRANÇAISE THOMSON-HOUSTON.

PARIS, June 14, 1897.

EDITORS STREET RAILWAY JOURNAL:

The transfer system used in Paris is quite different from any that I am familiar with in America. It is evidently designed to protect the companies from the various abuses which so often accompany any system of transfers. The tram cars or omnibuses have two rates of fare; the six cent fare entitles a passenger to sit inside or ride on the platform; the three cent fare is for the places on the roof. Passengers paying the six cent fare are entitled to one transfer. Those occupying the roof seats have this privilege by paying the full fare. The conductor only issues a transfer upon receipt of a cash fare. The tickets are printed upon stiff cardboard. They are dated and timed by pushing them in the slot of a machine placed near the door. The stamping of a ticket is indicated by the ringing of a bell. I imagine that there is a totalizer in the machine which would be a check upon the number of transfers issued by each conductor. At the crossing point of two or more lines there is a waiting room. An employe here gives a card colored to correspond to the line the passenger wishes to take, and with a number printed on it. These cards or "numeros" are issued on rotation as asked for.

When an omnibus or car arrives at this place the passengers wishing to, first descend. An employe permanently kept at the station then gives the conductor the proper number he should first call out. Passengers are admitted in the order in which they hold the numbered tickets, surrendering them to the conductor as they enter. Besides, all passengers having transfers give them up to the station employe who stands at the step to receive them. After the passengers have entered, the conductor rings up the total number of them. Two registers are provided for this, one for the interior and one for the roof places. This being done in the presence of the other employe, there is a check upon the proper registration. The station employe keeps the transfers, but credits the conductor with their number upon his trip slip.

After leaving the station the conductor collects his cash fares. He knows how many have entered and how many have given up transfers, so that he has every incentive to collect his fares, as they have been registered. For the same reason, those who might be inclined to pass themselves off as transfer passengers, if by so doing they could ride at the expense of the company, will not do so, for they know that they have been "rung up" and the conductor will have to make good any unpaid fares. It should be said that this method of ringing up the fares at once is employed whenever a passenger boards a car, be it at the transfer station or elsewhere. Coming to a transfer station, the cars will not stop when within a prescribed distance from such a station. This regulation is to avoid the abuse of people unprovided with "numero" tickets crowding into the usually too few vacant places at the expense of those waiting at the transfer station.

It can readily be seen that this system is not applicable to cars where the loading and unloading can be done at any other than one place, say, the rear platform. The system requires at least one employe at each transfer point. The official who gives the "numero" tickets is evidently not a part of the transfer system.

The advantage of the system is that while the conductor must ring up all passengers, cash or transfer, he does not receive the transfer tickets or account for them on his manifest. A. N. CONNETT.

More Danger Alarms and Safety Devices.

CHICAGO, ILL., July 5, 1897.

EDITORS STREET RAILWAY JOURNAL:

The power house engineer has at hand means of detecting danger in the operation of the machinery in his charge, that should be much more fully employed than it is at present. He has electricity "on tap" everywhere, yet how many appliances are there in use for giving an alarm when conditions exist that are favorable to accident? There are some, to be sure, but there could be a dozen where one is now in use. It is not to be understood that a lot of electric alarms are to be installed for the purpose of notifying station men when they should stop loafing and attend to pressing business. The writer does not believe in that kind of business.

Alarms should be used for notifying the engineer or dynamo man before even his trained senses can determine that something is wrong. The electric lamp made fast to the air-pump crosshead, or to some part of the rod, never leads the engineer to depend upon alarms instead of watching things himself. No! When that pump stops, the engineer knows it instantly. His eye detects instantly, the stopping of the motion of that light, and he is half way across the engine room before otherwise he would have been aware that the pump had failed.

The speed alarm can be very easily rigged on an engine. It is only necessary to put in a pair of contacts and connect them to bells and lamps in order to have both audible and visual signals. Then, when an engine gets up to a dangerous speed, the alarm is promptly given. But it will not do to depend upon the governing device for the operation of these alarms. If the regulating mechanism worked properly, there would be no occasion for the automatic alarm, hence it is necessary to attach the alarm to some other and independent part of the engine.

A "slow speed indicator" is a very good one. It may be attached to the dynamo and give warning of both a slipping belt, or an overload that the engine cannot drive up to speed under. Belts running off a pulley, are quickly detected when they bring electric contacts into play, and ring gongs or light up lamps.

STATION ENGINEER.

AN extensive electric railway is proposed through Tuscola and Sanilac Counties in Michigan, by F. S. Weeks, of Cairo, Mich.

LEGAL NOTES AND COMMENTS.*

Edited by J. Aspinwall Hodge, Jr., and George L. Shearer,
of the New York Bar.

Van Depoele Trolley Litigation.

The decision, in the Van Depoele trolley case, of the United States Circuit Court of Appeals for the Second District, delivered July 22, is best understood in connection with a brief account of the previous litigation on the patents involved.

Patent No. 495,443 granted Apr. 11, 1893, to the administrators of C. J. Van Depoele, assignor to the Thomson-Houston Electric Company, contains sixteen claims describing, particularly, combinations between a traveling contact and a suspended conductor. Patent No. 424,695 granted Apr. 1, 1890, applies more especially to combinations between overhead switches and the traveling contact. Both patents originated in a single application of Van Depoele filed in the Patent Office Mar. 12, 1887, but the application was afterwards divided so as to lead to the issuance of both patents.

The language of the two patents is similar and their illustrations are nearly or quite identical, but in the trolley switch patent of 1890, the inventor disclaims his intention of claiming generally a contact device of this description, though claiming certain details thereof which, while of special value in connection with the improved switching devices, are not essential features of the contact device itself considered without reference to the switch. In the trolley conductor patent of 1893, the inventor states that his invention consists more particularly in an improved traveling contact and the improved arrangements and construction of the switches by which the said traveling contact is directed into the proper conductor, but he does not propose to claim the switching devices, although the description and illustration of them are retained, because these devices have been already claimed in the patent of 1890. The patent of 1893 may be described as the broad "underrunning trolley" patent, while the patent of 1890 may be described as the narrow "underrunning trolley" patent, but the broad "trolley switching devices" patent.

Suit was originally brought on claims 6, 7, 8, 12 and 16 of the patent of 1893 by the Thomson-Houston Electric Company, against the Winchester Avenue Railroad Company, of New Haven, and came up for final hearing in the United States Circuit Court, District of Connecticut. The defense (conducted by the Westinghouse Company) was, first, that the alleged invention was made by an employe of the Van Depoele Company and not by Van Depoele himself; second, that there was lack of patentable novelty in view of the prior state of the art; and third, that the invention embraced in the patent of 1893 was disclosed in the patent of 1890 and that even "if the broadest form of the invention was not patented therein, nevertheless the form claimed by the patent in the suit was so inseparably involved in the patenting of the inventions in the forms described and claimed in prior patents, that the right to the patent was exhausted upon the issue of the prior patents and the broad form was waived and became abandoned to the public." Decision was rendered by Judge Townsend on Dec. 7, 1895, and was in favor of the Thomson-Houston Company on all the points of defense raised. Concerning the last point, his language is, "this patent for this specific purpose, applied for Oct. 22, 1888, after the original application had been allowed, but before the patent thereon had been granted, was earlier in the date of issue. The original application was delayed by interference proceedings in the Patent Office. Whatever may be the rule as to cases where the application for the generic patent was filed subsequent to the application for the specific patent, I do not think the patentee should be deprived of his broad patent when the application for such patent was made first and was delayed in the patent office through no fault of the inventor. Such a ruling would be a reproach to the law." An injunction and an accounting of profits was ordered to be entered against the defendants in this case.

Based on this decision, injunction proceedings were commenced by the Thomson-Houston Company in a large number of cases throughout the country, and were successful in the following instances:

In the suit against the Billings & Spencer Company as manufacturers.

In the suit against the Kelsey Electric Railway & Specialty Company as manufacturers. This suit was appealed to the United States Circuit Court of Appeals for the Second Circuit and the injunction was modified so as to permit the defendant to make and sell trolley bases by way of replacement of broken bases or those worn out by use, or substitution for trolley bases previously sold by the owners of the patents to its customers; but the defendant was warned against using this permission as authority to reconstruct or rebuild any combination sold originally by the owners of the patent.

In the suit against the R. D. Nutlall Company, as manufacturers.

In the suit against the Westinghouse Electric & Manufacturing Company as manufacturers.

In the suit against the Nassau Electric Railroad Company and the Steel Motor Company as users and manufacturers respectively.

In the suit against the Camden, Gloucester & Woodbury Railroad Company as users.

In the suit against the Ohio Brass Company as manufacturers. In this case the defense was, first, that there was no infringement, because certain parts only of the patents in combination were sold by the defendant, and, second, that the patent of 1893 was void, because the inventions claimed therein were previously described in the patent of 1890 and others. As to the last point, the lower court refused to go again into the merits of the case, but accepted Judge Townsend's decision, and on an appeal to the United States Circuit Court of Appeals for the Sixth District, the decree of injunction was affirmed, but the court refused to pass upon the second point raised, on the ground that it was unwilling to determine the question of double patenting without a full hearing as to the main facts in the case and the state of the art. The language of this decision indicated quite clearly that the court held grave doubts as to the validity of the patent of 1893 in view of the patent of 1890.

In the suit against the Walker Company as manufacturers.

In the suit against the Simonds Manufacturing Company as manufacturers.

In the suit against the Rahway Electric Light & Power Company as users.

In the suit against the Detroit Citizens' Street Railway Company as users.

In the suit against the Gibbs Electric Company as manufacturers.

In the suit against the Johnson Company and the Steel Motor Company as manufacturers.

In the suit against the Union Railway Company, of New York City, as users.

In the suit against Albert & J. M. Anderson as manufacturers.

In the suit against the Hoosic Railway Company in the Northern Circuit of New York and the Walker Company as users and manufacturers respectively. This suit was appealed to the United States Circuit Court of Appeals in the Second District and has just been decided in favor of the appellants.

In nearly all these cases the circuit judges accepted Judge Townsend's decision without argument on the main features of the case, and all the injunctions given were based upon the five specific claims only of the patent of 1893 passed upon by Judge Townsend. In the last suit, that against the Hoosic Railway Company, the defendants, with whom were associated the Walker Company, appealed to the United States Circuit Court of Appeals in the Second District for an adjudication of the point as to whether or not Judge Townsend was right in stating that the patent of 1890 is an anticipation of the patent of 1893. In rendering his decision in favor of the Walker Company Judge Wallace reviews the case at length and holds that the patent of 1893 is not the generic one and the patent of 1890 the specific one, but that in spite of the disclaimers in both patents, the inconsistencies therein, taken from the standpoint of these disclaimers, are such that the patents described cover practically the same inventions and the patent of 1893 is, therefore, certainly, so far as claims 6, 7, 8, 12 and 16 are concerned, null and void, being anticipated by the patent of 1890. Judge Wallace's language on this point, referring to Judge Townsend's opinion quoted above, is as follows:

"With these conclusions we are unable to agree. We should concur if we could disregard the later patent as the generic one, and the earlier, so far as it relates to the contact device, as limited to the structural improvements upon that device. But we are of the opinion that although the earlier patent contains matter of disclaimer inserted for the purpose of making the later patent ostensibly the generic one so far as it re ates to the contact device, such matter is antagonized by and is wholly inconsistent with some of the claims. These claims in which the switching devices are not an element have no place in the patent, and would be in effect obliterated, unless they cover combinations between the suspended conductor and such a contact device as is described in the specification. In case of conflict, the claims, which are the final and definite expression of the patentee's intention, must control. * * *

"It would be a waste of time to dwell upon the verbal differences in these claims. The changes in phraseology import nothing of substance into their respective combinations. They describe the same things in different language, and the draughtsman seems to have expended great ingenuity in cataloguing a group of synonyms."

The immediate effect of Judge Wallace's decision will be to make it possible for outside manufacturers in all the districts where injunctions have been granted to apply for a dissolution of these injunctions, with the certainty that they will be granted as a matter of course, particularly since the primary decision by Judge Townsend, on which all these injunctions were granted, was re-

*Communications relating to this department may be addressed to the editors, Johnston Building, 30 Broad Street, New York.

versed by the higher court in his own district. It is, of course, possible that the United States Supreme Court may issue a writ of certiorari, calling the case before it for review, but the probability that this will be done is exceedingly remote, as there is no *right* of appeal to the court, and as there are no conflicting decisions by courts of appeal. In other words, Judge Wallace's decision is likely to be a final one as regards the Van Depoele patent of 1893.

Another Federal Decision in the Indianapolis Case.

Judge Showalter of the United States Circuit Court of Appeals of the Seventh District, has sustained his former ruling in the Indianapolis case and holds that in spite of a contrary decision by the State Supreme Court, the Indianapolis three cent fare bill recently passed by the Legislature and aimed directly at the Citizens' Street Railroad Company, of Indianapolis, is not only unconstitutional as regards the Indiana Constitution on account of its being special legislation, but is unconstitutional as regards the United States Constitution because it acts to impair the validity of a contract, Judge Showalter holds that the charter granted by the state to the Citizens' Street Railroad Company, of Indianapolis, is a contract and that the Legislature has no authority to depart from the terms of this contract under guise of "police regulation" or of a reserved power to determine reasonable charges for semi-public service. Under the company's charter it is expressly provided that the directors shall have power to fix the fares on its street railroad at any rate not exceeding five cents. By Sec. 11, it is provided that "this act may be amended or repealed at the discretion of the Legislature." Judge Showalter holds that the right to fix fares cannot be modified otherwise than by amendment or repeal of the act and that this amendment or repeal must be read in the light of the restrictions in the Indiana Constitution bearing upon the matter of amendment. He holds that the recent act imposing three cent fares on the Indianapolis company cannot possibly be construed as an amendment to its charter and that to put it in operation would be therefore a breach of contract which is expressly prohibited by the United States Constitution. He holds also that "a law for the purpose of securing and enforcing fair and reasonable charges by common carriers is not to be classed with those laws making for the public health and morals, the power to enact which cannot be contracted away or parted with by the state."

Speaking of the opinion of the State Supreme Court rendered by Justice Monks, Judge Showalter says:

"The learned writer of the state opinion characterizes the enactment of 1897 as 'a mere regulation of an existing corporation.' In so doing he still has reference to the police power as the untrammeled source of legislative authority for the enactment. But the state contracted that no amendment, which would leave the act as amended a special or local law, should be made. The point is that the enactment of 1897 is not the kind of amendment which it was stipulated in the charter agreement could be made. The long settled doctrine is that the twelve sections of the act of 1861 constituted the contract between the state of Indiana and any corporation organized under that act, and the terms of that contract are ignored in the state opinion. The citations to the proposition that the act of 1897 is 'a mere regulation of an existing corporation,' concern what may be done when the state is not fettered by its own agreement, upon the face of which the other contracting party has acted and expended his money."

An appeal will doubtless be made by the city to the Supreme Court of the United States.

FRANCHISES, ORDINANCES, ETC.

NEW YORK.—The authority to make use of the public streets of a city for railroad purposes primarily resides in the state, and is a part of the sovereign power. City authorities have no power to grant the right, except in so far as they may be authorized by the legislature, and then only in the manner and upon the conditions prescribed by statute.

The Common Council of the city of New York cannot, under the provisions of section 93 of the railroad law, make a valid sale of more than one extension of an existing railroad at the same sale, to be struck off upon one bid, and a sale so made vests no right in the purchaser to build any of the extensions.

Two separate extensions of an existing railroad are not made one, so as to authorize their sale together, under section 93 of the railroad law, by the fact that they are connected by a section of the line of the existing road, and that the Common Council undertakes to sell with them, with the consent of the existing road, a right to use its tracks in such connecting section.

The "further conditions" which, by the last clause of section 93 of the railroad law, the local authorities are permitted to attach to their consent in the building of an extension of an existing railroad, relate to matters ejusdem generis with those specially enumerated, and do not authorize the local authorities to impose, as a condition of their consent, that the existing railroad, if it purchases the right to construct the extension, shall pay into the city treasury a lump sum of money, in addition to the percentage of gross receipts bid at the sale; and a sale made under such condition vests no right in the purchaser.

A condition in the resolutions authorizing the sale of a right to construct an extension of an existing railroad, that no more than five cents shall be charged for a continuous ride to or from such extension, though not a literal compliance with the requirement of section 93 of the railroad law that but one fare shall be exacted for passage over the extension and the main line of road, is, when taken in connection with the further condition that all laws affecting such railroads shall be strictly complied with, a substantial compliance with the statute.—(Beekman v. Third Ave. R. Co., 47 N. E. Rep. 277.)

NEW JERSEY.—1. Under Supp. Revision, p. 369, § 30, providing that no street railroad company may use electricity as the propelling power of its trains without having first obtained the consent of the municipal authorities having charge of the streets; and 3 Gen. St. p. 3231, prohibiting any such company from constructing its tracks on any street, without first obtaining such consent—a "resolution" purporting to give such consent is a nullity.

2. Pending a writ of certiorari to test the validity of a city ordinance purporting to grant to a street railroad company power to use for its purposes the streets of the city, and to use electricity as the propelling power of its cars, in which proceeding the company appeared for the purpose of upholding the ordinance, the company proceeded in evasion of the restraining force of the writ, and under color of the advice of counsel, to lay down its tracks under and by virtue of a "resolution" of the board of public works which had preceded the ordinance. *Held*, that the company, by reason of thus proceeding, was in contempt.—(State v. Bd. of Pub. Works of City of Camden, 37 At. Rep. 598.)

MISSOURI.—Where a city ordinance authorized a street railway company to change its motive power, and to operate its railway by electricity for thirty-five years, with the right to collect fares at certain rates, and with the duty of keeping in repairs the street between the tracks and for 2 ft. on each side, it was not thereby exempted expressly by implication from paying on its cars a license tax which the city was by statute authorized to impose; and hence a subsequent ordinance imposing such license, though it was imposed for revenue purposes, and not as a police regulation, was not void under Const. U. S. art. 1, § 10, as impairing the obligation of a contract.—(City of Springfield v. Smith, 40 S. W. Rep. 757.)

NEW JERSEY.—If boroughs possess the power to license "cars," the power exists under the act of March 28, 1892 (1 Gen. St. p. 274), and can be enforced only by a precise pecuniary penalty, fixed by the governing board of the borough.—(State v. Mayor, etc., of Brigantine, 37 At. Rep. 437.)

LIABILITY FOR NEGLIGENCE.

NEW YORK.—Plaintiff's intestate, who was employed to attach an extra horse to defendant's street cars to assist in pulling them up a hill, was thrown under a car while detaching the horse at the top of the hill. The evidence showed that, as the car approached the place where the horse was ordinarily detached, intestate stooped down as if to unfasten the hook by which the horse was attached. The horse then began to turn off from the car, and intestate alighted. The hook had not been unfastened, and, as the horse came around, intestate was caught by the chain, the horse was thrown down, and intestate was thrown under the car. It was claimed that the horse was vicious, in that he had a tendency to turn out too quickly as he approached the place of being detached. There was no evidence that the horse turned before intestate pulled him around with the rein, and it was shown that he turned slowly. There was no evidence that the failure to stop the car before it ran over intestate resulted from any defect in the appliances. *Held*, that a finding that defendant was negligent could not be sustained.—(Devlin v. Met. St. Ry. Co., 45 N. Y. Supp. 505.)

NEW YORK.—Plaintiff was working on an excavation between defendant's street railroad tracks. An approaching car stopped near the place until the track could be cleared. About the time the car started again, plaintiff crossed the track in front of it, and his leg was broken by a blow from a plank, which plaintiff had been using and which the car in some manner caused to fly up. Plaintiff testified that before the car started he signaled it to wait, and that he then went on the track to remove the plank, and that the car proceeded notwithstanding his signal, struck the plank and caused his injuries. The motorman testified that he did not see plaintiff's signal. *Held*, that whether the motorman was negligent in not seeing plaintiff's signal was a question for the jury, and therefore it was error to charge that plaintiff was entitled to recover if the jury found that the accident happened as plaintiff said it did.—(Morrissey v. Westchester El. Ry. Co., 45 N. Y. Supp. 444.)

NEW YORK.—A city ordinance which forbids passengers to ride on the front platforms of street cars does not authorize a street railroad company to accept a fare from a passenger while riding on the front platform when there is no room for him elsewhere, and then eject him from the car without returning the fare.

A passenger on a street car who receives a transfer to another line is not entitled to board the first car that reaches the transfer point, regardless of whether there is room for him on the car.—(Hanna v. Nassau El. R. Co., 45 N. Y. Supp. 457.)

MASSACHUSETTS.—Contributory negligence appears as a matter of law where plaintiff, who was very deaf, went on a car track in the daytime, and was struck by an electric car going 4 miles an hour; the street being clear, so that he could have seen 300 ft. in the direction from which the car came.—(Hall v. West End St. Ry. Co. 47 N. E. Rep. 124.)

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THE Niagara Falls Convention of the American Street Railway Association will be held Oct. 19-22, and every effort is being made by President McCulloch and the local committee to make the convention most successful. Those who attended the St. Louis meeting will realize that it will be very difficult indeed for those who have the coming convention in charge to surpass in attractive features the convention held at St. Louis, which is generally pronounced to have been the most enthusiastic and largely attended in the history of the association up to that time. The meeting last year was held, however, less than a month before an important presidential election, when the minds of men were given more to things political than to those of any other kind, and while it would be impossible for any local committee to exceed the St. Louis committee in efforts to provide for a profitable convention, the absence of exciting political conditions and the general revival of business, which has already commenced, will enable many to attend this year who could not visit St. Louis last October. The convention of street railway accountants at Niagara Falls will also be an added attraction this year. The arrangements for exhibits are said to be adequate, the hotels are planning carefully and wisely for the expected host of guests, and it is safe to promise all who propose to visit Niagara Falls this fall a royal welcome and a most enjoyable time.

DURING the month of September the New York State Street Railway Association and the Pennsylvania State Street Railway Association will also hold conventions, the first at Niagara Falls Sept. 14 and 15 and the second at Allentown, Sept. 1. While occupying an entirely different province from the National Association, the meetings of the state associations are usually quite as important to their members as is the national association. As the powers and privileges of street railway companies are so largely governed by state laws and not at all by national statutes, the street railways of any state have many interests in common and therefore at state meetings can discuss and take action upon a much broader field of subjects than can a national association. For this reason the increasing interest taken in the meetings of the national association has in no respect detracted from that in the meetings of the different state associations, but has, on the contrary, given an impetus to the desire for co-operative action which the latter are able to carry out, besides affording an excellent opportunity for neighboring officials to become acquainted and renew old friendships.

WE notice that the *Electrical Review*, of London, takes exception to the statement of President Clark, of the New York, New Haven & Hartford Railroad, that cars have been operated for hours over sections of his line when both the third rail and service rails were covered with water. The *Review* evidently thinks that such a thing is impossible and a "piece of exaggeration that any tyro would detect." It is true, nevertheless, that such things have happened and can happen and in fact may be expected to happen under such conditions as are found at Nantasket Beach, for it is a fact demonstrated repeatedly in conduit and third rail work that the resistance of rain water or even of water which is by no means chemically pure is sufficiently great to prevent a leakage approaching a short circuit on a line with only 500 volts pressure. Those who have tested railway plants with water rheostats can easily understand this, knowing the difficulty of forcing a large volume of current through a body of water, unless the plates are placed quite close together, and we may add, for the benefit of our doubting contemporary, that the recent heavy rains in Connecticut flooded the tracks of the Hartford-Berlin third rail electric road without interfering with operation.

THE use of "curves" for graphic presentation of data is capable of almost as wide application in the accounting department of a street railway company as in its engineering department. Two year comparisons of receipts, expenses, etc., are usually made in figures by accountants for the benefit of managers, but in this way the general relationship of the latest reports with those of earlier years is often lost sight of, and many interesting and important comparisons are never brought to light. By the use of curves, however, it is just as easy to show comparative annual receipts of fifteen or twenty years as two years, and the same holds true of operating expenses in

gross, and in as much detail as desired. Monthly returns from year to year can be compared in this way, increases and decreases of payrolls are instantly evident to the eye, and a mass of data can be quickly put into shape by an assistant in such a way as to save the manager himself an immense amount of time, and to give him, as well, a clear understanding of the financial and operating history of his road. Pocket memorandum books, with cross section paper, can be made for the manager, and kept up to date each month with comparatively little trouble, since, when the back history of the road is once made up, the current changes are put in by the addition of but a single line on each curve. This method of graphically presenting operating figures is now used by a prominent railroad manager of the West, who carries out the system in every detail, down to individual payrolls even, and the accounting work of some 300 employes on his system is crystallized by a single employe into his various books of curve data. On pages 468 and 469 of the present issue will be found illustrations of this method of presenting financial results.

ONE of the characteristic features of foreign railway construction is the favor with which composite rails are regarded. This is true not only of street railway construction proper, but also in steam railroad track. A variety of forms of composite rails is used, but the main object of all is the elimination of an abrupt break in the rail by lapping the joints of the different members of the composite rail, or where one single web rail is used, to make a long mortise if the web is concentric, or lap the webs if they are eccentric. The reports that these rails are able to stand up under heavy traffic are undoubtedly premature, as there has been little experience with electric traction abroad, but we must seek some reason other than inefficiency or impracticability to account for their non-use in America. One of these reasons is undoubtedly the fact that nearly all of the types of composite jointless rails used abroad require either considerable machining, or else a large amount of labor in assembling the different parts. Skilled labor is more expensive in this country than in Europe, so that the total cost of the rail as laid would be considerably higher. The greater cost was one of the principal objections urged against the introduction of one type of these rails by the rolling mills in this country upon the occasion of a visit to the United States of the agent of one of the best known patented rails used abroad. Another reason lies in the number of very excellent joint devices which have been brought out in America during the last few years. These have shown themselves so much superior to the old fish-plate joint that the need for the jointless composite rail has been very much reduced, and the success of some of these devices has been so great that even on the continent of Europe, where the cost of a composite rail laid is much less than it would be in this country, there has been a large sale of cast weld and other joints suitable for use with a standard single web rail.

Standard Distribution of Street Railway Receipts and Expenses.

WE venture to express the hope that the committee of the Street Railway Accountants' Association of America, which is to recommend to the association at its October meeting a standard system of distributing receipts and expenses, will not depart materially from the system adopted by the Board of Railroad Commissioners of the State of New York, which is the result of the best thought given to street railway classifications by nearly all the leading accountants of a state which has a larger amount of mileage and invested capital in street and steam railways than any other in the Union. It is true that this classification is not perfect, and in the following discussion we shall have certain recommendations to make regarding changes, but, these recommendations will be more in the nature of expansions of the general structure, than of radical changes in classifications, and, altogether, we believe the New York system to be well worthy of adoption in a larger field.

The Massachusetts classification is much less worthy of approval, strange to say, since we have grown accustomed to the best things only in steam and street railway decisions by that wise Board of Railroad Commissioners in the old Bay State. Several of its imperfections will be pointed out presently. The Interstate Commerce classification, of which both the New York and Massachusetts street railway systems are adaptations, is the well digested experience of the best steam railroad accountants in the country, and it is with much diffidence that we shall venture to criticise it, even in minor features.

As a basis for a critical review of these three independent attempts at classifying railway revenue and expenditures, we submit the following mode of presentation of income account and classification of operating expenses:

GENERAL INCOME ACCOUNT.

Gross earnings from operation
(including cash fares, sales of tickets, chartered cars, and mail, express and freight earnings).

Operating expenses
(excluding all taxes).

Net earnings from operation.

Income from other sources
(including receipts from advertising, track rentals, sale of power, rental of buildings or property, interest and dividends on securities owned).

Gross income from all sources.

Deductions from income
(including taxes of all kinds, interest on funded debt, rentals, and other deductions).

Net income from all sources.

Payments from net income
(including dividends and other payments not pertaining to operation).

Surplus (or deficit) for year.

OPERATING EXPENSES.

General Expenses.
Salaries of general officers and clerks.
General office expenses and supplies.
Advertising, stationery and printing.
Insurance.
Legal expenses.
Injuries and damages to persons and property.
Other general expenses.

Transportation Expenses.
Wages of conductors and motormen.
Wages of car house employes.
Wages of power house employes.
Wages of stable employes.
Other transportation wages.
Cost of fuel at power house.
Water and other power house supplies and expenses.

Cost of hired power.
Provender.
Rentals for tracks, buildings and other property used in transportation.
Other transportation expenses.

Maintenance of Way and Structures.
Repairs of roadbed and bridges.
Renewals of roadbed and bridges (including rails, ties, rail bonds, underground conduit and other roadbed material).
Repairs of overhead and underground feeder construction.
Renewals of overhead and underground feeder construction.
Repairs and renewals of buildings.
Removal of snow and ice.
Other repairs.
Other renewals.

Maintenance of Equipment.
Repairs of car bodies, trucks and other vehicles.
Repairs of electric (or cable) equipment of cars.
Repairs of station steam plant.
Repairs of station electric plant.
Renewals of car bodies, trucks and other vehicles.
Renewals of electric (or cable) equipment of cars.
Renewals of station steam plant.
Renewals of station electric (or cable) plant.
Repairs and renewals of tools and machinery.
Renewals of horses.
Repairs and renewals of harness and stable material.
Veterinary service and horseshoeing.
Other equipment repairs.
Other equipment renewals.

The above schedule closely follows the New York system. The principal differences between the three schedules lie in the treatment of injuries and damages, cost of electromotive power, and rentals of tracks and other property. In the Interstate Commerce and Massachusetts classifications, injuries and damages are carried in "Transportation Expenses," and in the New York classification in "General Expenses." Strong arguments can, of course, be made for both views of this item, but in the end it comes down almost to a mere matter of convention, and in spite of the weight of steam railroad and Massachusetts precedent, we believe that the New York system should be followed in this respect, representing as it does, the first distinct attempt to reduce street railway accounting to a standard.

In the handling of what the Massachusetts classification calls "Cost of Electromotive Power" the Massachusetts Board of Railroad Commissioners has certainly made a surprising ruling in ordering that repairs and renewals of the steam and electrical equipment of power stations shall be taken out of "Maintenance of Equipment," and placed in "Transportation Expenses" as a part of this "Cost of Electromotive Power." The exception made in this case to the general rule in railroad accounting that all maintenance items are properly to be classified in one of the two maintenance divisions can hardly be defended from the accountant's point of view. The object of doing this is, we presume, to obtain an item which by itself will represent the cost of an important department of operating expenses, for comparison with costs obtained elsewhere. This object is not accomplished, however, and cannot possibly be accomplished without throwing the whole scheme of railroad accounting completely out of joint. In order to get the true cost of electromotive power, it would be necessary not only to take from the "Maintenance of Equipment" division the repairs and renewals of power station plant, but from the "Maintenance of Way and Structures" division, the cost of repairs and renewals of power station buildings, and from the "General Expenses" division a pro rata share of insurance, general office salaries and expenses and other items, based on some method of division not necessary to be developed here. Moreover, interest upon power station investment must be taken out of fixed charges or surplus applicable to dividends, if a true cost figure is to be obtained possible to be compared with that of other plants. It would be far more logical, therefore, to adopt the Interstate Commerce or New York State classification in this matter of power station maintenance, while it is, of course, entirely possible for any manager to make up figures for this cost of electromotive power at any time by selecting items from all the different divisions in the way suggested above.

By the Interstate Commerce classification, rentals for tracks, yards and terminals and other rentals, are placed in "General Expenses," while in the Massachusetts and New York classifications, as well as in the one suggested above, these items are placed in "Transportation Expenses." It is an open question, as to whether such items should not more properly be put in the division of "Maintenance of Roadway and Buildings," as a rental of this character really means an avoidance of maintenance charges, and we imagine that the Interstate Commerce Commission may have decided to place it in "General Expenses" as being otherwise difficult to properly classify.

We believe very firmly that there is a clear distinction between "repairs" and "renewals," and that this distinction can be carried out in practice without difficulty. A manager should be able to determine from his accounts just how much is annually spent on pure repairs, i.e., on such changes and renewals of *parts* of the larger units of apparatus as will tend to keep those units in operation until they are worn out and fit subjects for renewal. By separating out these two divisions of maintenance, it is possible to better estimate the annual depreciation which eventually makes renewals necessary; and thus both the manager and the investing public are less likely to run across surprises in the nature of unexpected demands for money to bring a depreciated road and equipment back to good operating condition. Now, all three of the classifications under investigation, even the Interstate Commerce classification, are subject to criticism in this matter of dividing the maintenance accounts; though the latter is nearer the true idea in the division of "Maintenance of Way and Structures." Under "Maintenance of Equipment" it brings together repairs and renewals of locomotives, cars, etc., returning them in one item. In the New York classification, repairs only are given for equipment and overhead and underground construction, while repairs and renewals are lumped together for roadbed and buildings. The Massachusetts classification also includes repairs and renewals in one item.

Nomenclature is important in classification work of this kind where clearness of idea is essential, and we trust that the committee will give most careful thought to the different ways of expressing these classifications. The most important part of its work will be, of course, the "Instructions" accompanying the classifications, since these must of necessity cover all the details of charges which accountants are called upon to handle. It will be well for the association to appoint a permanent committee to pass upon questions arising among accountants, these decisions to be incorporated in later "Instruction Books."

CONSTRUCTION

Compressed Air Motors.

In a review of the mechanical tramway systems of Europe by E. A. Ziffer, read before the International Street Railway Association at its last annual meeting at Stockholm, the statement was made that compressed air cars were then in use on seven lines in Europe, aggregating about 40 miles of track and that several other lines were in course of construction. The General Omnibus Company of Paris has had compressed air motors on three of its lines for a number of years and they are giving, according to the general manager of the company, excellent satisfaction. Many attempts have been made in this country to operate compressed air cars, but up to recently with exceedingly discouraging results. The value, however of a motive power for street railways that will obviate the well known objections to trolley lines, and the enormous expense and delay of equipment of conduit lines, has brought about within the last year a very rapid development of compressed air, as a motive power for this purpose.

Reference has previously been made to the motors of the Compressed Air Power Company which has installed a number of motors in New York City and has during the last month put some motors in operation on the Eckington & Soldiers' Home Railway in Washington, D. C. This company was formed a little more than a year ago by several prominent New York and Philadelphia capitalists headed by Wm. C. Whitney and Thomas Ryan, of New York, and Messrs. Elkins, Widener and Dolan, of Philadelphia. The engineers secured by this syndicate to develop this system were two young men of long experience in electric and cable railroading, J. H. Hoadley and Walter H. Knight. The latter has been chief railway engineer of the General Electric Company and one of the pioneers in electric railroading while the former is a prominent designer and builder of electric railways. These gentlemen approached the problem from an entirely novel standpoint, following rather the lines of the electric motor equipment than those of compressed air cars, as the latter had been built theretofore. They sought first a motor that would be like an electric motor—iron clad, and resting with one end upon an axle, to which its crank shaft was geared.

The unsatisfactory results attending the use of side rods and exposed machinery, in connection with the electric motor, were, of course, well known, and it was realized at once that in any form of air motor it was essential that the moving parts should be enclosed in a case where they could run in oil, free from dust, and where they would lubricate themselves continuously without the attention of the operator. It also seemed extremely desirable to continue the use of standard street car wheels, axles, trucks and car bodies, as these have all reached a standardized form which is known to insure the least expense of maintenance.

FIG. 1.—COMPRESSED AIR MOTOR CAR—NEW YORK.

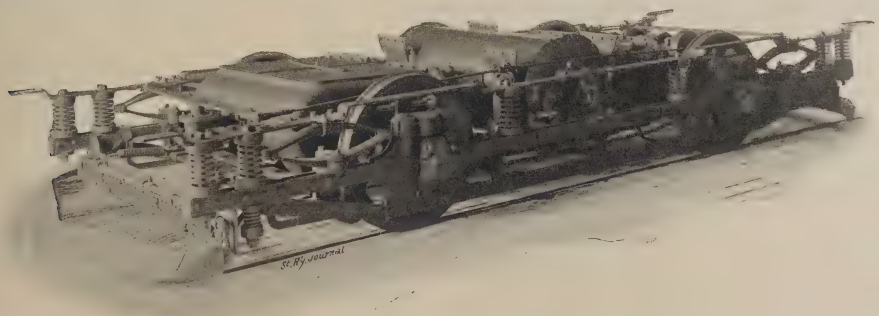


FIG. 2.—SIDE VIEW—COMPRESSED AIR MOTOR EQUIPMENT ON STANDARD BROADWAY TRUCK.

Owing also, to the limited intelligence of the motorman, and the necessity of more prompt control than is had

with steam locomotives, it was considered necessary to develop a controller, which could be operated by a single handle to perform all the various functions of the controller in their proper sequence without requiring thought on the part of the motormen. These three features of iron

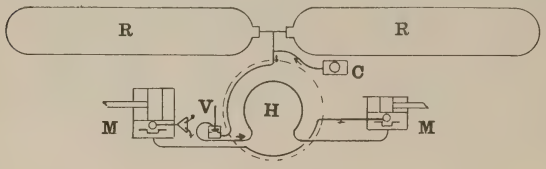


FIG. 3.—DIAGRAM SHOWING FLOW OF AIR

clad motors, running in oil, standard street railway rolling stock and single handle controller, were therefore made the distinctive features of the Hoadley-Knight system, which may be described more in detail as follows:

On each axle is mounted an iron clad motor, having two cylinders and cranks at right angles. One motor has two high pressure cylinders, 3½ ins. diameter and 6 ins. stroke, and the other motor has two low pressure cylinders, 7 ins. diameter and 6 ins. stroke. Upon the crank shaft is a pinion, about 9 ins. in diameter, meshing into a 23 in. gear wheel mounted on the middle of the axle; the axle is straight, as used for electric motors, and the wheels are ordinary street car wheels. The motor consists essentially of a cast iron case or basin, to which the two cylinders are bolted and in which all the moving parts, the piston rods, crossheads, connecting rods, cranks, gears, valve rods, eccentrics and reversing mechanism are located. The basin is covered with a lid which can be quickly removed, thereby exposing all the machinery for complete inspection. A sufficient quantity of oil is introduced into the basin to keep the moving parts continuously drenched with the lubricant, thus insuring for them the longest possible life, and reducing to a corresponding degree the maintenance account.

The air reservoirs, in the shape of seamless steel bottles, are under the seats of the car, and a pipe leads

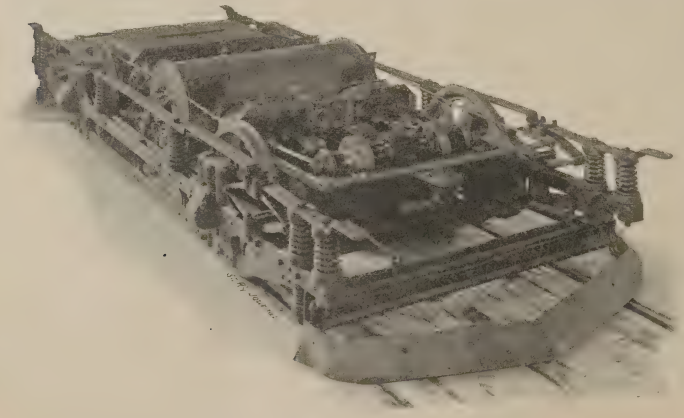


FIG 5.—TOP VIEW—COMPRESSED AIR MOTOR TRUCK.

from them to a combined reducing and throttle valve, which reduces the storage pressure to the working pressure. The pipe before reaching the reducing valve passes around the heater, so that the air can receive sufficient heat to prevent freezing any moisture that may be in it.

The heater consists of a seamless flask charged with hot water under a pressure of from 150 lbs. to 250 lbs.

The air on leaving the reducing valve passes through a coil kept hot by the heater to a temperature corresponding to the steam pressure of the hot water, and is then introduced into the high pressure cylinders, both of which are in one motor on one axle. During its passage between the reducing valve and the high pressure cylinder means are provided for injecting a certain amount of moisture into the air, this having been found to give certain advantages as will be described later. In exhausting from the high pressure motor the air is again heated and passes through the low pressure motor on the other axle, from which it escapes through a muffler into the atmosphere. By having one motor high pressure and the other motor low pressure, undue slipping of the wheels is prevented, as when the high pressure wheels slip the low pressure motor gets more air and more pressure, and the back pressure from the receiver tends to stop the slipping. When the low pressure motor slips its wheels, it draws down the receiver pressure and thereby

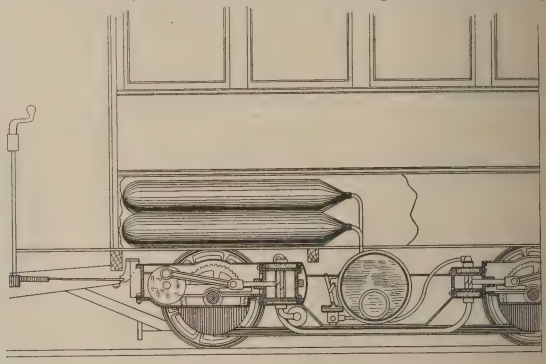


FIG. 4.—SECTIONAL VIEW OF MOTOR CAR.

weakens itself, correspondingly increasing the strength of the non-slipping motor. The direction of the flow of the air is shown in Fig. 3 where *R R* are the air reservoirs, *V* the reducing valve, *H* the heater, *M M* the motors.

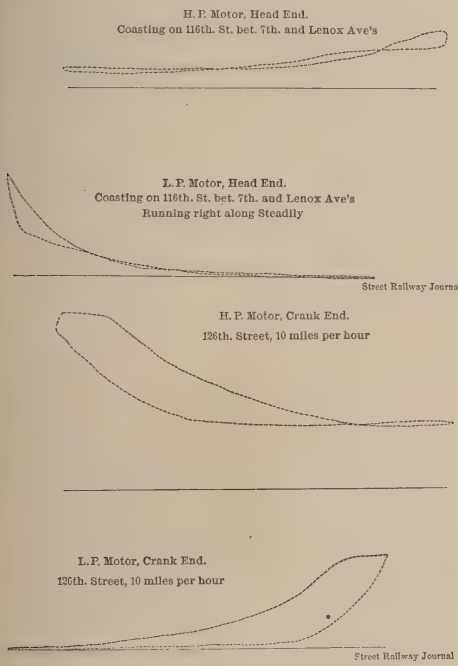
Twelve months' operation have demonstrated that these motors are highly efficient and exceedingly durable, all of the original parts being still in use. The manufacturers estimate that making a liberal allowance for the wear and tear that must occur and which, in the case of the more rapidly wearing parts, has been measured, the maintenance per car mile can be figured at not more than one cent, which compares favorably with that of the electric motor.

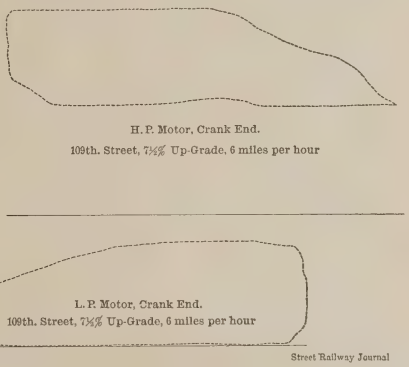
The weight of the standard Hoadley-Knight air car is tabulated as follows.

Car body	6,000 lbs.
Trucks	4,500 "
Air reservoirs	3,000 "
Heater	500 "
Motors (each 1500 lbs.)	3,000 "
Controlling apparatus	400 "
Piping	150 "
Total	17,500 "

The motors are capable of slipping the wheels on a dry rail under a weight of 30,000 lbs., and are therefore as powerful as the heaviest electric motor equipment. The total weight is little, if any, more than that of an equally powerful electric equipment, and the rigid weight on the axle, to which maintenance of track is mostly charged, is considerably less.

The air consumption of these cars varies from 30 lbs. to 40 lbs. per car mile, for a 34 ft. car of the Broadway type. About 11 lbs. of air can be compressed to 2000 lbs. per square inch per horse power hour. The cars require therefore, on an average a little over 3 h. p. hours per car mile, which in a modern compressor, running on a steady load and pumping into a reservoir of ample capacity, can be produced, it is claimed, for one-half cent per horse power hour, including all power house charges. To this must be added the cost of the hot water for reheating, which is given by the engineers of the system as one mill per car mile. The motive power expenses per car mile on this basis are therefore estimated as follows:


H. P. Motor, Head End.
Coasting on 116th. St. bet. 7th. and Lenox Ave's
L. P. Motor, Head End.
Coasting on 116th. St. bet. 7th. and Lenox Ave's
Running right along Steadily
Street Railway Journal
H. P. Motor, Crank End.
126th. Street, 10 miles per hour
L. P. Motor, Crank End.
126th. Street, 10 miles per hour
Street Railway Journal


H. P. Motor, Crank End.
109th. Street, 7½% Up-Grade, 6 miles per hour
L. P. Motor, Crank End.
109th. Street, 7½% Up-Grade, 6 miles per hour
Street Railway Journal

FIGS. 6, 7 AND 8—TYPICAL H. P. AND L. P. MOTOR INDICATOR DIAGRAMS.

COST PER CAR MILE OF MOTIVE POWER.

3½ h. p. hours at ½ cent.	$.0175
Hot water for reheating	.001
Maintenance of motor equipment	.01
Total	$.0285

This compares favorably with the best that has been done with electric motors. The storage capacity for a run of 17 miles would be 45 cu. ft.

The Hoadley-Knight motors are controlled by varying the cut-off as well as by the throttle, the two being operated simultaneously. This method of controlling is adopted because it not only gives the highest efficiency, but also gives the greatest range of power. A car can be started with a promptness only limited by the friction of the wheels on the rails, or may be started with almost imperceptile acceleration. In common with other air cars, the start is easy and free from jerks.

A forward movement of the single controller handle starts the car and the propelling force is proportional to the distance that the handle is moved from its starting peint, so that any degree of acceleration can be obtained. A backward movement to the starting position brings the valve to a minimum cut-off and closes the throttle. A still further backward movement reverses the motors and opens the throttle to back the car. The inventors claim that anything less simple than this is not feasible, or indeed safe for street car work, and they point out as sustaining this view, that the only successful electric controllers have been substantially as simple. Of course, with an electric motor the reversing handle has been kept separate, as it is undesirable to reverse an electric motor, but with an air motor there is no objection to reversing, and there is therefore no need of more than one handle on this account.

The inventors have made a large and exhaustive series of experiments on the subject of the heater. They have tried all the known forms. Their first experiment with the Mékarski heater, which is the one generally in use on air cars and in which the air is made to pass up through hot water, proved to them that such a method is liable to bring excessive quantities of water over into the motors, when heavy demands are made upon the air. They also found, what had not been generally recognized until they announced it, that such a heater, when the contained water is under a pressure exceeding that of the air, runs the motor, practically as a steam engine, with too much visible exhaust and too little air, and that after the pressure of the water in the heater falls below that of the air, practically no steam is generated, and the air enters the motor practically dry. Their experiments with dry heaters showed them that the same economy could be obtained with dry heat as with wet, but the heater itself proved objectionable and difficult to regulate. This brought about a return to the hot water heater, but with certain precautions against admitting the air to the water, which proved highly satisfactory.

Their experiments with air reservoirs have been probably the most extensive ever made. They have tried large numbers of each of the five different prominent manufacturers and have experimentally blown up all kinds repeatedly, both with air and water, and find that they are all very much alike, both as regards strength and character of rupture. They are now using the Ehrhardt flasks. It seems to be generally admitted that the air motor would have reached a practical state of perfection much earlier, had it not been for the slow development of the art of making high pressure flasks, which until the last few years were not obtainable of sufficient strength to give the desired capacity within a reasonable space.

One of these cars will run 15 miles on a good track on a charge that is restricted to a space under the seats, and this could be even increased to 20 miles by crowding in all the flasks that the space could allow.

As the air pressure in the reservoirs is always limited to that which the compressor can give, and as the reservoirs themselves are capable of withstanding nearly three times this pressure, it will be readily seen that the element of danger is practically eliminated. There is no possible way in which the air pressure can be increased to the bursting

pressure of the flasks. Furthermore they are protected by a safety pop set to open at a pressure slightly above that given by the compressor. There is no deteriorating influence incidental to their use. There has never been an explosion with any of these flasks by air, except when premeditated, and only then with the greatest difficulty and with apparatus especially constructed at great expense to bring the required force into play. Every flask is tested to 2½ times its working pressure before being used. Steam boilers are only tested 1½ times the working pressure.

The placing of the motor in the middle of the axle and the driving of the axle in the middle, by means of the gear, does away with all lateral oscillation, so common in side rod motors.

The car presents an appearance like that of an electric car without the trolley accessories, and it is claimed to accelerate as quickly, to run as fast, to be as free from vibration, start with greater ease, stop with greater promptness (owing to lack of momentum of armatures) and to possess in general all the advantages of the electric car, without any of its disadvantages.

It is true that every two hours the cars must be charged, but this is done in two minutes and at the end of the line, where it does not inconvenience the passengers, and therefore, so far as the traveling public is concerned, is attended with no disadvantages. To the street railway man it means practically almost no additional expense, as in general a wait of at least two minutes is made at the end of the line.

As compared with the storage battery car, which in its absence from dependence upon a distributing system the air motor resembles, the latter is claimed to possess the following advantages:

1. Its storage cells cost very little, comparatively.
2. They are a permanent investment, requiring practically no repairing.
3. The reservoirs can be charged in two minutes instead of six hours.
4. An exhaustion of the battery does not injure it (as with the sulphating of the electric battery).
5. The weight is about one-half.
6. There is no odor.
7. There is no corrosive liquid to slop over, or injure operatives' hands.
8. In case of necessity it can be charged along the line without leaving the line.

Barring fuel burning motors, which seem to be by common consent ruled out of the sphere of street service, compressed air stands alone as the only available stored force, which suffers no loss or deterioration while stored, which is instantly available, which requires no skill to utilize it and which is absolutely free from any offensive products. It is due to these practical features that compressed air has been so successful as a transmitter of force in mining work and air brakes, and the same advantages, it is believed by its promoters, will bring about its very general adoption for propeling vehicles.

The compressor problem for the high pressures used in this system is one which has required an especial amount of investigation.

It was found that the three stage compressors were unsatisfactory. For one thing, the temperature conditions required at least four stages to prevent the carbonization of the lubricant, and a four stage, belt driven compressor was constructed in demonstration of this and other points and was used afterward to run cars in Washington, D. C. With this compressor, a new system of compressor valves was worked out, with a view of saving the frequent renewals caused by such valves as were previously used. With the new style of valves this compressor has shown a capability of being run continuously night and day at full speed for six months, without requiring any renewals. The valves are of such simple construction as to cost almost nothing for renewal. With a four stage compressor there is not only the improvement due to better treatment of the lubricants, by reason of the lower temperatures, but also less back leakage, and greater economy to the extent of about 10 per cent, or more, as compared with a three stage compressor having the same elements of improved detail. As compared with any three stage compressor the market has heretofore offered, the saving is claimed to be much greater.

Taking advantage of the experience gained from the experimental four stage compressor, E. K. Hill, engineer

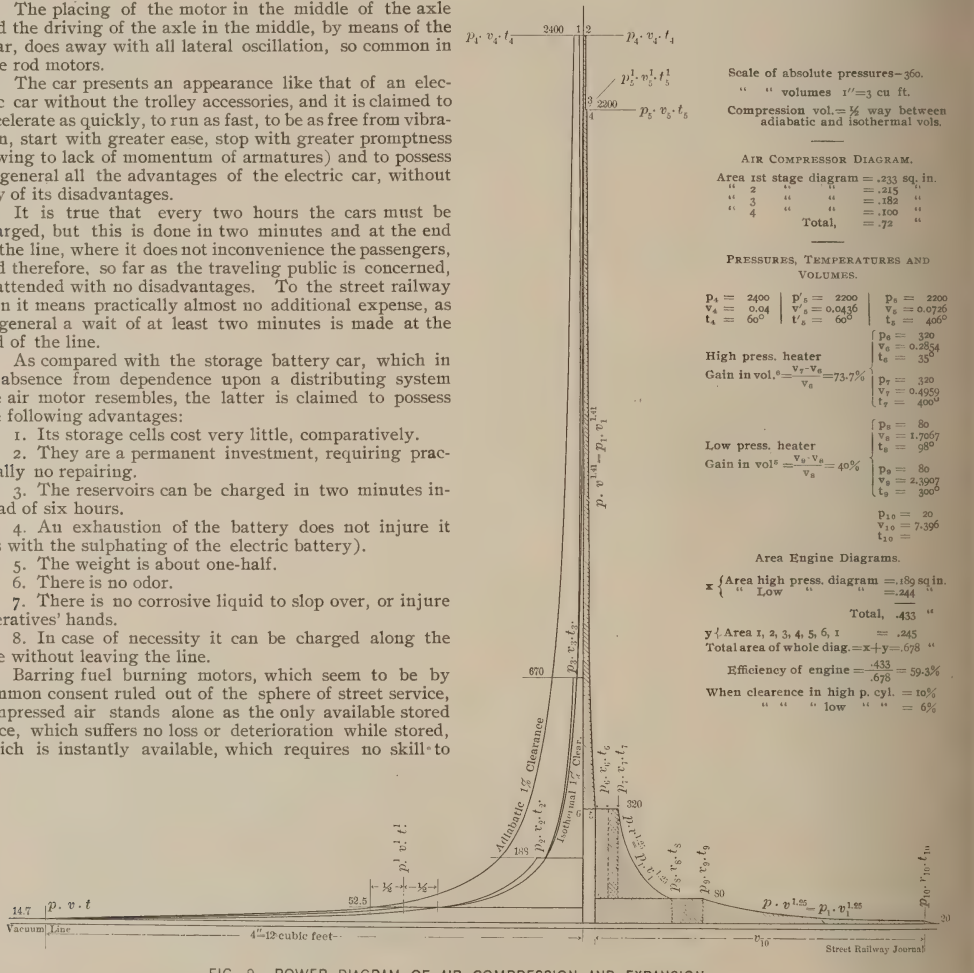

Scale of absolute pressures—360.
" " volumes 1"=3 cu ft.
Compression vol.=½ way between adiabatic and isothermal vols.
Air Compressor Diagram.
Area 1st stage diagram = .233 sq. in.
" 2 " " = .215 "
" 3 " " = .182 "
" 4 " " = .100 "
Total, = .72 "
Pressures, Temperatures and Volumes.
High press. heater
Gain in vol.=73.7%
Low press. heater
Gain in vol.=40%
Area Engine Diagrams.
Area high press. diagram =.189 sq in.
" Low " " =.244 "
Total, .433 "
Area 1, 2, 3, 4, 5, 6, 1 = .245
Total area of whole diag.=x+y=.678 "
Efficiency of engine = .433/.678 = 59.3%
When clearance in high p. cyl. = 10%
" " " low " " = 6%
Adiabatic 15% Clearance
Isothermal 15% Clear.
Vacuum Line
4"-12 cubic feet
Street Railway Journal

FIG. 9.—POWER DIAGRAM OF AIR COMPRESSION AND EXPANSION.

of the American Wheelock Engine Company, designed a line of large compressors of a novel type, from which the builders claim to be able to produce most satisfactory results in extreme high pressure work as regards economy and durability. This type is shown by the accompanying side elevation which will give a general idea of the machine.

The steam end is a vertical engine of ordinary kind in general, but specially adapted to have connected upon each side of the column, the horizontal air compressing ends each of which has two stages arranged in tandem form. The steam end drives a center crank with shaft resting in bearings on each side. The crank shaft has a triple construction, i. e., there are three crank pins, one being driven from the steam end while the others serve to drive the compressor ends. These pins cannot, of course, be in the same vertical plane, but they are large in diameter and correspondingly short, so that in effect the center lines of the steam and air ends are in the same plane. Furthermore the steam and air cranks are of different lengths, the stroke thus differing, the steam end having a longer stroke. By this construction the proper relation between the piston speeds of steam and air ends is secured.

By this general arrangement of steam and air elements in the machine, the relation of power applied to resistance offered is extremely favorable to a uniform turning effect, so that a relatively small flywheel suffices to give the necessary regulation. The forces exerted oppose and balance to a degree that renders the total friction of the machine very small.

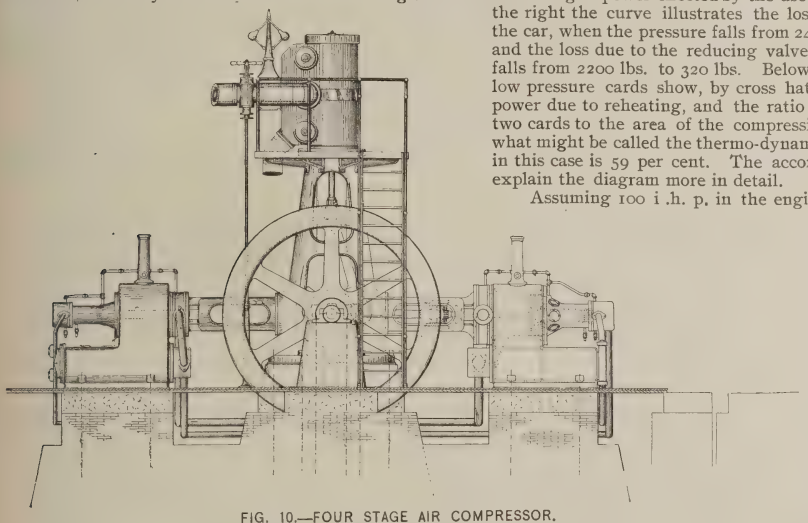


FIG. 10.—FOUR STAGE AIR COMPRESSOR.

The arrangement and means of driving the air compressing cylinders is clearly shown in the illustration. This design gives directness and rigidity in highest degree. The air cylinders are mounted within and supported upon beds or housings which constitute water tanks for jacketing the cylinders and intercoolers, the latter consisting of tubes placed in the lower part of the housings. The cylinders are jacketed over the entire barrel and head, and an intercooler is provided between each cylinder as well as one for the final delivery. When consideration is given to all the pipe connections and other details necessary for the air and water in four stages, it will be evident that this design is singularly compact and direct.

The cylinders are all single acting and fitted with special care to secure tightness of pistons. The air valves are made upon a novel system the result of extensive experimenting. All usual forms of valve that were tried were found inadequate to answer the severe requirements of endurance and tightness under heavy pressures. The valves are conveniently accessible without disconnecting any main part of machine, and can be replaced in a few minutes.

The machine as shown has a single steam cylinder, and has the outboard end of shaft carried in a bearing. The design is such, however, that the shaft of a duplicate machine can be connected, thus forming a duplex compressor with a single flywheel between, and using compound steam cylinders, or the single machine can be fitted with vertical, tandem, compound cylinders.

The steam end is supplied with a high grade automatic cut-off valve gear, and all the details have been worked out with great care, the special features having been developed by exhaustive experimental use. It would seem that the claims of the builders that they have a unique and extremely efficient compressor in an entirely new class of machines, is well founded.

The power diagram shown in Fig. 9 illustrates in a graphic manner the effect upon the air during the four stage compression, and the subsequent two stage expansion; the left hand half of the diagram showing compression, and the right hand expansion. The compression side shows how closely the four stage compression approximates the isothermal. The adiabatic curve from atmosphere to 2400 lbs., also is shown, to give a graphic idea of the saving in power effected by the use of four stages. On the right the curve illustrates the loss, due to charging the car, when the pressure falls from 2400 lbs. to 2200 lbs., and the loss due to the reducing valve, when the pressure falls from 2200 lbs. to 320 lbs. Below this the high and low pressure cards show, by cross hatching, the gain in power due to reheating, and the ratio of the area of these two cards to the area of the compression cards, gives us what might be called the thermo-dynamic efficiency, which in this case is 59 per cent. The accompanying data will explain the diagram more in detail.

Assuming 100 i .h. p. in the engine during the compression, there is found to be a loss of 20 per cent in the friction of the engine and compressor. Of 80 h. p. thus exerted in compressing the air, 40 per cent is lost in the subsequent reduction of the pressure. Of the 48 h. p. developed in the motor cylinders, there is a further loss by leakage of about 10 per cent and the friction of the motor brings the residual power delivered to the axle down to 35. This comparatively low efficiency is largely offset by the fact that the compressor runs on a practically constant load, and at a correspondingly high efficiency.

The expense of installing this system does not differ materially from that of the electric trolley system. The compressed air power plant can be installed for the same amount as an electric power plant, and the cars, while costing somewhat more than the trolley cars, are more than offset, it is claimed, by the expense of the trolley line itself. As compared with the underground trolley, there is of course, a saving of the interest and maintenance of the conduit, a sum which would in itself exceed in many cases the whole motive power expense of the compressed air car.

THE Washington Street Electric line of the North Hudson County Railway Company was put in operation last month. The equipment of this line has been delayed up to the present time by litigation.

Overhead Construction in Kansas City.

The Electrical Installation Company has just finished for the Metropolitan Street Railway Company, of Kansas City, a very complete and substantial as well as extensive piece of electrical work.

This consists in general of the overhead construction in Wyandotte Street and Southwest Boulevard together with a complete feeder system (Fig. 1) for the same; also a heavy motor circuit from the Kaw River power house to the Ninth and Washington Streets power house.

This latter station supplies power to the Fourteenth Street line.

The trunk feeder line extends from the Kaw River power house just built, to the corner of Southwest Boulevard and Twenty-fourth Street a branch being carried along the elevated railway structure to Ninth and Wyandotte Streets. In all there is carried on this line upwards of 300,000 lbs. of copper of from 1,000,000 c. m. to No. 0000.

The pole line consists of about 3 miles of specially selected cedar poles with 8 in. tops and 15 in. butts. The cross arms are of extra heavy oak, 4 ft. × 4 ins. × 5 ins. mortised into and bolted through the poles. The insulators are "iron clad" furnished by the Ohio Brass Company and the H. W. Johns Manufacturing Company. All poles are set on a stone base and with a concrete filling.

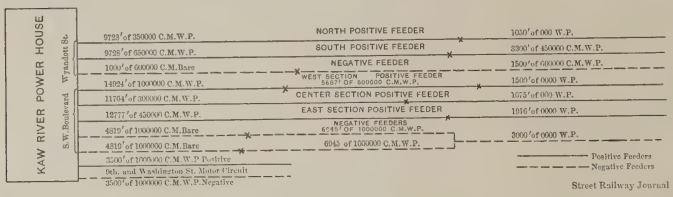


FIG. 1.—DIAGRAM OF FEEDERS.

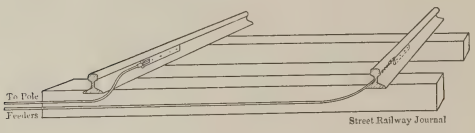


FIG. 2.—METHOD OF CONNECTING RAILS TO RETURN FEEDERS.

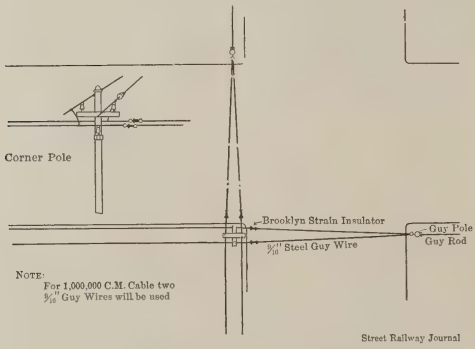


FIG. 3.—METHOD OF DEAD ENDING CABLES AT TURNS.

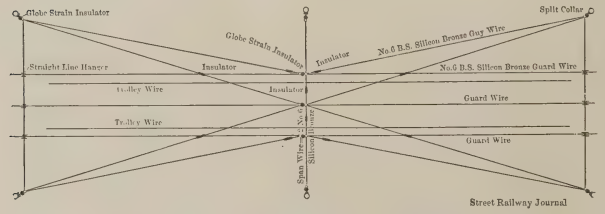


FIG. 4.—PLAN OF SPAN STRAIN CONSTRUCTION.

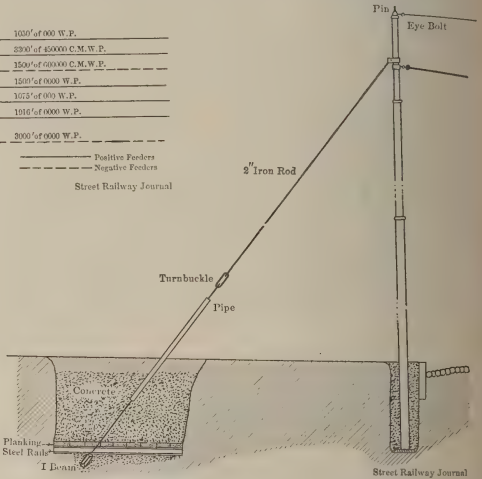


FIG. 5.—SECTION SHOWING METHOD OF GUYING SPAN POLE.

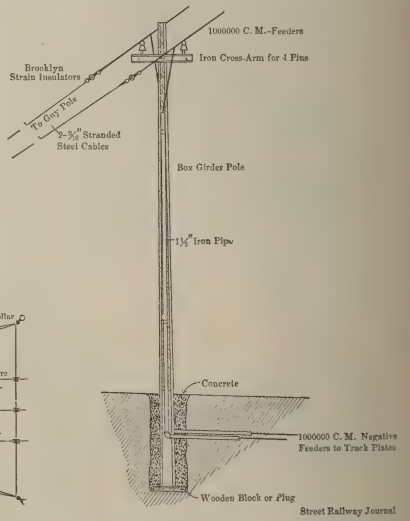


FIG. 6.—RETURN FEEDER AND RAIL CONNECTIONS.

The cables are dead-ended at all turns (Fig. 3), the strain being taken through two heavy Brooklyn strain insulators; the insulators are attached to $\frac{9}{16}$ in. steel guys, as shown.

All feeder ends, as well as all corners or curves in the line, are held by means of anchors or guys set in concrete, as shown in Fig. 5. This system of anchoring was made necessary by the unustually heavy cables. This is probably the first instance, in the West at least, where 1,000,000 c. m. cables have been carried on pull lines, in fact,

500,000 c. m. seems to have been considered the safe limit for aerial construction. Some idea of the strain to which this line is subjected may be had from the specifications exacted—that there be no more than 9 ins. of sag in any cable between supports—the finished construction shows, however, no greater than 5 ins. of sag in any case, so that these large cables, 1¾ ins. in diameter, look to be hanging in practically a straight line.

FEEDER SYSTEM LEADING FROM KAW RIVER POWER HOUSE—KANSAS CITY.

On the Wyandotte Street trolley line, which consists of 2¾ miles of double track, the ordinary city overhead construction is employed. On this line iron poles are used which weigh 925 lbs. each, the extra heavy corner ones weighing 2000 lbs. The poles are capped with acorn tops and carry ornamental malleable iron cross arms for the feeders.

The span wire is of ⅜ in. galvanized steel insulated with 2½ in. Globe strain insulators. The line is fully equipped with lightning arresters and other safety appliances; No. 6 silicon bronze guard wires are used the entire length.

The Southwest Boulevard consists of 4 miles of double track, the overhead construction being practically the same as that on Wyandotte Street; cedar poles however are used instead of iron.

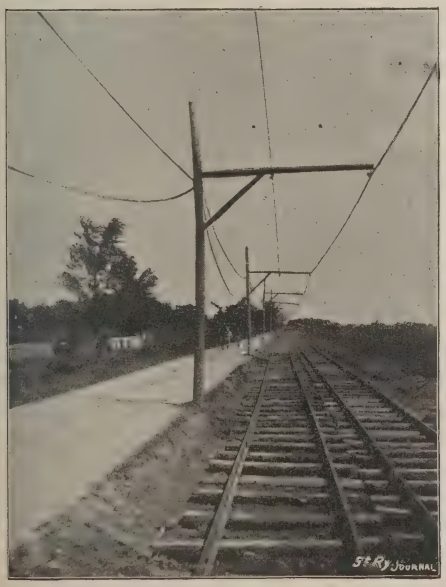
The entire overhead system was designed and built by the Electrical Installation Company which employed about seventy workmen and completed the work inside of sixty days.

A Record Breaker in Street Railway Construction.

The Suburban Railroad Company which owns several valuable franchises in the western suburbs of Chicago, and operates a number of miles of leased lines by steam, is engaged in installing electricity on the leased lines and constructing new track on its own right of way.

The power house is completed and in operation, the car barn is finished and the rolling stock on hand, but owing to strong opposition by rival companies almost every foot of track has been fought into place. Naugle, Holcomb & Company are the contractors for the system with equipment complete. The contract of this firm also includes the operation of the road for two years.

The main line to La Grange occupies about a mile of the streets in the village of Riverside and an injunction has been in force for a year to prevent the building of this portion. Knowing that strenuous efforts would be made to secure a new injunction upon the dissolution of the old, preparations were made by the construction company to get as much work done as possible in the interim. A material train carrying ties, rails, etc., was made up at the yards 3 miles away and put in readiness to start at a mo-



SECTION OF ONE MILE OF TRACK, CONSTRUCTED IN TWELVE HOURS AND FIFTY-THREE MINUTES—CHICAGO.

ment's notice. The neighboring woods along the line afforded convenient cover for the workmen; a messenger with a bicycle was stationed in town at a telephone waiting for the word; at 10:25 o'clock Tuesday morning nothing was in sight on Woodbine Avenue, Riverside, except one man, the superintendent of construction, leaning against a tree with his eyes on the bend in the road leading to the telephone. At 10:27 o'clock the messenger swung into sight at a scorching pace, the signal was given and 300 men swarmed out of the woods and fell upon the street with pick and shovel; the material train was pushed up to the scene and at 11:20 o'clock Tuesday night the track was ready for operation through Riverside. As it had been supposed that a new injunction would probably be secured before night no preparations had been made to string the trolley wire. But as night drew on and no restraining order appeared it was decided at 9 P. M. to proceed with the overhead work.

The pole construction required by the ordinance was iron bracket, center pole construction. This material was not at hand so a substitute was necessary, and cedar poles with 2 in. × 4 in. oak brackets were utilized. This material, including wire and applances, was 3 miles from the work; as rapidly as possible it was loaded and hauled to the scene of action. A train was sent to the nearest lumber yard, 4 miles away, the watchman held up and the necessary 2 in. × 4 in. oak secured.

Fifty holes 6 ft. deep were dug, poles were set, trolley wire hung, insulated and guyed, and a trolley car run over the entire length of the new work at 7 : 25 in the morning.

Electricity as a Motive Power on Elevated Railways.

By S. H. Short.

The elevated railways of New York, Brooklyn and Chicago were built to satisfy a crying demand for rapid transit from the business centers to the suburban districts of these great cities. So long as they had for their only competitor the slow moving horse car, they were considered a great convenience, notwithstanding that one was obliged to walk from one to three blocks and climb a difficult flight of stairs to reach these rapidly moving trains.

Since the "trolley car" has come into general use, people have been educated to a still more rapid rate of travel, and where the trolley car parallels the elevated railroad, as in Brooklyn and Chicago, the frequent, speedy and accessible surface car is, by far, the more popular. In New York, however, the elevated railways still enjoy a very large traffic, because the electric cars do not parallel their lines, nor are the facilities for transportation yet sufficient for the enormous masses to be moved back and forth in that city. However, the surface lines are soon to be equipped electrically, and their carrying capacity thereby enormously increased to the detriment of the elevated railway travel. In order to retain their traffic, it will be necessary for the elevated railways to move their trains more frequently, and at a much greater rate of speed, to compensate the traveling public for being obliged to walk some distance and climb those disagreeable stairs.

It would add greatly to the travel on these roads, were some plan devised for mechanically lifting passengers to the elevated stations.

The elevated roads are all built on the same general plan, the structure being provided with double track throughout the entire length, with stations about one-third of a mile apart. The grades are slight, and the curves of not less than 90 ft. radius. The structure is made to safely carry the standard elevated train, i. e., five passenger coaches, each 48 ft. in length, weighing, when loaded with seventy-five passengers, 20 tons, drawn by a locomotive weighing 23½ tons, making a total of 123½ tons for the complete train.

The locomotives are constructed so that 65 per cent of their weight, or 15¼ tons are upon their drivers, giving an adhesion, and therefore a maximum horizontal effort for accelerating the train, of 7,650 lbs. This effort is utilized for accelerating the train for fifty or sixty seconds, and a speed of 20 to 25 miles per hour is attained, while a maximum of 300 h. p. is developed by the locomotive. The brakes are then applied with a negative acceleration and the train is brought to a standstill at the next station, where it remains on an average of thirteen seconds.

In the accompanying diagrams (Figs. 1 and 2) I have illustrated graphically the performance of one of these trains between stations, also the consumption of power, as calculated from the weight and speed of the train. It will be seen therefrom that it is not possible, with steam, to make a better schedule time than is at present in force, i.e., 13½ miles per hour, unless the weight of the locomotive be increased or the trains be lightened. The heavier locomotives would endanger the safety of the entire structure. The lighter loads would necessitate more frequent trains, consequently a much larger force of skilled employes to run the extra locomotives. The cost of fuel for operating a steam locomotive amounts to about 20 per cent of the total operating expenses of these roads, the fuel consumption being about 7 lbs. to 8 lbs. of coal per horse power per hour.

With good compound condensing engines, driving electric generators at a station, the coal consumption is reduced to about one-third of that amount.

Were steam locomotives discarded, it would be possible to replace the high priced skilled labor, necessary for their operation, by ordinary trustworthy men, who are not skilled mechanics; whose rate of wages is about one-half that of a locomotive engineer, and only one man would be necessary to operate the electrical propelling mechanism. We believe the repair account will be materially lessened, both in the units of motive power and in the permanent way, were the trains equipped with motors. The care of a steam locomotive is very onerous, the average run being only about 100 miles, when it must be thoroughly overhauled and inspected by skilled mechanics before being used again. Contrast with this the all day service of most electric motors, 200 or 300 miles a day for days and weeks, without inspection, cleaning or care of any kind.

The standard electrical equipment for an elevated train consists of the present elevated car, as illustrated in the accompanying engraving (Fig. 3) provided with two swiveled trucks of special construction, arranged to receive electric motors of a type adapted especially for this service. The wheels of the trucks are 33 ins. in diameter, and the wheel base does not exceed 6 ft. for the largest motors, and is reduced to 5 ft. 6 ins. where motors of the smaller size are used. The weight of the motor car, loaded to its full capacity with passengers, is 32 tons, including trucks, motors and the electrical equipment. In most cases it is advisable to use only two motors upon a motor car, and both should be placed on one truck for convenience in repairing. There is, therefore, 19½ tons upon the drivers, or 61 per cent of the total weight of the motor car, which corresponds favorably with the percentage of the total weight of passenger locomotives upon their drivers. This gives an adhesion, and therefore a maximum practical horizontal effort, for the motor of 9750 lbs., or, a total possible horse power of 400, in accordance with standard motor rating.

This pair of motors is, therefore, capable of accelerating a train of three standard elevated cars, at the rate of 1.85 ft. per second, and of making a schedule of 16½ miles per hour, including stops, as illustrated graphically by the accompanying diagram (Fig. 4).

If the other truck of the motor car is also equipped with motors, a train of double this size will operate in exactly the same manner, and one more car may even be added, because the tractive effort required per ton decreases materially, as the number of the cars in the train increases, there being but one motor car on the train. It is not advisable to use more than two motors, owing to the complications which arise in the controlling devices.

The requirements of the service to be rendered on the

different elevated railways necessitates very careful consideration being given to the size of the motor to be used upon the different roads. There seems to be no question about the advisability of using as large a motor as possible upon a road like the Sixth Avenue in New York, where the travel is constant throughout the day, and trains of from four to five cars can follow each other at short intervals all day. But in Brooklyn and Chicago, where the traffic is heavy during short periods of time, and light during a larger part of the day, it seems desirable that trains of few cars, or even single motor cars, shall be run at frequent intervals without a printed time table; thereby practically securing a high speed street car service on the elevated structure.

Another reason for frequent and light trains, is that these roads have branches, which, by this method, would be served to better advantage. It is possible also, that these single motor cars or short trains may be coupled into longer trains during the rush periods of the day, and be operated from the front platform by one motorman, if a suitable controlling apparatus is provided, by means of which all of the motors of the train can be simultaneously controlled.

A motor of much smaller size than would take up the full adhesive power of the truck could be used, where this method of equipment is adopted. It has, however, the disadvantage of multiplying the electrical apparatus necessary to move the rolling stock of the road. It will also consume more power per ton miles of train, because the tractive effort per ton of the trail cars is about half that required by the motor cars, the difference being due to the friction, windage, etc., of the motor cars.

The accompanying diagram (Fig. 5) illustrates the Baldwin standard elevated truck equipped with two standard 200 h. p. L motors, which we have recently designed for this work. These will operate a standard elevated train of three cars, fully loaded, at a schedule speed of 16½ miles per hour. We give also the train data sheet for this equipment, and speed and horizontal effort curves for the motors. (Figs. 6 and 7.)

TRAIN NO. 1.

Elevated Railway Service.		
Number of cars in train	3	
Full speed of train on level track (miles per hour).	31	
Average speed, stops ⅓ mile apart " " " .	16.5	
Motor Car.		
Weight of motor car body	10	Tons.
Weight of both trucks.	10	"
Weight of two motors	7	"
Weight of seventy-five passengers	5	"
Total weight of loaded motor car.	32	"
Number of motors on motor car	2	
*Commercial rated power of each.	200	H. P.
Safe constant load for each	100	"
Safe temporary tractive effort of equipment.	10,000	Lbs.
Safe constant tractive effort of equipment.	3,500	"
Weight on drivers.	19.5	Tons.
Ratio of weight on drivers to total weight.	26%	
Adhesive power.	9,750	Lbs.
Ratio of safe temporary tractive effort to adhesion.	100%	
Ratio of safe constant tractive effort to adhesion	36%	
Complete Train.		
Total weight of loaded motor car	32	Tons.
Weight of two coaches.	32	"
Weight of 150 passengers in coaches	10	"
Total weight of loaded train	74	"
Maximum horizontal effort in accelerating train.	9,750	Lbs.
Horizontal effort per ton during acceleration	132	"
Maximum power in accelerating uniformly to full speed.	412	H. P.
Maximum current at 500 volts accelerating train uniformly to full speed	780	Amp.
Time required in accelerating uniformly to full speed.	34	Sec.
Distance in which train will acquire full speed	900	Ft.
Horizontal effort, train running uniform speed	1,300	Lbs.
Power consumed, " " " "	106	H. P.
Tractive effort per ton.	18.25	Lbs.
Maximum practical negative horizontal effort in braking.	13,800	Lbs.
Time required to bring train to full stop	16	Sec.
Distance traversed by train during braking	370	Ft.

TRAIN PERFORMANCE.

Track.	Horse Power.	Current at 500 Volts.	Speed Miles per Hour.	Horizontal Effort.
Level	106	190 Amperes.	32	1,300 lbs.
1% grade	170	290 "	22	2,780 "
2% "	235	400 "	20.8	4,260 "
3% "	295	505 "	19	5,740 "

The next diagram (Fig. 8) shows a standard Jackson & Sharp truck, equipped with two 125 h. p. L motors, of the same design, capable of moving a standard elevated train of two cars fully loaded, at a schedule speed of 16 miles per hour. Figs. 9, 10 and 11 give a train data sheet (train No. 2) and curves for this equipment.

TRAIN NO. 2.

Character of Service; Elevated Railway.		
Number of cars in train	2	
Full speed of train on level track (miles per hour)	31	
Average speeds, stops ⅓ mile apart	15.8	
Motor Car.		
Weight of motor car body	10	Tons.
Weight of both trucks	10	"
Weight of two motors	5.5	"
Weight of 75 passengers	5	"
Total weight of loaded motor car	30.5	"
Number of motors on motor car	2	
*Commercial rated power of each	125	H. P.
Safe constant load for each	60	
Safe temporary tractive effort of equipment	5,600	Lbs.
Safe constant " " " "	1,600	"
Weight on drivers	18	Tons.
Ratio of weight on drivers to total weight	35%	
Adhesive power	9,000	Lbs.
Ratio safe temporary tractive effort to adhesion	62%	
" " constant " " " "	18%	
Complete Train.		
Total weight of loaded motor car	30.5	Tons.
Weight of one coach	16	"
Weight of 75 passengers in coach	5	"
	51.5	"
Maximum horizontal effort in accelerating train	5,640	Lbs.
Horizontal effort per ton during acceleration	109	"
Max. power in accelerating uniformly to full speed	280	H. P.
Max. current at 500 v. " " " " "	500	Amp.
Time required in " " " " "	37.5	Sec.
Distance in which train will acquire full speed	953	Ft.
Horizontal effort, train running uniform speed	1,000	Lbs.
Power consumed, " " " "	115	H. P.
Tractive effort per ton, " " " "	19.7	Lbs.
Max. practical negative horizontal effort in braking	11,000	Lbs.
Time required to bring train to full stop	16	Sec.
Distance traversed by train during braking	390	Ft.

TRAIN PERFORMANCE.

Track.	Horse Power.	Current at 500 Volts.	Speed Miles pr. hour.	Horizontal Effort.
Level	92	175 Amperes.	31	1,013 lbs.
1% grade	135	250 "	24 8	2,043 "
2% "	176	320 "	21.3	3,073 "
3% "	220	390 "	19.9	4,103 "

The next diagram (Fig. 12) shows two 60 h. p. motors of the L type, mounted upon a standard McGuire truck, capable of operating a single standard elevated coach at a schedule speed of 15½ miles per hour, with its corresponding train data sheet (train No. 3) and curves (Figs. 13, 14 and 15).

*This motor will deliver the commercial rated output for one hour without heating more than 75° C above the surrounding air.

*This motor will deliver the commercial rated output for one hour without heating more than 75° C. above the surrounding air.

TRAIN NO. 3.

Elevated Railway Service.		
Number of cars in train	1	
Full speed of train on level track (miles per hour)	26	
Average speed, stops one-third mile apart (miles per hour)	15	
Motor Car.		
Weight of motor car body	10	Tons.
Weight of both trucks	10	"
Weight of two motors	3.5	"
Weight of seventy-five passengers	5	"
Total weight of loaded motor car	28.5	"
Number of motors on motor car	2	
*Commercial rated power of each	60	H. P.
Safe constant load for each	25	"
Safe temporary tractive effort of equipment	3,300	Lbs.
Safe constant " " " "	700	"
Weight on drivers	16	Tons.
Ratio of weight on drivers to total weight	56%	
Adhesive power	8,000	Lbs.
Ratio safe temporary tractive effort to adhesion	41%	
" " constant " " " "	8%	
Complete Train.		
Total weight of loaded train	28.5	Tons.
Maximum horizontal effort in accelerating train	2,600	Lbs.
Horizontal effort per ton during acceleration	91.5	"
Max. power in accelerating uniformly to full speed	122	H. P.
Max. current at 550 v. " " " "	220	Amp.
Time required in " " " " "	36.5	Sec.
Distance in which train will acquire full speed	810	Ft.
Horizontal effort, train running uniform speed	712	Lbs.
Power consumed, train running uniform speed	51	H. P.
Tractive effort per ton, train running uniform speed	25	Lbs.
Max. practical negative horizontal effort in braking	5,300	Lbs.
Time required to bring train to full stop	14.5	Sec.
Distance traversed by train during braking	305	Ft.

TRAIN PERFORMANCE.

Track.	H. P.	Current at 500 volts.	Speed, Miles per hour.	Horizontal Effort.
Level	51	90 Amperes.	26	712 Lbs.
1% Grade	68	124 "	19.9	1,282 "
2% "	85	154 "	17.2	1,832 "
3% "	101	182 "	15.5	2,422 "

For the convenience of engineers making calculations for the required current in amperes at 500 volts pressure, which will be necessary to operate a given line of road with trains as specified above, the table herewith (Fig. 16) is given showing the maximum current consumed by trains during acceleration; the current necessary to operate the trains at full speed; and the average current and horse power for the various trains.

MOTOR BEST SUITED TO ELEVATED SERVICE.

As there is neither dust nor water to contend with, the motor can be left entirely open, for the free circulation of air over the armature and field magnets, and not only thorough ventilation, but 20 per cent more output, can be obtained from a given machine in this way. The open motor can be much more easily inspected and kept free from oil and grease.

The accompanying diagram (Fig. 17) shows the form of motor which we have designed for elevated railway service. This motor is intended to be taken apart by running the truck from under the car, and lifting the upper half of the magnetic ring by means of an overhead crane; this exposes the armature, left with its bearings in the motor frame, which is journaled to the car axle at one side and supported by the truck bolster at the other side. The motor frame has cast, integral with it, the lower half of the magnetic ring. Each half of the magnetic ring has two pole pieces, wound with a few turns of heavy copper ribbon, so that the magnetic system of the motor is symmetrical, and of very large sectional area, to provide for the rapid acceleration control, which will be discussed later.

The magnetic ring is large in diameter and the axle is made to pass inside the ring, between the magnet coils, so that the distance between the gear centers is short. This makes the gears small in diameter, and gives a large clearance above the stringers inside the rails.

The armature is especially large and heavy, provided with deep slots to secure the bar winding, which makes but one turn per commutator bar. By this means the self-induction of the armature windings is reduced to a minimum, and there is a very low voltage between the commutator bars, providing for perfectly sparkless commutation.

Bronze is used for both the armature and axle bearings, and the lubricant is oil instead of grease. The brasses are so arranged that the thrust caused by the gears brings the shafts against solid unbroken surfaces. The oil is stored in cellars and is carried to the bearings by means of waste, which wipes the entire length of the shaft within the brasses.

Provision is made at the ends of the bearings to collect all of the oil which may escape and return it to the cellars to prevent a drip on the structure and street beneath. The bearings are made exceedingly long and the shafts are large in diameter, the pressure per square inch being reduced to the very low value of 37 lbs. The armature bearings are solid and are lifted out of the motor together with their oil cellars when the armature is removed by an overhead crane. The gear housing is made of heavy cast iron in halves, the lower half being permanently fastened to the motor frame, while the upper half may be lifted off independently by the overhead crane. The housing is grease tight and the gears run in oil. The entire motor is cast from the best quality of steel.

THE CONTROL.

The motors are controlled by a series-parallel controller, which provides for keeping a constant current through each of the motors, of such a quantity as will just avoid slipping the wheels during the time of acceleration. We have named this the maximum, constant current acceleration controller. In order to accomplish this kind of a control, the counter e. m. f. of the motors is prevented from rising until the train has reached the maximum speed at which it is desired to operate it. The counter e. m. f. is then instantly raised to a point which reduces the current to a quantity which produces a horizontal effort sufficient to overcome the resistance of the train and maintain a constant speed.

The accompanying diagram (Fig. 18) shows the acceleration curve of an ordinary series-parallel controller and two series motors; also a curve of the constant current method of control, with two motors of the same size. The advantages of this latter method are apparent in the decrease of the schedule time and the decrease of power consumption.

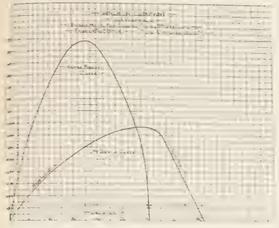
THE BRAKES.

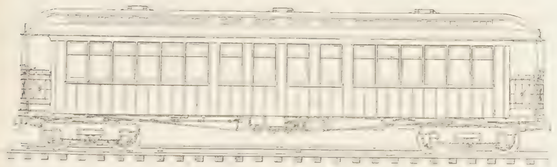
Westinghouse automatic air brakes are used on all trains, with a brake applied to every wheel, enabling a train to be brought to a stop with a negative acceleration of 3 ft. per second which is not disagreeable to passengers.

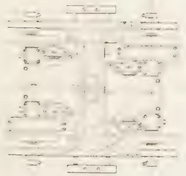
The train pipe for this system of brakes is fed with air from a main reservoir attached to one side of the truck bolster (Fig. 19) of the idle truck of the motor car, as illustrated in the engraving. On the other side of the truck bolster is attached an electric motor air compressor as illustrated. The motor is arranged to automatically stop and start under the influence of the varying pressure in the main reservoir. The object in putting the air compressing apparatus on the truck instead of on the car body is to avoid the disagreeable noise due to the operation of the pump; and to facilitate repairs, as the truck with its entire air compressing outfit is run out from under the car in the same manner as the motor truck.

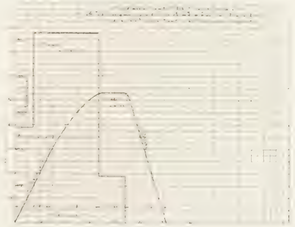
*This motor will deliver the commercial rated output for one hour without heating more than 75° C above the surrounding air.

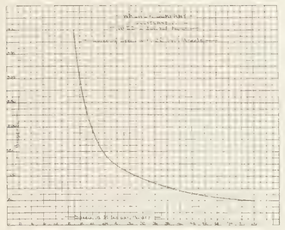
ELECTRICITY AS A MOTIVE POWER ON ELEVATED RAILWAYS.

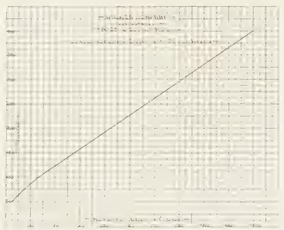


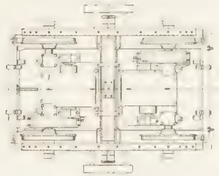


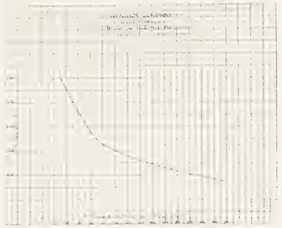


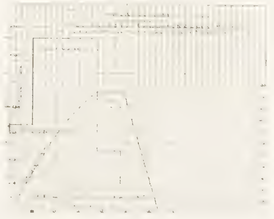


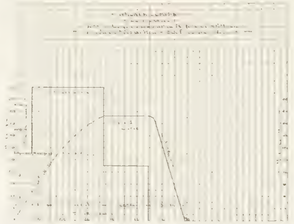


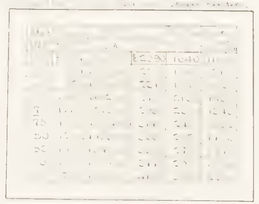


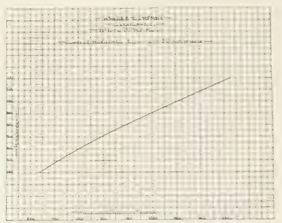


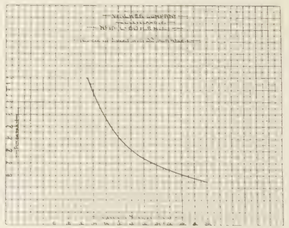


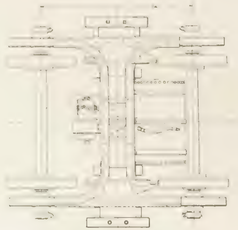


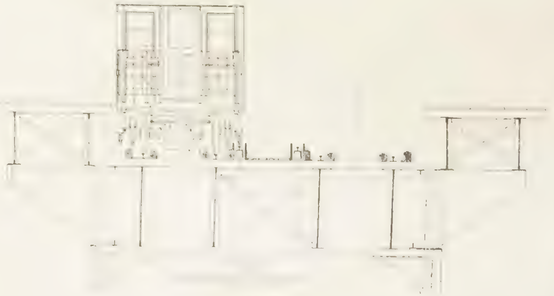












THIRD RAIL FEEDER SYSTEM.

A third rail of varying section should be mounted throughout the entire length of the road on substantial insulators. Heavy rails should be laid near the station and gradually taper off to the ends of the road. For most "L" roads it is not necessary to use auxiliary feeders of any kind, as the entire power necessary to operate all trains can be carried by the third rail. This rail should be placed on one side of the track with its head some inches above the track rails, so that sliding shoes, made of cast iron and attached to the trucks, may slide freely along their upper surface (Fig. 20).

The table (Fig. 21) on the inset shows the amount of power which rails of different sections can carry, with a drop of 100 volts per mile, when all the power is delivered at the end of the mile. Of course, the same amount of power can be distributed with the same drop over 2 miles of track. The table also shows the relative cost of this method of distribution as compared with copper feeders.

BONDING.

All rails, as far as practicable, should be in 60 ft. lengths. The third rail as well as the track rail joints should be bonded by a flexible copper bond, attached to the under side of the foot of the rail by means of a number of rivets, and the area of contact with the rail should be sufficient to provide that not more than 100 amps. per square inch should be required to pass through the joint between the steel and copper. The sectional area of the bond must be one-sixth the sectional area of the rail itself. The track rails should be electrically connected frequently with the elevated structure. Care should be taken that all joints between copper and steel should be made with clear bright surfaces and no space be left to admit water or air to corrode the joints.

The Sprague Multiple Unit System.

The first train to be equipped with Frank J. Sprague's new "multiple unit system" of train control is now operating experimentally on the private "heel path" track of the General Electric Company at Schenectady and a description of its main characteristics will be of much interest to elevated railway and steam railroad managers who are contemplating the adoption of electricity, although for reasons connected with the securing of the patent rights, it is not yet possible to give to the public the full mechanical details of operation. This new "Sprague system" is intended not for ordinary street railway service, but for the handling of electric *trains* of any number of cars in such a way as to provide for the greatest possible flexibility and economy in operation.

By this system each car in a train is an absolutely independent unit, equipped with motors, controllers and power braking apparatus as completely as if its sole function were to operate as a single car in regular service. When joined together in trains, each of these independent cars performs its pro rata proportion of the total work done in propelling the train, and takes from the line its pro rata proportion of the electric energy required for the performance of this work. The entire train can be propelled from any car platform in the train, usually, of course, from the front platform, as the train is made up. Injuries to motors or equipment on individual cars will not interfere with the operation of the train, the remaining cars being only called upon to do slightly more than their regular work in making up for the apparatus temporarily cut out of service.

The accomplishment of these important results is exceedingly simple in theory, but decidedly difficult in practice, and Mr. Sprague is undoubtedly to be given great credit for overcoming a number of perplexing problems in achieving the mechanical solution of these difficulties. Given, as aforesaid, the condition that each car is equipped with standard motors, standard controllers and some form of current collecting devices taking power from trolley or third rail, the method devised by Mr. Sprague for handling a train made up of these units is to provide an apparatus for moving controllers on all cars in the train in an exactly synchronous way through the various controller steps to the different power taking points of each, thus making each car do its exact proportion of the total train work. It will readily be seen that the main difficulty lies in obtaining this synchronism. If the controller of one car should place its motors in multiple at a time when the controller of the next car has placed its motors in series the result would be that the first car would do far more work than the second and the consequence might be disastrous to the motors.

The apparatus for obtaining synchronism cannot now be described, but it is sufficient to say that it is successful in practice as shown by the experiments at Schenectady. That part of the controlling apparatus which the train "engineer" or motorman is called upon to use is of the simplest possible description, simpler even in some respects than the ordinary car controller inasmuch as there are fewer positions of the handle to be used. This train controller, too, uses extremely small currents, sufficient only to handle the movement of the controllers, and it is therefore very light in weight and takes up little room on the platform. The main controllers may be placed under the cars, on the platforms or, as in the experimental train at Schenectady, under the canopies, which may be specially strengthened to support their weight and that of the small auxiliary apparatus.

The air brake apparatus on the cars at Schenectady is of the Westinghouse type so far as engineer's valves, train pipe and reservoir system are concerned, while the compressing apparatus consists of a motor compressor and automatic regulator which are placed under the seats inside the car. This disposition of the controlling and braking apparatus gives upon the platform plenty of passenger space and provides for great simplicity in train control from every point of view.

The advantages of a system of this kind in the heavy railroad service which is so prominently before electrical engineers, are obvious. The most important one is, perhaps, that of divisibility. For example, a train of ten, fifteen or twenty cars starts out from a city station controlled by a single engineer standing on the front platform. Each car in the train has ample power for its own propulsion. The total motor power of the train is also ample and no traction difficulties come in to prevent the operation of trains as long as may be desired. Each car being also provided with its own braking apparatus, the total braking effort is sufficient for quick stops even with very long trains. As every trainman throughout the entire train length can, in an emergency, handle the train independently from his position, no helper or assistant, corresponding to the fireman of a steam locomotive, is necessary to the engineer, except in some cases perhaps, where it is desirable to take special precautions, and even then the first "gateman" can ordinarily serve this purpose by simply stepping to the front platform as soon as the train starts.

On reaching different branch lines cars may be dropped from the train and, in charge of their own "gatemen," may proceed on their several and independent ways over the branches, returning later, perhaps, to make up another combination train inward bound. Arriving at the station the trains may be broken up and the cars distribute themselves to their various sheds and "round houses," or be made up into other trains, without the use of switching engines, and all, of course, with the quietness and freedom from other disagreeable concomitants characteristic of electric railroading.

Again, it is possible in elevated railway and railroad service to accomplish by this system very desirable reforms in car schedules. At present, with steam locomotives, a train service cannot profitably be made too frequent, on account of the large proportion of train labor cost with light loads. On a system of this kind, however, it is possible to establish a regular train frequency throughout the day such as, for example, ten minute, fifteen minute or thirty minute intervals. In light hours of

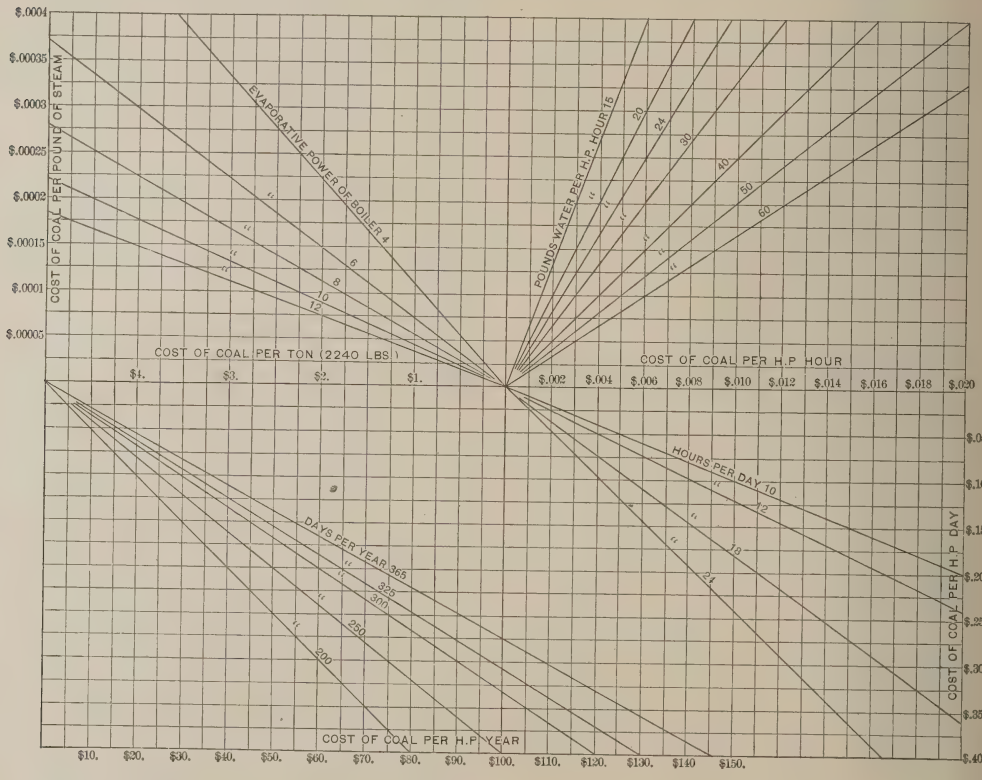
the day single cars can be used, and two-car, three-car, five-car or ten-car trains in the heavy hours—all running at the same schedule intervals and all with practically equal safety on account of the multiple braking system.

Of importance almost equal to that of divisibility of trains are two other characteristics of this system which go hand in hand, namely, maximum tractive power possible to obtain, and maximum a ccelerative effort. Mr. Sprague claims that about 58 per cent of the weight of the train and its load is available for traction when cars are equipped by the multiple unit system—an amount so much greater than can possibly be obtained by any locomotive or single-car system as to present a startling contrast indeed. So great an amount of traction necessarily means that the limit of train acceleration possible to produce will be gaged in practice only by the amount of power which it is found economical to use in bringing additional traffic to the road by means of high schedule speeds. Mr. Sprague believes that the multiple unit system has so large reserve capabilities in this direction as to make its adoption by elevated railways and suburban railroads a matter of necessity.

It is upon these broader economical considerations to be found in electric railroading that Mr. Sprague bases his chief claims for advantage in the multiple unit system. There are also others of less importance, but still worthy of consideration. It is probable that there will be some saving in train labor though not to any great extent. It is probable, too, that in a twenty-four hour day the fuel requirements *for the same work done* will be slightly less than would be the case with the ordinary method of operating a train by a single motor car, this saving being due to the fact that the train motors in the multiple unit system would run more nearly at their points of highest efficiency, throughout a complete day, than would be the case with the large motors necessary for a single motor car controlling trains of different sizes. In practice, however, no direct comparison of fuel consumption could ever be drawn, for the reason that all questions of fuel economy would sink to insignificance beside that of gaining higher schedule speeds and greater traffic, and for the accomplishment of this, the multiple unit system would be freely granted an amount of power from the lines which could not possibly be used by the locomotive system.

Diagram for Computing Cost of Coal in Power Station Operation.

The accompanying diagram for computing the cost of coal per horse power per annum was presented by H. A. Foster at the July meeting of the American Institute of Electrical Engineers.



From this diagram the cost of coal per horse power per annum is calculated as follows: beginning at "Cost of Coal per Ton," at the left of the center of the sheet, ascend the vertical line to the diagonal marked "Evaporative Power of Boilers," then follow the horizontal line to the right to the diagonal marked "Pounds Water per Horse Power Hour," then follow the vertical line downward to the diagonal marked "Hours per Day," and from this point follow the horizontal line to the left to the point of intersection with the diagonal marked "Days per Year." From this point of intersection follow the vertical line downward to a scale at the bottom of the diagram giving "Cost of Coal per Horse Power Hour."

SCIENCE · ENGINEERING · INVENTION ·

A BAD trolley car accident was reported last month on the Interurban Railway Bridge, in Saginaw, Mich., caused by a car running through the open draw. Several persons were drowned and a number injured.

IT is stated that no change in the motive power of the Sixth and Eighth Avenue roads, in New York city, will be made till the Court of Appeals renders a decision in regard to the city's right to purchase these roads.

BY a recent ruling of the Government of India sleepers intended for tramways not under the Indian Railways Act of 1890 may in future be imported at a customs duty of 1 per cent *ad valorem*, instead of as heretofore, at 5 per cent.

FOR the first four months of 1897, French imports from the United States are said to have amounted to about $30,000,000, an increase of about $4,700,000, and exports to the United States amounted to about $18,000,000, a decrease of $460,000.

FREDERICK UHLMANN, receiver of the Brooklyn Elevated Railroad, of Brooklyn, N. Y., has stated that he will receive on Aug. 1 bids for equipping the road with electricity. It will take about a year to equip the road. Station elevators will be built at the same time.

THE Brooklyn Heights Railroad Company, of Brooklyn, N. Y., has contracted for the purchase of sixty new closed cars. One-third of the order was given to the La Clede Car Company, one-third to the J. G. Brill Company and one-third to the St. Louis Car Company.

THE flow of steam of any pressure through an opening into any other pressure, less than three-fifths of the initial, has practically a constant velocity, 888 ft. per second according to *The Engineer*. The weight discharged per minute in pounds avoirdupois may be found by multiplying the area of opening in inches by 370 times the weight per cubic foot of the steam.

THERE are over 7,000 miles of railways in operation in Brazil, There are also 6,000 miles in process of construction and 12,000 miles projected. The Government owns 1800 miles, costing nearly $100,000,000, and is operating these lines so poorly that the expenses exceed the receipts. A Brazilian engineer has offered to take charge of and operate the railroads for an indemnity amounting to $53,075,000, and arrangements are to be completed this year. About 13,000,000 passengers and 750,000 tons of merchandise were carried in 1895, and the gross receipts amount to about $20,000 per mile.

AN underground railway operated by electricity is now in operation in Berlin. A tunnel 380 yds. long and 3 ft. 4 ins. below the level of the street has been made by the Allegemeine Elektricitäts Gesellschaft to connect its two factories in Brunnen Strasse and Acker Strasse. There are two curves of 50 ft. and 80 ft. radius respectively, and a gradient at one end of the line of 1 in 15. The line is of normal gage and single track. The overhead system is used for conveying current to the locomotives. The latter have two motors, and are designed to draw 10 tons.

A NOVEL scheme of charities was carried out in Elgin, Ill., on June 22, when the street railway company of the city turned over to the members of the Women's Club, the operation of the complete system for one day with the understanding that 60 per cent of the gross receipts were to be given to the club and 40 per cent to the company. A number of nickel catching amusements were organized for the day and every effort made to increase the receipts to the utmost possible figure. The ladies of the club acted as conductors and change was refused in every case where the unwary passenger would allow it to be done. The experiment was a great success and a large amount of money was realized both for the company and for the club.

THE Metropolitan Street Railway Company, of New York, has been so far successful in the litigation arising out of its announced intention of changing t e motive power on several of its lines in New York City to the underground conduit system, the various suits for condemnation brought by property owners having been decided in favor of the company. It is probable that the Commissioner of Public Works will use at once the necessary permits for tearing up the streets on the Fourth Avenue line, and that active work will be commenced early in August. The attempt to establish the city's right to take over the franchises of the Sixth and Eighth Avenue lines under the clauses in their franchises apparently giving the city power t› do so has also failed.

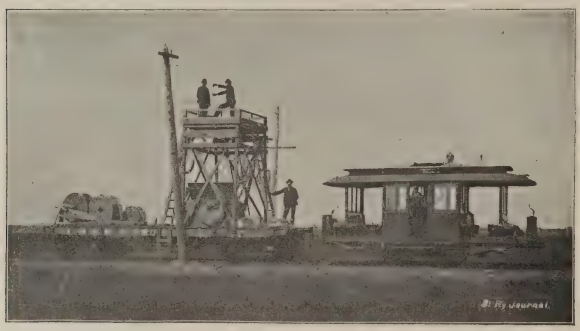
SOME interesting details upon the reduction in the cost of steam power from 1870 to 1895 were recently brought out by F. W. Dean, the well known steam expert of Boston, in a recent paper before the Association of Mechanical Engineers. He stated that for years the pumping engine has been considered the most economical in the use of steam, but that within the last few years several engines have been designed and built which compare most favorably with the best of pumping engines; and that compound engines are now being built which produce power from 12¼ to 12¾ lbs. of steam per horse power hour. He cites the case of four such engines, viz.: Grosvenor-Dale, Conn.; Natick, R. I.; West Boylston, Mass.; and Berkley, R. I. The first three cases named are the improved Wheelock engines with Hill valves.

THE Trenton Passenger Railway Company issues a special transfer ticket when cash fares are paid on the cars running to Spring Lake Park, its beautiful pleasure resort, stating that "this transfer will admit the bearer to the pavilion at Spring Lake Park. If presented at the box office with five cents, it will entitle the bearer to a reserved seat ticket." Since this method was introduced, the character of the audiences at the entertainments in the pavilion is raised, and the plan has been found very pleasing to the patrons of the road. Under the old plan when everybody was admitted, the walking population and the bicycle riders filled the pavilion long before the patrons of the road arrived. The company is purchasing this summer 10,000 Japanese fans for distribution on its cars throughout the city, the fans bearing an advertisement for Spring Lake Park.

UNDER a recent Act of the Massachusetts Legislature, Governor Wolcott has just appointed Hon. Charles Francis Adams, of Lincoln, Mass.; Hon. William Crapo, of New Bedford, and Hon. Elihu B. Hayes, of Lynn, a Special Street Railway Commission to investigate the relations existing between cities and towns and street railway corporations; the taxation of street railways and their franchises in Massachusetts and other states and countries; and the need, if any, of legislation to establish a more fixed tenure of franchises for street railways and an equitable method of taxing them. The Commission is empowered to summon and compel the attendance of witnesses, and one-half of the expenses of the Commission is to be borne by the street railway companies. The Commission's report is to be made to the Legislature on or before the first Wednesday in February, 1898.

Electric Locomotives in Overhead Trolley Construction Work.

In constructing the overhead work of the Suburban Railroad in Chicago, as mentioned in the last issue, the Patton motor was used



ELECTRIC LOCOMOTIVE IN CONSTRUCTION WORK.

continually after the failure of the locomotive which was in use part of the time. The expense of a day's run with the locomotive and with the Patton motor was as follows:

LOCOMOTIVE.

1¼ tons coal @ $5	$ 7.50
Engineer	3.50
Fireman	2.00
Total	$13.00

PATTON MOTOR.

15 gals. gasoline @ 6¼ cts.	$ .94
Motorman	2.00
Total	$2.94

The motor had also the advantage of being without smoke or fumes to interfere with the tower men.

One special run of sixty-six hours and ten minutes was made without stopping work and two runs of twenty-four hours and thirty-six hours respectively without stopping.

In one period of twenty-four hours 1¼ miles of track and overhead work were completed with this motor, the trains handled consisting of three cars, two loaded with steel and one with ties.

Bicycle Hanger for Street Cars.

The accompanying engravings illustrate a new and ingenious method of carrying bicycles, employed on the cars of the Market

FIG. 1.—READY FOR WHEELS.

Street Railway and most of the other lines in San Francisco. As is well known, this city is situated on a number of hills and the traffic of carrying bicycles is found to be enormous.

The carrier consists of a simple rack on the dash, which, when not in use, can be folded flat, taking no room on the street. When in use the arms of the rack are swung out so that two bicycles can be carried at each end of the car. A fare of five cents is charged for each wheel, the wheel being at the owner's risk, and on a number of lines the racks have paid for their cost each month. The device

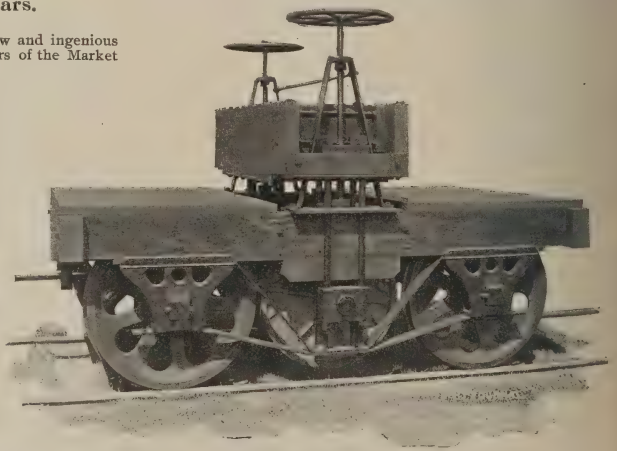
FIG. 2.—CARRYING ONE WHEEL.

weighs only 25 lbs. and is easily detachable. It is so located as not to interfere in any way with other equipment, neither is the dash marred or scraped. It has proved so successful in operation that the inventor has arranged with the Graham-Woodward Equipment Company for placing it on the market.

Roadbed Roller.

The many extensions into the outlying sections where macadam is used for road material recently made and contemplated by the Springfield (Mass.) Street Railway Company, has induced the general manager of that company, Austin E. Smith, to make a special study of the construction of this class of work with a view of substituting machine hardening for the hand rammer commonly used. As a result he has had built, for this purpose, the machine shown in the accompanying engraving. The principle is that of the steam roller simplified and adapted to track work.

It consists of a very strong, wooden framed, four wheel truck, carrying in the center a heavy iron roller 33 ins. in diameter and 4 ft. 7 ins. long. This roller is built up in sections so as to leave the road with the necessary crown. The several sections are pressed on to a steel axle 4½ ins. in diameter. The ends are carried in self oiling boxes which are raised and lowered by means of screws, so arranged that the roller can be raised to a height of 4 ins. above top of rail for transportation on its own wheels over roads already built, and



ROADBED ROLLER.

lowered 4 ins. below the top of the rail or held at any intermediate point. If, however, the roller meets with any obstruction, means are provided by which it will pass over it without lifting the truck

wheels from the track. The total weight of the machine as shown is 11,000 lbs. Directly over this roller and connected with it by means of iron posts is a strong box designed to be filled with iron so as to give additional weight, if desired. The ends of the roller can be raised independently of each other so that the shape of ground line can be varied.

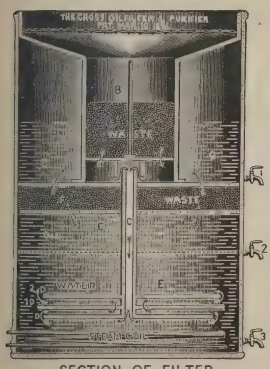
Should it be desirable to roll the bed outside the rails, the adjustable screws will lift the four flanged wheels entirely from the rails, thus permitting the roller to go where guided. The truck is coupled to and receives its motive power from an electric construction motor car, and affords ample room for transporting men and tools to and from the place of work. The ro ler is manufactured by the Wason Manufacturing Company.

Oil Filtering.

Every user of lubricating oil appreciates the fact that the larger portion of all the oil he buys is not consumed by the machinery on which it is used, but passes through, and, but for the fact that it becomes filled with dirt and grit, could be used again. Because of the dirt and grit in it, however, it must either be thrown away as waste oil or else filtered. For this reason the best method of filtering oil is an important question in economical station operation. The ways of doing this are various, but one that has been found to be very successful is that of the Burt Manufacturing Company used in the Cross oil filter.

The illustration shows the construction of this filter. It is made of extra grade, heavy galvanized iron, all joints soldered, lapped and riveted, and is painted, with polished brass fittings and nickel-plated rim. The bottom chamber (*E*) is filled with pure, warm water, which is heated by means of a steam pipe passing through the filter. Very little steam is required, and if the filter is kept in a warm place it will not be necessary to make steam connection at all.

The waste oil is poured in through the top grating, *A*. It then passes into chamber *B*, through the layer of waste, which collects all the heavier impurities. From thence through the perforated bottom of chamber *B*, down in the direction shown by the arrows into tube *C*, and from here into filter plate *D*, where the increased weight of the water has a tendency to keep the oil back in tube *C*. However, the pressure of oil in chamber *B*, forces it down and spreads it out over plate *D*, in a very thin film which constantly changes surface and grows thinner as it travels from the center to the circumference of plate *D*, thus exposing every particle of waste oil to the action of the water. It then flows upon plate *D'* and *D*², going through the same process in each case. When the oil leaves the filter plate *D*², it is in a finely divided state of separation and thoroughly mixed with water, which washes it out and from which it separates by gravity all the remaining impurities, which settle in chamber *E*, and can be removed through cock No. 3. From plate



SECTION OF FILTER.

*D*² the oil again filters through the stratum of filtering material *F*, and from there it rises to chamber *G*, the reservoir containing the purified oil. It is then drawn off as required from cock No. 1.

Practically no attention is required after the filter is started, and the first cost is the only expense, excepting a few cents a year for waste. The filter cannot clog up, and there is nothing about it that can break or get out of order. It has been manufactured by the present builders for seven years and is supplied in any size from 3 gals. to 120 gals. capacity.

Clinching Ear.

The Central Electric Company has had upon the market for some months past an article termed the "Central clincher ear." This clincher ear is made in various lengths, viz., 15, 12, 9, 7 and 6 ins. The standard tap is for a ⅝ in. stud. This clincher ear has been successfully used for over a year on figure 8 wire, without the use of solder, and upon various occasions tests have been made to determine the firmness with which the wire is held. The tests are said to prove that the clinching strength of the ear is far in excess of the requirements. Thousands of these ears are to-day in use on roads using No. 0, 00, 000 round trolley wires, and the first instance is to be recorded where any one of these ears has ever allowed the trolley wire to drop.

There is practically no wear on the clincher ear, as it does not pass under the trolley wire, but covers only two-thirds of the wire. From this it may be seen that by the use of this ear, sparking is reduced to a minimum, and the wear of the ear is entirely avoided.

Most quick repair or rapid construction devices for this purpose necessitate the trolley wheel passing over it. There is no ear

CLINCHING EAR.

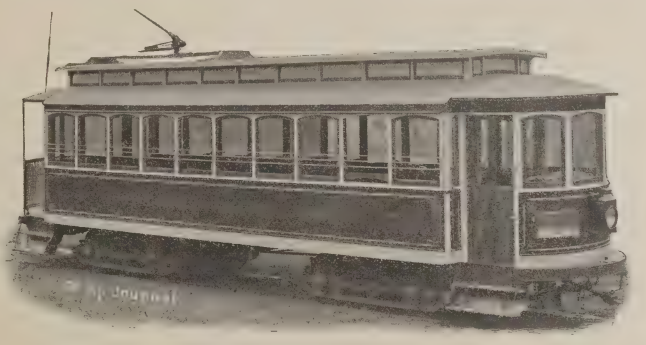
or clip which passes under the wire, which is subjected to continual wear. The design of these ears is such as to overcome this objection, and they are made as slender as possible, with a safe margin of strength, and it has been found advisable in most instances to use the long ear, so that the ear will partake of the flexibility of the wire, thus overcoming crystallizing by the constant bending at the point of the ear, as is the case with many short clips. These ears are also very satisfactory for curve work, as they can readily be bent to the desired radius of the curve.

Attractive Suburban Cars.

The accompanying engraving shows an attractive type of car for suburban service recently put in service by the Cleveland & Chagrin Falls Electric Railway Company. The main dimensions of the cars, which were built by the G. C. Kuhlman Company, are as follows:

Width over sills	8 ft. 5 ins.
" inside	7 " 6 "
Length over sills	29 " 6 "
" " all	40 " 6 "
Rear platform length	6 "
Vestibules, length	5 "
Height inside of car from floor to ceiling	8 "

Each car has sixteen reversible seats and four corner seats with backs, making the seating capacity of the car forty passengers. The doors are in the ends of the body and are of the twin folding type, being 42 ins. in width. When the doors are open and the windows are down the cars are similar to an open car and well fitted for summer service. All window glass is put in with rubber cushions,



STANDARD CAR—CLEVELAND & CHAGRIN FALLS RAILWAY.

and stops are set in from the outside, thereby preventing the water from working through the glass. This, it is claimed, is a very important feature.

The upper decks are 56 ins. wide inside, which gives car a roomy appearance and also aids ventilation. The seats are covered in frieze plush, the interior finish of cars is in mahogany and the ceilings are of pure white birch. A unique idea of trussing the side panels of the cars is used. It is so arranged that the cars will not buckle up and will remain straight at the sill and window rails. The main sills are faced with steel, as are the platform knees, giving, in fact, a construction that is exceedingly strong. The buffers are extra heavy and are faced with ½ in. × 6 in. steel. This use of steel plates for facing both sides of the side sills has been found most useful by the Kuhlman Company in the manufacture of baggage cars.

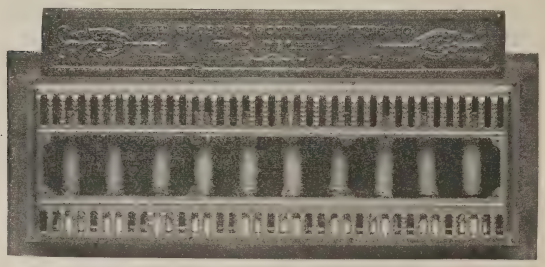
These cars are mounted on Peckham trucks with Walker equipment, and are evidently giving unusually good satisfaction and are admired by all, as the railway company has recently given out an additional order for three cars, duplicates of those described.

A New Electric Heater.

The accompanying engraving shows a panel of the type B electric heater manufactured by the Globe Electric Heating Company. In the view the center plate is removed to give a better idea of the character of the heater. This heater, which is manufactured under the Fraley patents, has been in use on a number of electric lines during the past winter, including that of Chester Traction Company, Camden, Gloucester & Woodbury Railway Company, Roxborough, Chestnut Hill & Norristown Railway Company and Consolidated Traction Company, of New Jersey, with satisfactory results.

The heater differs radically in construction from any other electric heater on the market. The conductors are wound in forms of cylindrical coils entirely separate from each other, that shown in the engraving having ten of these coils. The cores upon which these coils are wound are hollow and provided on the inside with metallic reflectors facing each other, by which it is claimed the effective work of the heater is increased 45 per cent. The core also serves as a return conductor, one end of the coil being attached thereto. The coils are each wound for 50 volts, taking ten in series for each 500 volt heater. By changing the connections to two in series, the heater can be changed for use on a 110 volt circuit.

Another important feature of the heater is the construction of the case which is proportioned to give the best results for a given



ELECTRIC HEATER.

amount of energy. The cold air is admitted at the bottom through a grated opening and circulates through and around the coils, during which it comes in contact with the iron reflector around the heater; it is then expelled through the opening in the top.

Graphite Trolley Bushings.

Careful study and long experience in electric railroading have solved many problems which puzzled the early workers in the field, and in no department has this been more noticeable than in the minor parts of electric car equipments. As a result many economies have been made possible in the apparently insignificant portions of the electrical apparatus, and these have not only simplified the work of the railway superintendent, but have added not a little to the total efficiency of the service.

As an example, the Bound Brook graphite trolley bushings, and motor bearings for which the Central Electric Company is agent, might be quoted. These bushings were first brought out in the early days of electrical construction, and the first order was placed by the Thomson-Houston Electric Company, of Boston, for one dozen, or thereabouts and upon examination and trial, were found to be eminently desirable for the purpose for which they were designed. They have since grown continuously in favor, until at this time they are extensively used for bushing trolleys.

There are a great many people who use the Bound Brook products, without the knowledge of their utility, or a proper treatment of such an article. Most railway companies, or their employes, have gotten into the habit of continuously doping the trolley bushings.

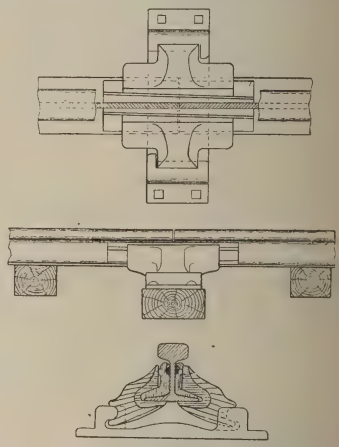
With certain forms of bearings, this may be necessary, but with the Bound Brook, the use of oil is not necessary. Many bushings are ruined by the excessive use of oil. If these bushings are properly treated, they should outlive the best trolley wheel, and the manufacturers of this bushing assure their Western agent, the Central Electric Company, that if new bushings are placed upon new pins, the replacing of axle pins in the trolley harp will be rarely known. The same remark would apply to the graphite self-lubricating motor bearing. This, the manufacturers state, has been conclusively proven by some of the leading railways of this country. The Central Electric Company carries thousands of these bushings in stock, and is prepared to make prompt shipments upon receipt of orders.

The Central Electric Company is also prepared to furnish overhead material for figure 8 and clover leaf wire, as well as for No. 0,00, and No. 000 round trolley wire. The company has lately equipped several roads with its appliances, having furnished materials for all of the various designs of trolley wire. It has just completed one eighteen mile road, and the letter which the managers have received from the president and general manager of this road is most gratifying. The company has also a complete line of hangers, clips, ears, splicers, cross-overs, insulators, etc., and feels sure that but an opportunity is needed to demonstrate that its work is satisfactory.

The company has lately furnished several equipments of its Helios 500 volt, railway enclosed arc lamps. These lamps are said to be giving splendid satisfaction. It is a great convenience to be able to place on a 500 volt circuit, an arc lamp which requires trimming but once in 150 hours. Such is the case with the Helios lamp. These lamps can be adjusted to work on any voltage from 450 to 550. The adjustment is made at the factory, as per specifications furnished by the customer. These lamps are furnished for interior as well as exterior purposes, and are made waterproof, when desired to be used in pavilions, parks, etc.

A New Truss Rail Joint.

This joint is composed of five parts, a bedplate, two side flanges and two wedges or keys. No bolts or nuts are used and no drilling of rails is necessary. The chief feature is its truss principle and by it the two rails are so closely bound together that it is impossible for one rail end to move without the other. This insures



PLAN, SECTION AND SIDE ELEVATION OF TRUSS JOINT.

a true truss made as firm as the apex of a bridge, so that the wheel passes smoothly over the joint without jar or pounding.

The strength of the ordinary joint depends upon the bolts and the width of the fishplate, and with the first wear a see-saw motion begins, which sooner or later destroys the joint. By reference to the cut it is easily seen that the heavier the weight upon this joint the more firmly does it hold the rails together. Should there be any wear the lost motion is taken up by the car's weight before the wheel reaches the joint and it is impossible for the joint to be loose while the weight is upon it. The inventor claims that the joint cannot wear loose during the life of the rail, but if it should the motion may be taken up by driving the wedges in further. It is also claimed that this joint does away with the necessity of bonding.

Benj. J. Weeks, superintendent Quincy & Boston Street Railway Company, states under date of March 26, 1897, that "one of the railway joints patented by J. Hinckley Williams, was placed in position on the Quincy & Boston Street Railway near Neponset Bridge in November, 1895, and is still in use there. This line we consider as being our heaviest in trips as well as passengers carried. We consider this joint one of the best we have ever seen."

A Novel Three Wire System.

One of the most difficult electric railway schemes yet proposed is the equipment with motors of the Florence & Cripple Creek Railway. This road starts at the coal banks on the Arkansas River, near Florence, Colo., and winds around through the mountains, a distance of some 40 miles, to the Cripple Creek Gold Mining Camp, the latter point being at an elevation of about 5000 ft. above Florence. The road has one nearly continuous 4 per cent grade for a distance of 24 miles. It is at present operated with twelve Baldwin locomotives of the latest narrow gage pattern. The proposition is to displace them with electric locomotives of nearly double the capacity, and to generate the current with steam power at the Florence coal banks.

J. C. Henry, one of the early electric railway designers, has had the problem under consideration for some time. It was apparent

from the start that the ordinary trolley system would be undesirable in many respects.

The general plan is shown in the accompanying diagram. The main transmission lines carry a three phase current at 20,000 volts pressure. This is transferred at substations to direct currents at 800 and 1200 volt pressure, which are connected in the ordinary three wire way to the trolley lines. Each locomotive is provided with four 1000 h. p., 600 volt, direct current motors. By means of a specially arranged controller the motors are connected in series or in series multiple, with either or both sides of the three wire system. This not only effects a tremendous saving in copper, but provides an ideal method of motor regulation, as five or six different speeds are provided for without artificial resistance in the armature circuits. To secure improved adhesion the field magnets are magnetically coupled together, they being separately excited from the low voltage side of the system. The field magnetization which also controls the speed is varied by a rheostat. This makes the well known advantages of shunt motors available, and avoids the objectionable use of fine wire on the field magnets. The problem of descending the 24 mile 4 per cent grade safely is of the greatest importance. This has been met by running the motors as dynamos, their voltage being controlled with the ordinary controller. The tonnage down hill being greater than that in the opposite direction, and the former

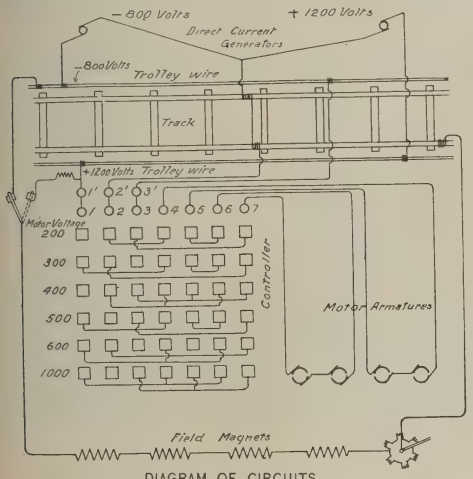


DIAGRAM OF CIRCUITS.

increasing in greater proportion, it seems only a question of a short time when enough electrical energy can be recovered to operate the road without assistance from the generating plant. In this event, storage batteries arranged to give or take will probably be substituted in place of the three phase circuits and transformers.

The system presents a number of new features of advantage which would seem to be great improvements over the existing railway practice where double trolleys are permissible. First, it is a double system; should any derangement occur to the trolley, trolley wire, or dynamo, on one side, the cars may proceed with current from the opposite side. Second, the system has all of the theoretical advantages of the Edison three wire method, but avoids the difficulties of maintaining a balance which have been met with when applying that method to the fluctuating requirements of railway work. Third, the motor regulation is without loss. Fourth, when descending grades or stopping the train, the energy is returned back to the line and lightens the labor of the dynamos. It has long been known that shunt wound motors would accomplish this desirable result within certain ranges, but to maintain the voltage as the speed of the motor (when working as a dynamo) decreased, required immense fields and they were necessarily wound with very fine wire. In the system described, the ordinary railway motors are used, the only difference being the fields a e wound with somewhat smaller wire than common. When the motors are being worked as generators for braking purposes or when descending grades, to maintain the voltage as the speed decreases, the motors are connected from parallel to series with first one then the other of the three circuits, i. e., with the low side, the high side or the two sides combined in series. Further regulation is obtained by varying the field's magnetization, the controlling cylinder and the field magnet rheostat being operated by a single lever.

W. B. TARKINGTON, master mechanic of the "Omaha (Neb.) & Council Bluffs Railway Company," was in Chicago recently inspecting the different Chicago street railway plants and interviewing manufacturers' agents with a view of enlarging the power house of his company.

Mutual Casualty Insurance for Electric Railways.

For a number of years various insurance companies have been experimenting in insurance upon horse and electric railways, but the results have been so little encouraging that most of these companies have either discontinued business entirely, or have made their rates almost prohibitive. The trouble seems to have been that when street railway managers are wholly relieved from responsibility for accidents the tendency is to grow somewhat more careless in the handling of their roads, and perhaps even in care for the immediate settlement of damage suits. There is still, however, an urgent demand for some means of averaging accident risks through insurance, and in March, 1896, a number of street railway managers organized the Electric Mutual Casualty Association, established headquarters at Philadelphia, and entered into "Self Insurance" on much the same principles first made familiar to the insurance world by the very successful Manufacturers' Mutual Company of Massachusetts. This association has grown and has become a successful adjunct of careful electric railway management. There are certain intrinsic advantages which such a system of insurance possesses, among which are economy in management, careful selection of risks (large city systems being generally excluded), systematic inspection of adjustment of claims, and the self interest which comes from the fact that no company is wholly relieved of the burden of its own loss, so that care in management will bring about a reduction in insurance charges.

The company now assesses its members 3 per cent of the gross receipts, and has the right to levy an additional assessment of 2 per cent, so that the maximum rates which any member has to pay does not exceed 5 per cent per annum. Profits are divided into two parts, one passing to a surplus fund which is established to provide for the safety of the business, while the other is returned to the members in the form of dividends. The company intends to allow this surplus to grow to a point such that not only will all chance of assessments beyond the 3 per cent limit be avoided, but that a reduction to 2 per cent may be rendered possible.

The company's general corps of adjusters is composed of the different railway managers themselves, who work in the interest of the association without remuneration. No large general office salaries are paid, nor salaries to numerous resident and traveling agencies and little advertising for business is necessary. No commissions are paid for the securing of members, and for all these reasons, with others, the company's operating expenses are said to be less than 16 per cent of its premium income, as against from 50 to 60 per cent usual with other companies. Through the close relationship existing between railway managers and the company, the latter is able to obtain a thorough knowledge of every applicant for membership, not usually possible with other companies.

One of the features of the company's policy is that it pays property damages to the extent of $500, a clause rarely introduced in contracts made by other companies; moreover, the contract is not one of co-insurance in which the street railway company pays a percentage of its own losses, but the entire loss is borne by the insurer.

The company has at present a membership of forty-five exceptionally good risks, among which are the following well known companies: Staten Island Midland Railway Company, the Hamilton (O.) & Lindenwald Electric Transit Company, the Schuylkill Valley Traction Company, of Norristown, Pa.; the Norwalk (Conn.) Tramway Company, the Chester (Pa.) Traction Company, the Bergen County Traction Company, of Fort Lee, N. J., the Reading (Pa.) & South Western Street Railway Company, the Warren (Mass.), Brookfield & Spencer Street Railway Company, and the Brockton (Mass.), Bridgewater & Taunton Street Railway Company. An annual premium income of over $60,000 is obtained from the members, with a contingent liability of $40,000 additional. In sixteen months of operation the company has accumulated a surplus of over $25,000.

The receipts and expenses for the first sixteen months of operation ending Aug. 1, 1897, have been as follows (it being remembered that during the first twelve months the premium rate was fixed at 2 per cent of the gross receipts and during the last four months at 3 per cent).

Gross receipts		$61,382.33
Expenses	$27,343.43	
Claims and attorneys' fees	16,918.49	44,261.92
Balance		$17,120.41

The expenses for the last four months have been much less in proportion than those for the twelve months preceding, the latter including, of course, all expenses of organizing the company. All the claims against the company to date have been paid, with the exception of $1006 which will be settled in a short time. The company has, of course, received numerous reports of accidents which may or may not develop into claims against the different members. Some are also being contested by advice of the members themselves, as some cases have occurred in which there is either no liability on the part of the road or else the claims are for such excessive amounts that adjustment in court is necessary. It is the company's policy, however, to keep out of the courts whenever reasonable settlement can be made.

STREET RAILWAY NEWS

Convention of the American Institute of Electrical Engineers.

The fourteenth general meeting of the Institute was held at Greenacre-on-the-Piscataqua, Eliot, Me., on July 26. Papers were presented on the following subjects: "The Precision of Electrical Engineering;" "The Alternating Current Induction Motor;" "A New Form of Induction Coil;" "Effect of Heat upon Insulating Materials;" "The Effect of Armature Inductance upon the Electromotive Force Curves of an Alternator;" "Electric Metering from the Station Standpoint;" "Development of the Fire Alarm Telegraph;" "Electrical Traction.—Notes on the Application of Electrical Motive Power to Railway Service;" "The Cost of Steam Power;" "Efficiency and Life of Carbons in Enclosed Arc Lamps;" "Armature Reactions in a Rotary Transformer;" "The Economy and Utility of Electrical Cooking Apparatus."

Annual Outing of the Massachusetts Street Railway Association.

The annual summer outing of the Massachusetts Street Railway Association was held July 12 and was largely attended. The members of the association were guests of the Quincy & Boston Street Railway Company, of which John R. Graham is president. The programme included a ride from the new subway in Boston to Nantasket Beach by special cars of the West End Street Railway Company. The new subway naturally attracted much attention from the delegates. This was officially opened July 3, when a special car carrying President Little, of the West End Railway, and some fifty invited guests, made the trip from the Public Gardens to Park Street. The round trip was made in five minutes. The railway will be open for public service about Aug. 2.

After making the circuit of the subway the attendants at the convention were carried on special cars to Dorchester where barges were taken for an inspection of the new power house of the West End Street Railway Company on Freeport Street. Barges conveyed the party to the cars again, and the run was made to Neponset bridge, the end of the West End system, and where connection is made with the Quincy & Boston Street Railway. Three cars of the latter company, each containing fifteen benches, which are the largest cars on any street railway in Massachusetts, were at the disposal of the party. The cars were gayly decorated with flags and bunting.

While riding through Quincy the party met a street band playing in front of a restaurant, and President Graham, the host of the day, hailed the leader, and in a moment the whole troupe was aboard the car, playing lively and popular airs. Quincy Point was the destination of the party, and there the power station of the Quincy & Boston Street Railway Company was thoroughly inspected and a very appetizing collation enjoyed.

Half an hour later dinner was served in the big dining pavilion at Downer Landing. Plates were laid for 200. Prentiss Cummings,

PRENTISS CUMMINGS,
PRESIDENT MASSACHUSETTS STREET RAILWAY ASSOCIATION.

J. R. GRAHAM,
PRESIDENT QUINCY & BOSTON STREET RAILWAY CO.

GROUP OF MEMBERS—MASSACHUSETTS STREET RAILWAY ASSOCIATION.

president of the association, sat at the head of the table with Mayor Quincy on his right, but that was as far as the formality extended. After dinner the host presented to each one present a souvenir of the occasion in the shape of a polished disk of granite, cut from a sleeper used in the construction of the first railway built in America, completed Oct. 7, 1826, leading from the granite quarries to the Neponset River.

The party boarded electric cars again for the trip through Weymouth and Hingham to Hull and Nantasket Beach. The harbor

ENTRANCE TO SUBWAY—BOSTON.

trip included a sail on the steamer "City of Quincy" as far as Boston Light, and then up and around the battleship "Massachusetts," and then home, Boston being reached about 6. The outing was one of the best ever enjoyed by the association.

Convention of the Northwestern Electrical Association.

The fifth semi-annual convention of the Northwestern Electrical Association was held at La Crosse, Wis., commencing on Wednesday, July 21. The Cameron Hotel was the official headquarters, and the convention was largely attended. Papers were presented on "Meter Tests," "220 Volt Lamps," "Use of Oil in Transformers," "Utilization of Exhaust Steam," "Evolution of the Incandescent Arc Lamp," "Rotary Transformers" and "Fuels for Central Stations."

Notes From England.

(*By our London Correspondent.*)

The best that can be said about the accounts of the Tramways Committee of Glasgow Town Council for the year ending May 31 last, which have just been issued, is that they show a net surplus of revenue over operating expenses of about the same amount as those of the previous year. But the surplus should have been greater. The gross revenue increased from £334,377 to £370,882, but the working expenses rose from £251,110 to £286,286. The surplus accordingly increased only from £83,267 to £84,596. The profit as usual is devoted to paying interest, accumulating sinking and depreciation funds, and writing down the value of plant, equipment and tracks. The number of passengers carried during the year was about 99,000,000. About £4000 of the increased expenditure is due to a rise in wages granted to the employes, but on the other hand the cost of provender for the horses per head was the lowest on record. The leading Glasgow newspaper has been very severe on the Tramways Committee for not writing off larger sums for depreciation, especially on horses, and it continues to urge the necessity of getting rid of horse traction with all its uncertainties and risks as soon as possible. The tramways during the year have had to face a much keener competition than before, owing to the opening of new underground railways, but the extraordinary lowness of the fares on the tramways has done much to preserve the traffic. I give you these details because the Glasgow tramways are the biggest system in the country under municipal management, and because, as readers may remember, electric traction is about to be tried.

Glasgow Town Council at a meeting the other day warmly debated the question whether for the experimental trolley line about to be equipped the current should be provided by an extension of the Council's existing electric lighting station, or whether the Tramways Committee should generate the power at a station of its own. The matter is of much importance in this country, because many cities have large electric lighting undertakings under municipal control and there is a wide spread feeling in favor of the municipalities supplying power from the one station both for lighting and for electric tramways about to be installed. The economy and convenience of such a plan have been hotly debated in several towns, and expert evidence has not been all on one side. But apart from that there is one consideration in the case of Glasgow which ought to be conclusive. The line to be equipped is an experimental one, and many people are still dubious as to how electric traction will pay. To solve the problem it is absolutely necessary that the current for the tramway should be produced independently of any other generating station, so that the cost of it may be accurately known. If it was generated at a lighting station it would hardly be possible to tell exactly what it cost. Then it can be shown that if the electric cars can at all pay their way on a short experimental line they will pay very much better when the system is extended. Though this view was not expressed by any of the Councillors at the recent meeting, it was determined by a large majority that the tramway current shall be generated independently of the electric lighting station and in a separate building.

While speaking of Glasgow I may say that the underground cable railway known as the District Subway, which has been in operation since the beginning of the year, is working very satisfactorily. I am informed that the directors from their experience are convinced that by no other power could they handle the traffic so nimbly. The average duration of stoppages at the stations, which are less than half a mile apart, is about fifteen seconds and full speed (12 miles an hour) is attained almost at once on starting. Single cars are run on a 3½ minute headway, but trains of two cars each are about to be put on. The financial results are said to be gratifying, but detailed accounts have not yet been published.

James Ross has not succeeded in his offer to Birkenhead Town Council for a lease of the local tramways and their electrical equipment. Between his company in Birmingham and the Birmingham Town Council the deadlock to which I have previously referred continues. The company declines to put in electric conduits all over the system unless a longer lease is given, and the Council refuses to extend the lease. Negotiations have been renewed in Belfast for the introduction of electricity while in Dublin the work of installation, promises soon to be general. A contract has been concluded for the equipment of an electric line in Blackburn, and construction work will soon be going ahead in Halifax.

Gas Engines in Swiss Power Stations.

In the summer of 1896, the generating station of the Lausanne Electric Tramways was started with two double-cylinder gas engines each of 130 effective h. p. The speed of the engines is 160 r. p. m., and they are coupled direct to the dynamos.

The gas plant, which is large enough to supply four of these engines, consists of two generators, each 6 ft. 6 ins. in diameter by 11 ft. 6 ins. high, and each capable of producing gas for engines working up to 300 h. p. The fuel used is close grained Belgian coal. The cooling water for the engines is drawn from a reservoir by means of an electrically driven pump. Only two men are required to look after the present plant, namely, a stoker for the generators and boilers, and a mechanic to superintend and lubricate the engines. At present one engine and generator work for seventeen to eighteen hours a day without stopping, charging a battery of accumulators, the second engine being sometimes used to complete the charging should the requirements of the traffic demand it. When necessary, both generators are used together for four or five hours. They are kept constantly lighted ready to supply gas if required, and each of them works on an average 280 hours a month.

Notwithstanding a number of rather adverse conditions for obtaining the most economical results, the coal consumed during the month of November, 1896, including the fuel daily consumed in lighting the boiler, amounted to 1.8 lbs. per kilowatt hour, say, 1.2 lbs. per effective horse power, reckoning an efficiency of 89 per cent in the dynamo.

If the coal consumed at starting the generators and when they are at rest is deducted, the consumption of fuel for the normal working load is at the most 1.1 lb. per effective horse power per hour.

At the Zürich central tramway station where two gas engines of 60 effective h. p. and one 120 effective h. p. are installed, the engines are worked with gas made from Belgian anthracite. During a fourteen days' trial recently made the consumption of anthracite, the engines only giving off three-quarters of their full power, was only 1.4 lbs. per effective horse power per hour. This amount did not include the coal used at starting, but taking this into consideration, the total consumption only amounted to 1.5 lbs. per effective horse power per hour. The above figures are taken from the London *Engineer*.

THE Borough Council, of Carlisle, Pa., has declared forfeited the franchise of the Carlisle Electric Railroad, and ordered that the tracks be removed from the streets. It is claimed that the company has failed to make certain extensions called for in the franchise.

Foreign Notes.

Bangkok, Siam.—The Minister of Finance of Siam has granted an important concession to L. E. Bennett, an American engineer, being the exclusive right to work for 10 years the concern known as the Siam Electric Light Plant, with an option of holding the concession with all exclusive rights for an additional 10 years. Mr. Bennett is given the exclusive right to light Bangkok in the suburbs. A local company has been formed with a capital of about $50,000 to put the plant in first-class condition. The capital was eagerly subscribed by local parties.

Beziers, France.—Bids will be received for the equipment of the street railways of Beziers with electric traction. Applications for plans, etc., should be made to the Conseil Municipal, Beziers, Herault, France.

Chihuahua, Mexico.—R. M. Burke, United States Consul at Chihuahua, reports the following: The Mexican Government has officially promulgated a concession for a steam railroad from Chihuahua to the Pacific Coast. Alfred A. Spendlove and E. C. Creel are empowered to construct the road, which will be 372.8 miles long. Mr. Spendlove is the general manager of the Chihuahua Mining Company, of Chihuahua, and Mr. Creel is a local banker and the manager of the Banco Mines, of Chihuahua.

Clontarf, Ireland.—It is stated that the Dublin-Clontarf Electric Tramway will be probably opened for public traffic shortly. The power house is nearly completed, as is also the track and overhead work.

Cordoba, State of Vera Cruz, Mex.—A dispatch from Cordoba is as follows: "The steel rails have arrived here from Pittsburg, Pa., for use on the electric road which is being constructed from Jalapa to this city, a distance of 50 miles. This will be the first electric railway in Mexico and will be both a freight and passenger line. About 25 miles of grade are completed and the work is being pushed vigorously.

Dublin, Ireland.—The terms of the tramways agreement arrived at between the Corporation and the Dublin United Tramways Company have now been made public. The Corporation grants the company a lease for forty years from Dec. 31, 1898, and promises to help the company to get its Tramways Bill through Parliament. This Bill includes clauses authorizing the company to introduce overhead electric traction and to construct additional lines both within and without the city boundary. For this concession the company agrees to pay a yearly rental of £500 per street mile of tramways, with a minimum annual payment of £10,000.

THE Great Northern Railway Company of Ireland has secured parliamentary permission to equip a portion of its main line from Sutton to Houth for both electric and steam trains, and to build an electric line from Sutton to Houth around the Hill of Houth, a distance of about 5½ miles. This will make a complete electric railway around the hill. The estimated cost of the work is about $200,000.

Dundalk, Ireland.—It is stated that this town will before long enjoy the convenience of communication with the neighboring watering place of Blackrock by means of an electric tramway, that will also afford facilities for quick transit through the main streets of Dundalk itself. The scheme is promoted by the Irish Development Syndicate of Dublin. The Dundalk Town Commissioners and the County Louth Grand Jury have both given their approval to the venture, and the sanction of the Dublin Privy Council has also been obtained.

Dunedin, New Zealand.—The Roslyn Tramway Company, (Ltd.) now operating a cable line in Dunedin, has accepted the franchise offered it by the Municipal Council for extensions. Some form of mechanical power will be used, probably electricity or gas.

Honduras, C. A.—A concession is said to have been granted the American-Honduras Company, of Washington, to construct the proposed electric railway of the Fryer system, from Puerto Cortes to Truxillo.

Hull, England.—An electric railway 10 miles long is to be built at Hull, contracts for which have not yet been let. A. E. White, Borough Engineer, can give further information.

Jalapa, Mex.—A press dispatch states as follows: M. W. Ensign, engineer and manager of the Jalapa-Cordoba Electric Railroad in Mexico, recently announced that more than half the grading on this new road had been completed. The total distance from Jalapa to Cordoba is some 50 miles. The power for the operation of the line will be derived from the Tiocelo River. The power house, it is expected, will be completed by Aug. 1. It is said that considerable material is yet to be purchased for this road, and that manufacturers wishing to get specifications for bids, etc., could get them by addressing Mr. Ensign at Jalapa, Mex.

Johannesburg, Transvaal, South Africa.—A telegram from Oakland, Cal., states that a concession covering the entire electric street railway system of Johannesburg has been granted to a British-American syndicate headed by Henry A. Butters, of Oakland, Cal. Mr. Butters left for Europe July 4. Among the Americans interested in this syndicate are J. K. Waterman, formerly general freight manager of the Colorado Midland Railway, of Denver; John Hays Hammond, Henry Butters, and his brother, Charles Butters, who is now in Johannesburg. The consummation of the negotiation is taken to mean that President Krueger has adopted a different policy toward the Uitlanders than prevailed during the Jameson troubles.

Kingston, Jamaica.—B. F. Pearson, Halifax, N. S., is trying to secure a franchise for an electric railway in Kingston.

London, England.—The accounts of the City & South London Railway Company for the half-year ended June 30 show a balance, after providing for the debenture interest and the full dividend on the 5 per cent preference shares, sufficient to allow the payment of a dividend on the consolidated ordinary stock at the rate of 2 per cent per annum, carrying forward a balance of £1035 to the new account. The dividend for the corresponding period last year was at the rate of 1⅜ per cent per annum, the balance carried forward being £1072. The amount of £1000, received as rent for the Jubilee stands, has been carried to a reserve account.

THE Select Committee of the House of Lords has given its sanction to the Brompton and Piccadilly-Circus Railway Bill, under which it is proposed to construct an underground electric railway, 2 miles in length, running from Piccadilly-Circus to Brompton, and having communication to South Kensington with the District Railway Company. There will be seven stations on the line including the terminals, and it is intended to introduce a three minute service, and to run the trains at such a speed as will enable the total distance to be covered in about ten minutes.

Nice, France.—The existing method of propelling the tramcars on the Nice-Cimiez line, *i. e.*, by motors operated by accumulators, not having proved suitable to the nature of the line, owing to its steep gradients, the Nice Municipal Council has recently authorized the present company to alter its system of traction to the overhead trolley system.

Port Elizabeth, South Africa.—The electric tramways of this town were officially opened by the Mayor July 8.

Sofia, Bulgaria.—A foreign exchange gives the following: "The Municipality of Sofia will receive offers up to Sept. 22 for the concession of the public and private lighting of the city, for power, and also for electric tramways. The duration of the concession is for fifty years. Particulars in French or Bulgarian can be obtained for 5f. from the Mairie, at Sofia. The mayor is D. M. Yablanski, and the engineer Chr. Taneff. NOTE.—In accordance with a custom prevalent in the Balkan States, when the tenders have been opened, it will be admissible for anyone to underbid the lowest one up to Oct. 2. In the language of the notice, tenders will be received for either or both of the undertakings at the offices of the Municipality of Sofia up to Sept. 22 next, and will then be examined, but a final adjudication will be held on Oct. 2, if in the interval a reduction of 5 per cent is offered on the tenders containing the most favorable terms."

Car Heaters.

W. C. Baker, whose system of car heating has had a long and remarkably successful record on steam railroads, also manufactures a line of hot water and hot air heaters especially destined for electric and cable cars. The hot water heater for a 22 ft. car has a diameter of 18½ ins. and height of 3 ft., and is fitted with hot water pipes which run clear around the inside of the car and at the feet of every passenger. The heater is designed to stand in the motor vestibule where it will warm the motorman and keep frost from the window so that he can clearly see the track. The hot air heaters are manufactured in several sizes and are well arranged for furnishing a maximum amount of hot air.

Heaters are also designed to be carried underneath the car if desired. In this case they are fired from the outside, and the exposed portion is thoroughly protected from the weather and from burning the adjacent woodwork. The smoke pipe is run up through the back side of the car seat, and close to the side of the car. It is covered with polished sheet copper, is but 3 ins. in diameter, occupies no available seating room, and is not unsightly. The consumption of fuel is certainly very small. The fluid in the hot water heaters is non-freezable.

News Notes.

Akron, O.—The Akron & Cuyahoga Falls Rapid Transit Company has been given a franchise for a double track between Akron and Cuyahoga Falls. In consideration of the franchise the company agrees to make extensive improvements in the roadway.

Appleton, Wis.—The Milwaukee *Wisconsin* prints the following: "The incorporation of the company which is to build the new interurban electric line in the Fox River valley, has been perfected, and the articles of incorporation filed. The company is to be known as the Fox River Valley Electric Railroad, and its capital stock is $200,000. The incorporators are H. D. Smith, of Appleton, F. G. Bigelow, H. C. Payne, Charles N. Pfister and B. K. Miller, Jr. The Cleveland people who are interested in the enterprise are M. J. Degnon, C. W. Collister, J. J. Hogan and William Christy, vice-president of the Akron, Bedford & Cleveland Railroad. These gentlemen are to build and equip the road and take pay in stock. They have already sent on their tools and will begin work immediately. Mr. Degnon is to have charge of the work of construction. Work is to be commenced on both ends and the line is to be completed between Neenah and Appleton before Oct. 1."

Brooklyn, N. Y.—The plans of the Brooklyn trolley roads for using the bridge have just been filed with Chief Engineer C. C. Martin. They are complete with the exception of the plans for connecting with the Brooklyn approach and for raising the roof of the New York station. When these are submitted it will be a question of only a few weeks before the contracts are ready for signing. The plans of the Brooklyn Elevated road are in, and those of the Kings County Elevated road, which are simple, will be ready in a short time, it is understood.

Canton, O.—Surveys are being made for an electric railway between Canton and Louisville. G. P. Williams is engineer.

Carlisle, Pa.—William E. Fought, Burgess of Carlisle, has vetoed the ordinance recently passed by Council, which took from the Electric Railroad Company its right to run cars through the town streets.

Cincinnati, O.—J. B. Martin of Cincinnati, is interested in a proposed electric railway from Linwood to Bethel.

Clinton, Mass.—The Worcester & Clinton Street Railway Company has applied for a franchise in Clinton. Chas. E. Dresser, of Leominster, Mass., is one of the largest stockholders.

Coxsackie, N. Y.—Four street railway companies have been incorporated with the Secretary of State, having the same interests behind each. The roads are to be constructed in Greene, Albany and Scoharie Counties, to be operated by electricity or some power other than steam, and will carry passengers, express and freight.

The first company is the Coxsackie & Greenville Traction Company, to operate a road from the terminus of the Greene County Traction Company's line in Coxsackie to Greenville and Durham, a distance of 12 miles. The capital is $150,000. The second is the Oak Hill Traction Company, to construct a road 20 miles long from the above terminus to Oak Hill, Conesville, Cooksburg, Rennselaerville, East Durham and Cairo, in Greene County. Capital stock, $250,000.

The Middletown & Oak Hill Traction Company is the name of the third company, formed to connect with the last-named road near Rensselaerville, Greene County, running thence to Rensselaerville, Albany county, to and through Broome and Middleburg, Scoharie County, a distance of 25 miles. The capital is $300,000.

The name of the fourth is the Windham Traction Company, formed to connect with the second-named company near Durham, thence to run to Conesville, Manor Hill, the towns of Windham and Ashland and the villages of Harrisonville and East Windham, to a point near Butt's Hotel, in Durham, a distance of 20 miles. The capital stock is $250,000.

The directors of these companies are: W. G. Raines, T. E. Smith, W. F. Leland, W. F. Smith, M. E. Ingersoll, P. Anderson, E. Richter and Albert A. Lasson, of New York City, and George C. Spencer, of Chicago. The principal office of these companies will be in NewYork City, and T. E. Smith, of New York City, subscribes for a majority of the capital stock of each corporation.

The Greene County Traction Company of Coxsackie is the name of a fifth company incorporated some time ago by these interests, and with which the four other companies are to connect. The company has already applied to the State Railroad Commission for permission to construct its road.

Cripple Springs, Col.—Charles W. Hascall of Cripple Springs, one of the promoters of the proposed Canon City & Cripple Creek Gold Belt Electric Railroad, is reported as saying that the road will be built without fail.

Denver, Col.—Geo. Arthur Stiles, of 1239-43 Larimer Street, Denver, Col., who is interested in a proposed 30 mile electric road near Denver, writes us that the organization of the company is not yet fully perfected. He states that the road will have two power houses, and will be chiefly a freight line, hauling coal to Denver. Electric locomotives will be used for handling freight, and combination passenger and baggage motor cars for the passenger traffic.

Du Bois, Pa.—The property, right, franchises, etc., of the DuBois Passenger Railway Company and the DuBois Electric Light, Power & Heat Company are advertised for sale by the sheriff at Clearfield, Pa., Aug. 6. Liabilities are estimated at about $75,000 and assets at $100,000.

East St. Louis, Ill.—An ordinance has been passed by the City Council granting a franchise to the East St. Louis Electric Railroad Company. Julius S. Walsh is president of the company.

Flint, Mich.—At a recent meeting of Flint capitalists it was decided to build a street railway from Flint to Long Lake and Fenton, a distance of 16 miles. $150,000 was promised by Geo. H. Johnson, who is believed to reside at 48 East Forty-first Street, New York City, representing Eastern capitalists. The right of way and a franchise have already been obtained. Great enthusiasm is shown over the project. The local committee is represented by Geo. Durand, W. C. Durand, Geo. Buckingham, William C. Lewis and H. C. Spencer.

Frankfort, Ky.—Charles Craine, of Springfield, O., and others have organized the Frankfort & Suburban Street Railway Company, with Mr. Craine as president; Patrick McDonald, vice-president; J. T. Buckley, secretary.

Gloucester, Mass.—It is stated that W. B. Ferguson, president of the Gloucester, Essex & Beverly Street Railway Company, is planning to build an electric railway from Essex to Manchester.

Greensburg, Pa.—It is stated that Benjamin F. Myers, of Harrisburg, Pa., and ex-Judge Sadler, of Carlisle, Pa., are interested in the proposed electric road to be built from Greensburg, with branch lines extending from the city to a number of points.

Hagerstown, Md.—The Hagerstown Electric Railway will make a park out of the Watts Grove, at Funkstown, along Antietam Creek.

Houston, Tex.—A strike of motormen and conductors on the Houston Electric Street Railway Company took place July 4 and continued for nearly two days. It was caused by a refusal of the management to reinstate two men discharged for cause, and to recognize the Amalgamated Association of Street Railway Employes of America. It was finally decided by the company's withdrawing its opposition to the Union, and agreeing to leave the cases of the discharged men to an arbitration committee consisting of three well known business men, who decided in favor of the company, but recommended that the men be granted another trial. To promote harmony and good feeling the management decided to adopt the recommendation of the committee, and reinstate the men. No further trouble is anticipated.

Hudson, N. Y.—The Hudson Electric Railway will probably be extended to Philmont in the near future.

Jersey City, N. J.—The Consolidated Traction Company of New Jersey has applied for permission to extend its line in Newark.

Joliet, Ill.—The incorporators of the Kankakee, Wilmington & Morris Electric Railroad Company have completed their organization. The following officers and directors have been elected: president, J. A. Henry, of Joliet; vice-president, Thomas J. Divens, of Chicago; secretary and treasurer, John Hulsizer, of Joliet. Directors, Thomas J. Divens, of Chicago; C. L. Bennett, J. L. Lins, P. L. Cromwell, of Wilmington; A. D. Ehrich, of Kankakee; F. D. Hardwerk, of Morris. It was decided to proceed at once to solicit subscriptions to stock and to secure the right of way.

Knoxville, Tenn.—Work on the Knoxville Street Railway extension has been commenced. H. B. Krotter, of Knoxville, has the contract for laying the first mile of the extension from that place to Galesburg. Arthur Dunbar has the contract for hauling the ties. Every effort will be made to secure a speedy completion of the work.

Lansing, Kan.—It is expected that the County Commissioners will grant the application of Willard E. Winner, of Lansing, Kan., for a franchise for an electric street railway from the terminus of the Leavenworth line at the Soldiers' Home to Lansing.

Leavenworth, Kan.—It is stated that a charter will be applied for at once for a company which will build an electric railway from Leavenworth to Kansas City. A Mr. Getty, an attorney of Kansas City, Kan., is looking after the interests of this company. It is also reported that Mayor Jones of Kansas City, Mo., is interested in the enterprise.

Lowell, Mass.—The Lowell & Suburban Street Railway Company is building several extensions to its lines.

Mansfield, O.—The Lucas Construction Company writes us that the proposed road between Mansfield and Shelby is to be a steam road, and not an electric line.

Meadville, Pa.—Smethurst & Allen, 1216 Betz Building, Philadelphia, have been awarded the contract for all the overhead work on the interurban electric line of the Meadville Traction Company.

Milwaukee, Wis.—A temporary injunction has been granted by Court Commissioner Ryan restraining the Milwaukee & Waukesha Electric Railway Company from entering into a contract with Townsend & Reed, of Chicago, for the construction of a street railway line through Milwaukee and to the city of Waukesha.

New Brighton, Pa.—The Riverview Electric Street Railway Company has awarded the contract for the construction of its road to Simon Harold. The road is to be 2 miles in length, leading from the Pittsburgh & Lake Erie station, in Beaver Falls, across the town, and on the heights west of the town, and connecting with the Beaver Valley Traction Company's line. The work is to be done in forty-five days. The company's officers are: E. L. Hutchison, president; F. W. Walker, secretary, and F. G. Barker, treasurer.

New Haven, Conn.—The New England Construction Company has just organized. The purpose is to build and equip street railroads, electric light plants, etc. The capital stock is $30,000. Some of the stockholders are ex-Gov. Thomas M. Waller, of New London; I. A. Kelsey, of New Haven; Attorney S. Harrison Wagner, Julius Watterman, Henry L. Mitchell, of Bangor, Me.; Charles B. Wellington, of Albion, Me.; Arthur B. Hopkins and a number of other well known Bangor capitalists.

New York, N. Y.—Papers have just been filed with the Secretary of State certifying to the extension of the Dry Dock, East Broadway & Battery Railroad in New York City from Park Row at Broadway to Fulton Street, connecting with the company's tracks on that street.

Norristown, Pa.—The Schuylkill Valley Traction Company has leased Oak View Park and will make a number of improvements so as to make this place a first class pleasure resort.

Oneonta, N. Y.—The State Railroad Commissioners have just granted the application of the Oneonta & Otego Valley Railroad

for a certificate permitting that company to construct 10 miles of electric street railroad in and about Oneonta. At the same time a certificate was granted to the Westfield, Mayville & Chautauqua Railroad Company to construct a road to be operated by storage battery power between the places mentioned in the name of the company.

Passaic, N. J.—The Passaic & Newark Electric Railway Company is preparing to double track its lines in Franklin Township and Passaic County.

Racine, Wis.—A new company has been incorporated by Thomas M. Kearney, E. J. Hueffner, Jackson I. Case, Frank J. Miller and G. N. Fratt, for the purpose of purchasing and operating the property of the Belle City Street Railway Company, which was recently sold at foreclosure. The capital stock of the new company is $200,000. About $25,000 will be spent in improvements.

Saco, Me.—The Saco River Electric Railway Company, recently incorporated, has been granted a franchise for its proposed road. Among the directors are Oliver Downing and E. B. Loring, of Boston, Mass.

Saginaw, Mich.—Homer Loring, of Boston, and George B. Morley, of Saginaw, Mich., have been appointed receivers for Union Street Railway Company of Saginaw upon application of the Boston Safe Deposit & Trust Company, which company also asked that a temporary injunction be issued against the city, restraining it from disposing of the street railway franchise. The Union Street Railway gives notice of appeal to the Supreme Court.

Salinas City, Cal.—John J. Kelly, City Clerk, writes us that Wm. Vandehurst has applied for a franchise for an electric railway in Salinas City. The company represented by Mr. Vandehurst has already been granted a franchise in Monterey County.

San Francisco, Cal.—The managers of the reorganized San Francisco & San Mateo Electric Railway Company are going forward with the work of reconstructing the system. Extensive contracts and important purchases of materials which will involve an outlay of $80,000 have been authorized.

Schenectady, N. Y.—A test was made at the works of the General Electric Company here last month of the Sprague unit system of car government. There were present at the test Leslie Carter, president of the South Side Elevated Railroad Company; M. Hopkins, its general manager; A. J. Allen, its master car builder, and A. D. Lundy, of Sargent & Lundy, its local consulting engineers; together with M. G. Hubbard, of the McGuire Manufacturing Company, whose trucks were ordered by Mr. Sprague for this initial six-car train; H. P. Merriam, of the Standard Air-Brake Company, whose air brakes were in use on the train; George H. Guy of the *Electrical Engineer* and Edward E. Higgins, of the STREET RAILWAY JOURNAL.

Worcester, Mass.—Electric railways connecting the following cities are now being built by the Worcester Construction Company, of Worcester, Mass.: Torrington & Winsted, Conn., a line of 14 miles; Marlboro, Northboro and Worcester, 20 miles; Milford and Medway, Mass., 10 miles; Montpelier and Barry, Vt., 8 miles; Warren and West Warren, Mass., 3 miles; Roxbury and Roslindale, 3½ miles.

THE Worcester Construction Company intends to build the following lines this season: Westboro and Northboro, 4 miles; Westboro and Hopkinton, 7 miles; Fitchburg and Gardner, Mass., 12 miles; Ashland and Marlboro, Mass., 10 miles; Easton and Bethlehem, Pa.; 12 miles; and in all probability a 20 mile line in Kingston, Jamaica.

Youghiogheny, Pa.—The Versailles Council has passed the ordinance granting the right of way to the Youghiogheny Valley Railway Company through that borough. This is the company which desires to build a trolley line from McKeesport to West Newton, and which has already secured most of the right of way between those points.

Personals.

Mr. Clift Wise, of Chicago, was in New York last month.

Mr. E. I. Robinson, of St. Louis, was in the East last month.

Mr. Warner S. McCall, has resigned as superintendent of the Chattanooga Electric Street Railway Company.

Mr. R. J. Mercur, general sales agent of the New York Car Wheel Works, sailed for Europe on the "Paris" last month.

Mr. Edwin R. Davis has been appointed superintendent of the Shelburne Falls & Colrain Street Railway Company, of Shelburne Falls, Mass.

Mr. Henry W. True, has been elected president of the Lewiston & Auburn Electric Railway Company, *vice* Mr. John W. Robbins resigned.

Mr. Samuel A. Purdy has been appointed superintendent of the Westport (Conn.) & Saugatuck Street Railway Company, *vice* Mr. A. C. Kendall resigned.

Mr. Billings P. Learned, of New London, Conn. has been elected president of the Norwich Street Railway Company, *vice* Mr. Winthrop Coffin, resigned.

Mr. P. M. Kling, of the St. Louis Car Company, was in New York last month on business. Mr. Kling has recently returned from an extensive European trip.

Messrs. George A. Yuille and W. F. Furbeck, have resigned their positions with the West Chicago Street Railway Company, as the result of the recent consolidations in that city.

Mr. E. A. Merrill, formerly with the Pierce & Miller Engineering Company, of New York, is now connected with McIntosh, Seymour & Company, whom he will represent in New York.

Mr. R. M. Douglass, general manager of the Schuylkill Valley Traction Company, of Norristown, Pa., has been elected secretary and treasurer of the company, *vice* Mr. W. F. Kling, resigned.

Mr. James Rawle, secretary and treasurer of J. G. Brill Company, has been elected president of the Fairmount Park Transportation Company, in place of Mr. George Gandy, resigned. Mr. Gandy remains in the board.

Mr. W. P. Jackson, of Columbus, has been appointed superintendent of the Marion Street Railway Company, of Marion, O. Mr. Jackson has recently been connected with the Consolidated Company, of Columbus.

Mr. L. N. Wheeler has resigned as superintendent of the Shelbourne Falls & Colrain Electric Railway, of Shelbourne Falls, Mass., and has accepted the position of superintendent of the Amherst & Sutherland Electric Railway.

Mr. James D. Parker, has been appointed general manager of the Sandusky, Middletown & Norwalk Electric Railway, *vice* Mr. Thomas Wood resigned. Mr. Parker has been closely identified with the management of the road since its beginning.

Mr Charles C. Hansen, who has represented the C. & G. Cooper Company in New York, has severed his connection with that company and will represent in Canada James Cooper & Company, of Montreal, large builders of machinery.

Mr. W. G. Meloon, superintendent of the Augusta, Hallowell & Gardiner Railroad Company, of Augusta, Me., has severed his connection with that company to accept a position in the same capacity on the Kittery & York Beach Railway, now in course of construction.

Mr. Thomas C. Jenkins, has been elected secretary of the Consolidated Railway Company, of Baltimore, the successor of the Baltimore Traction Company and the City & Suburban Railway Company, of Baltimore. Mr. Jenkins is the son of Mr. George C. Jenkins, superintendent of motive power.

Mr. A. N. Connett, formerly chief engineer of the Metropolitan Railroad Company, of Washington, D. C. and now connected with the Cie. Française Thomson-Houston, of Paris, was in New York last month for a short trip, but returned to Paris July 24. Mr. Connett reported a great interest in electric traction in France.

Mr. Lytle J. Hunter, of Cincinnati, secretary of the Hunter Illuminated Sign Company, was in New York lately on business for his company and stated that the company had placed trial orders for sixty-two roads since January last, and that several of these roads had since the trial of the signs placed orders for full equipments of them.

Mr. Frank Pooler, Mr. S. Y. Hyde and Mr. J. E. North have been elected president, vice-president and treasurer of the La Crosse & Onalaska Street Railway Company, of La Crosse, Wis., and not of the La Crosse City Railway Company, as stated in last issue. The officers of the latter company are the same as in 1896, and were all re-elected at the annual meeting of the company in January, 1897.

Mr. W. W. Wheatley, formerly division superintendent of the Brooklyn Heights Railroad Company, has been appointed assistant general superintendent of the company, and Mr. C. E. Harris has been transferred to the southern division. Mr. R. K. Haldame, who has been in charge of the Fulton Street line, has been appointed in charge of a number of the divisions of the Brooklyn, Queens County & Suburban Railroad.

Mr. R. D. Weaver was elected, July 14, president of the Metropolitan Railroad Company, of Washington, D. C. At the same meeting Judge A. B. Grunwell was elected vice president, G. B. Coleman, secretary and general manager, and William J. Wilson, treasurer, and the following directors were elected: S. Thomas Brown, John Cammack, G. B. Coleman, John Joy Edson, William B. Gurley, A. B. Grunwell, Charles R. Spence, R. D. Weaver and Nathaniel Wilson.

Mr. James F. Heyward, who recently resigned as general manager of the City & Suburban Railway Company, of Baltimore, has accepted the position of assistant to the president of the United Traction Company, of Pittsburgh, Pa. This corporation was recently organized to consolidate the Federal Street & Pleasant Valley Railway Company, the Pittsburgh, Allegheny & Manchester Traction Company, the Second Avenue Traction Company, and other important properties in Pittsburgh.

Mr. H. F. MacGregor, of Houston, Tex., long and favorably known in street railway circles, on account of his connection with the Houston City Street Railway Company, both while it was

operated as a mule line and later by electricity, has purchased a large block of stock of the reorganized company, and on July 16, assumed the management of the property, succeeding Mr. A. H. Hayward, who has managed the road since Dec. 1895. Mr. Hayward, during his stay in Houston, has carried out many substantial improvements and has made a great many friends, both in a business and social way, and many regrets have been expressed that he has to leave Houston permanently.

Obituary.

S. W. BOWNE, one of the directors of the Brooklyn Heights Railroad Company, died last month. He was one of the members of the New York Produce Exchange.

HENRI REMAURY, mining engineer, of Paris, died recently, at the age of sixty-four, after a protracted illness. He was for many years chairman of the board of directors of *Le Génie Civil*, the important French engineering paper.

COLUMBUS R. CUMMINGS, one of the principal stockholders of the Consolidated Street Railway Company, of Grand Rapids, Mich., died July 13, in Chicago. Mr. Cummings took an active interest in railway affairs and was at one time president of the Erie Railroad and of the Nickel Plate Railroad. He was also at one time president of the International Bank of Chicago.

E. M. G. EDDY, Chief Railway Commissioner of New South Wales, died at Brisbane, June 21. Mr. Eddy was appointed Chief Commissioner in July, 1888, at the time when the railways and tramways in New South Wales, owned by the Government, were in a very poor condition as a result of political mismanagement. The railways were taken out of politics, and were greatly improved under the management of Mr. Eddy and of his two associates, Messrs Fehon and Oliver. The physical condition of the roads was greatly improved, and in spite of the fact that the rates were reduced, the operation of the lines now shows an earning of 3½ per cent on capital, instead of a loss. The last quarterly report of the railways and tramways was published in the last issue of the STREET RAILWAY JOURNAL.

AMONG THE MANUFACTURERS.

The Falk Manufacturing Company, of Milwaukee, Wis., has recently been awarded the contract for the extension of the Madison Street Railway, of Madison, Wis.

The American Electrical Works, of Providence, R. I. issued last month as a tasteful souvenir of Independence Day an illustrated card on which was printed the Star Spangled Banner.

The Brownell Car Company, of St. Louis, Mo., on July 23 transferred to Ford W. Thompson all of its property in trust for the benefit of its creditors. The liabilities are given as $56,422, and assets, $294,592.

James Leffell & Company, of Springfield, O., have issued a neat new pamphlet, "D" replete with numerous illustrations and descriptions of the throttling and automatic engines, with portable and stationary boilers, which they are building in a variety of sizes and styles.

Wendell & MacDuffie, of New York, have been appointed Eastern agents for the motor gears and pinions of the Western Gear Company, of Milwaukee. This firm is doing now a large business in street railway supplies and has the agencies for a number of the most prominent manufacturers in the trade.

The A. & J. M. Anderson Manufacturing Company, of Boston, Mass., has published a pamphlet descriptive of its switches, switchboards and lightning arresters. It is illustrated by a number of engravings showing the Ajax knife and quick-break switches as well as other switches, the Ajax lightning arrester and several views of complete switchboards.

H. G. Issertel and W. S. Turner, of No. 1 Nassau Street, New York, have been retained as consulting engineer for the Chester County Central Railway Company. This road is to be built and equipped by the mos modern methods and when completed will be one of the finest interurban roads in the country. Orders for material have all been placed.

The Cahall Sales Department, of Pittsburgh, Pa., agents for the Aultman & Taylor Machinery Company, of Mansfield, O., has issued an attractive circular entitled "Big Boilers," descriptive of the B. & W. and Cahall boilers manufactured by the Aultman & Taylor Machinery Company. The advantages of this boiler are clearly explained, and the pamphlet is illustrated by two sectional engravings.

Chas. G. Smith, of New York, the well known manufrcturer of lamps and headlights, has appointed W. Potts Woods his exclusive agent for the city of St. Louis and suburbs. Mr. Smith has enjoyed a very large business in the manufacture and sale of lighting supplies of every description and under the title of Smith of New York, his concern has occupied a leading position in this business for over half a century.

The Partridge Carbon Company, of Sandusky, reports that its business during the month of June and up to date has been very good and much better than for the two years past and that the outlook for the trade is excellent. The reports on these carbons from users have been most satisfactory and the popularity which these goods have enjoyed since they were placed upon the market, seems to be constantly increasing.

The Pearson Jack Company, of New York, announces that it has made an important reduction in the prices of its jacks, amounting to 33⅓ per cent. This brings the sizes used by street car railroads down to a very small figure and will enable every company to send a pair out on every car and then be prepared for every emergency. The company still offers for a limited period to send out a pair on trial at its own expense.

The Hunter Automatic Fender Company, of Cincinnati, has closed an important contract with the Columbus Central Street Railway C mpany, of Columbus, O., for the equipment of all its its cars. One hundred and two fenders will be required. The order is a high testimonial to the value of the Hunter fender, as the officials of the railway company made a careful investigation of all the the different fenders on the market before giving the order mentioned above.

The Hunt Air Brake Company, of Pittsburgh, Pa., has recently received an order from the Schuylkill Electric Railway Company, of Pottsville, Pa., for three motor brake equipments. These are for cars being built by the J. G. Brill Company. This order is a result of the success achieved by the Hunt air brakes on the Wilkesbarre Railway described in the last issue, as the manager of the Schuylkill Railway Company, Mr. Wright, made a personal examination of the Wilkesbarre works before placing his order.

J. Holt Gates & Co., Chicago agents for the Walker Company, Card Electric Company, and Wagner Manufacturing Company, have recently associated with them several gentlemen who are well known in street railway circles. These are F. B. Duncan, formerly foreman of the Siemens-Halke Electric Company, and later of the Northern Electric Company, of Madison; George W. Henry, formerly Western manager of the Steel Motor Company, and one of the pioneers in the electrical business, and George B. Foster, formerly of the electrical department of the World's Fair. These gentlemen bring with them an extended experience in electrical work.

The Catskill Foundry & Machine Works, Catskill, N. Y., is enjoying an excellent trade in the manufacture and sale of motor gears and pinions. For this work the company has exceptional facilities, being machinists of established reputation and having recently introduced a line of modern gear cutting machinery. Among the prominent roads to which this company has supplied gears and pinions are the Union Railway Company, of New York, Coney Island & Brooklyn Railroad Company, and the systems in Troy, Albany, Poughkeepsie, Kingston, Fishkill, Sing Sing, Binghamton and Utica. The company manufactures gears and pinions for all types of motors and makes gears of steel and iron.

The McGuire Manufacturing Company, of Chicago, reports unusual activity in its lines. The company is working full time on truck orders for the Ashland & Catlettsburg Street Railway, Ashland, Ky; Consolidated Traction Company, Pittsburgh; Canadian General Electric Company, Toronto; Rochester Railway Company; New South Wales Government; Port Norfolk Electric Railway, Portsmouth, Va. The company also reports several orders already booked and many inquiries for its combination sweepers. From the great demand which the company's Star grain door is now having the managers of the McGuire Manufacturing Company predict a general resumption in business through the country.

The Composite Brake Shoe Company, of Boston, Mass., has appointed Mayer & Englund as its agents in the Middle States for the exclusive sales of the "Compo" brake shoes for electric street railway service. The company's agents are now: the Barbour-Stockwell Company, of Cambridgeport, Mass., the New England States; Mayer & Englund, of Philadelphia, Pa., the Middle States; Hayes & Arthur, of Cleveland, O., the states of Ohio, Michigan and West Virginia, and western Pennsylvania and western New York. The shoes will be shipped at present from foundries at Boston and Buffalo, but all purchases and settlements are to be made with the above agents. This arrangement will be an advantage and convenience to parties who wish to use this well known shoe.

The Carnegie Steel Company, Limited, of Pittsburgh, has just placed an order for 6500 h. p. of Cahall vertical boilers for its blast furnaces, D and E, at the Edgar-Thomson Steel Works. This is the fourth order placed for this kind of boilers by the Carnegie Steel Company, aggregating a total of nearly 15,000 h. p. The Cahall people are also building 4000 h. p. for the Shenango Valley Steel Company, of New Castle, and 6000 h. p. for a new sugar refinery. It has in its shops now unfinished orders for upwards of 30,000 h. p., including boilers for the Brooklyn Edison Company, the Union Traction Company, of Philadelphia; the Detroit & River St. Claire Electric Railway Company, the Pittsburgh Plate Glass Company, the Buhl Steel Company, of Sharon, Pa., the North Hudson Railway Company, and the Hudson Electric Light Company, of Hoboken, N. J.

The Taunton Locomotive Manufacturing Company, of Taunton, Mass., whose snow plows enjoyed a great popularity last

winter, is evidently ready to receive and fill orders for the coming winter season as it has recently published a most a tractive circular descriptive of its heavy nose plows, standard snow plow and double track share plow. The pamphlet is attractively illustrated by large half tone engravings of the different types of plows manufactured by it, and also with views of some of the drifts through which the plow cleared its way last winter. Accompanying these illustrations are several of the numerous letters received by the company last spring from users testifying in most unequivocal terms to the high merits of this plow. Wendell & McDuffie, of New York, selling agents for these plows, report an unusual interest among street railway managers at this time of the year in the snow plow question.

The Western Electric Company, of Chicago, has just issued a very beautiful and complete catalogue of its E, EE and Q switches. The different sized switches are described by numbers with their capacity in amperes, and all the dimensions of the switches are plainly given in tables, so that it is possible to drill switchboards before the switches are received, with the assurance that the switches will fit when they are placed in position. Further than this, a cut and catalogue number of every switch part is given, which facilitates the ordering of small parts at any future time. Special switches are made for 500 volts, and the Q switches, which represent the quick-break type, are made in all sizes from 25 amps. up. There is also shown in the catalogue the latest design of the round type Ellicott voltmeter switch, the "V" changing switch, and the switchboard springjacks, plugs and cords, all of which are extremely high grade.

The Westinghouse Machine Company, of Pittsburgh, Pa., has recently is ued a handsome pamphlet descriptive of the gas engines which the company is now manufacturing. This engine has a general similarity of appearance to the Westinghouse steam engine which it also resembles in many of its important features, the upright self contained construction and the self lubricating principle being particularly apparent. The small engines are started by hand. The larger sizes are started by compressed air, which can be stored either by hand or by power from the main shaft of the engine, after the latter has been put in operation for use upon a subsequent occasion. The engine operates on what is popularly known as the Otto cycle and receives an impulse at every revolution whether running fully loaded or not. The amount of the explosive mixture admitted for each charge is regulated by a governor. The regulation of the engine is said to equal that of the best steam engines.

The New York Switch & Crossing Company, of Hoboken, N. J., reports an increasing interest on the part of electric railway managers in its electric automatic railroad switch. This track switch, which has been described in the STREET RAILWAY JOURNAL, is operated from the platform of an approaching car without the use of any auxiliary apparatus. A section of about 30 ft. of track, distant about 8 ft. from the switch is insulated and the switch is turned by passing over this section with the current on. If the motorman does not wish to change the position of the switch, he simply passes over this section by momentum. The working parts are simple and are well protected from moisture and deterioration. The switch has been employed on the lines of the North Hudson County Railway Company, for the past three years, and this company has several in use at present. The switch is also used on the lines of the Brooklyn Heights Railway Company, the Brooklyn City & Newtown Railroad Company and others.

Mr. W. B. Upton, electrical engineer and contractor, of Washington, D. C., has formed a firm under the title of W. B. Upton & Company, with offices in the Washington Loan & Trust Building, Washington, for conducting a general engineering and constructing business. The firm will make a specialty of steam, electric and hydraulic plants and machinery, iron and steel contractors' materials, timber, masonry and concrete construction, and the installation of railways, power stations and buildings. Mr. Upton has had a long and successful experience in cable and electric railway construction, being recently the mechanical engineer of the Washington & Georgetown Railway Company (now the Capital Traction Company), chief engineer of the Columbus Railway Company and consulting engineer of the Washington, Alexandria & Mt. Vernon Railway Company. Mr. Upton has also acted as consulting engineer for several prominent buildings and power plants in Washington, D. C.

The Berlin Iron Bridge Company, of East Berlin, Conn., has the contract for furnish ng and erecting all the steel work and covering for the power station now being completed by the New York & Staten Island Electric Company, at Livingston, S. I. The walls of the building are brick and the roofs have steel trusses covered with corrugated iron. The roofs are arranged with suitable monitors with skylights for light and ventilation. On the building is a large wire tower of steel construction. The engine room is arranged for a traveling crane of 13 tons capacity. The building has been constructed with the idea of having it absolutely fireproof, and arranged in an up-to-date manner. The roof of the engine and dynamo portions of the building is lined underneath the corrugated iron with the Berlin Iron Bridge Company's anti-condensation fire proof roof lining. The Saratoga Gas, Electric Light & Power Company, of Saratoga, N. Y., is rebuilding and rearranging its gas plant, and has also let the contract for the steel work connected with the generator house roof and the roof over its cold storage building to the Berlin Iron Bridge Company. The roofs have steel trusses covered with corrugated iron.

The Ball Engine Company, of Erie, Pa., reports that its works are full of work. This company is one of the pioneer builders of automatic engines for electric purposes, having been building the Ball automatic engine for fifteen years. Under the present management the engine has reached a high degree of perfection. The Ball engines can be found in a large number of the electric light and electric railway central station plants in this country, and a great number of these engines that have been running from eight to fifteen years are to-day in constant and satisfactory use. The company also reports that the Chesapeake & Ohio Railroad has ordered through Crook, Hornor & Company, the Baltimore representatives of the Ball Engine Company, two 75 h. p. Ball engines for electrical purposes. One of these engines is direct connected to a generator. The engines will be used at Newport News, Va. The Mt. Washington Electric Light & Power Company, Mt. Washington, Md., has recently increased the capacity of its station by adding a 100 h. p. Ball engine, being the third engine of this manufacture now in the station. The Mt. Vernon Company, of Woodberry, Md., and the Sterling Varnish Company, of Pittsburgh, Pa., have also purchased Ball engines.

Henry R. Worthington, of Brooklyn and New York, the well known manufacturer of pumping engines, has recently published a special catalogue descriptive of the Worthington condensers, jet, surface and self-cooling. The condensers of the Worthington Company have always possessed a high reputation for efficiency and excellent workmanship, and the catalogue is worthy of careful steady by steam users as every variety of condenser is illustrated. The twin cylinder, vertical condenser is particularly interesting to those station managers who are limited in floor space and desire an air pump and condenser which will occupy the minimum floor room. For large plants the company manufactures a condenser with triple expansion steam cylinders where the feedwater is heated by economizers or exhaust steam from sources other than the auxiliaries These machines are built in sizes varying from 1000 h. p. to 10,000 h. p. capacity. The Worthington self-cooling condenser which produces a vacuum without natural water supply, has already been described in these columns. The principles of this condenser are carefully described and fully illustrated, and will appeal to those managers whose necessities have compelled them to install power stations at points where condensing water is not readily available.

The Standard Underground Cable Company, of Pittsburgh, New York, Chicago and St. Louis, has recently secured from the Bell Telephone Company, of Missouri, and the Kinlock Telephone Company, both of St. Louis, two of the largest contracts ever let in this country, and probably in the world, for telephone cables; these two orders comprise all the underground work in St. Louis yet contracted for, and constitute the complete cable equipment for both telephone companies. Both contracts were secured in the face of the most severe competition, and the well known excellence of the telephone cables manufactured by the Standard Underground Cable Company largely influenced the placing of the order with it, as the prices were exceedingly close. To fill these contracts there will be required more than 650,000 ft. of cable, which in turn requires about 100,000,000 ft. of No. 19 B. & S. G. copper wire, and 2,000,000 lbs. of lead. To meet this extraordinary demand, the manufacturing facilities of the cable company in the paper covering department, have recently been doubled. This places it in a position to not only handle this enormous volume of business rapidly and easily, but at the same time to fill without any delay, the large and constantly increasing orders for telephone cables, electric light and power cables, rubber insulated wire, etc., which are being daily entered Considerably more than one-half of this cable will be installed by the cable company; it has contracted to turn the cable system of the Kinlock Company over to that company, complete and ready for service. A large force of expert workmen will be employed for nearly a year in this work, under the direct supervision of the St. Louis office.

The Harrison Safety Boiler Works, of Philadelphia, report the following recent sales of their Cochrane feedwater heaters and purifiers: Griffin & Barnes, Galveston, Tex., 100 h. p.; Crown Cork & Seal Company, Baltimore, Md., 100 h. p.; F. H. Lawson & Company, Cincinnati, 100 h. p.; Union Foundry & Machine Company, Pittsburgh, 100 h. p.; W. M. Thompson & Company, Sioux City, Ia., 150 h. p.; Medina (O.) Electric Light & Power Company, 150 h. p.; Georgetown (Ky.) Water Supply Company, 350 h. p.; Port Royal (Pa.) Coal & Coke Company, 425 h. p.; McKeesport (Pa.) Water Works, 350 h. p.; Weston Furnace Company, Manistique, Mich., 600 h. p.; Shoen Pressed Steel Company, Pittsburgh, Pa., 600 h. p.; National Tube Works, McKeesport, 800 h. p.; Firth-Sterling Steel Company, Demmler Station, Pa., 850 h. p.; Albert Trostel & Sons, Milwaukee, 1000 h. p.; Clinton Iron & Steel Company, Pittsburgh, 2000 h. p.; Oliver-Snyder Steel Company, Pittsburgh, 3000 h. p. And of their Cochrane live and exhaust steam separato s, the following sales: De La Vergne Refrigerating Machine Company, New York; New Camden Water Works, Morris Station, N. J.; Massachusetts Heating & Ventilating Company, Boston; De Courcy Building, New York; Lawrence (Mass.) Water Works; Ginnochio Electric Company, Dallas, Tex.; Pennsylvania Industrial Reformatory, Huntingdon, Pa.; Stora Kopparbergs Bergslags Aktiebolag, of Falum, Sweden; Pittsburgh Tin Plate Company, New Kensington, Pa.; Stearns-Roger Manufacturing Company, Denver, Col.; H. B. Pancoast & Company, Philadelphia; Genesee Fruit Company, Rochester, N. Y.; A. I. Root Company, Medina, O.; C. & G. Cooper

Company, Mt. Vernon, O.; Sleepy Eye (Minn.) Milling Company; Wallace, Elliott & Company, Farmington, N. H.; Roman Catholic Protectory, Fatland, Pa.; City of Boston (Street Department); Norway Iron & Steel Company, New Castle, Pa.; North Western & Pacific Hypothek Bank, Spokane, Wash.; Weston Furnace Company, Manistique, Mich.; Geo. F. Blake Manufacturing Company, Boston; Homœopathic Hospital, Boston; Maginn & Bradley Company, Chicago; Buffalo Railway Company, Buffalo, N. Y.; Cincinnati (O.) Street Railway Company; Pacific Mills, Lawrence, Mass.; McGinniss-Smith Company, Pittsburgh; Pfister & Vogel Leather Company, Milwaukee; J. C. Miller Brewing Company, Philadelphia; Braman, Dow & Company, Boston; Chicago (Ill.) Public Library; Clinton Iron & Steel Company; Waclark Wire Company, Elizabeth, N. J.; Barr Pumping Engine Company, Philadelphia.

New Publications.

REPORT OF THE FIFTH ANNUAL MEETING OF THE PENNSYLVANIA STREET RAILWAY ASSOCIATION HELD AT ALTOONA, SEPT. 2–3, 1896.

This pamphlet contains the papers presented at Altoona by Messrs. Darlington and Neilson, together with a verbatim report of the discussions, an account of the meeting, the constitution of the association and a list of the members. It is tastefully bound.

THE CITY STREETS OF ST. LOUIS, MO. Published by A. N. Milner, Street Commissioner. Forty pages. Illustrated. Paper.

This is a compilation of statistics of the Street Department of St. Louis, and describes particularly the different kinds of street paving used in that city. Sectional drawings and specifications of each are given. The pamphlet also contains a number of fine half tone engravings.

DUNCAN'S MANUAL OF TRAMWAYS, OMNIBUSES AND ELECTRIC RAILWAYS. Twentieth edition. Published by T. J. Whiting & Sons, Limited, London. 388 pages, cloth. Price, 3*s.* 6*d.*

This is a list for 1896 of the tramway and omnibus companies of the United Kingdom and the foreign and colonial companies that are registered in England and a digest of their financial reports. The book shows that there was a slight increase from 1895 to 1896 in the United Kingdom in mileage and capital invested.

THE STREET RAILWAY SYSTEM OF PHILADELPHIA: ITS HISTORY AND PRESENT CONDITION. By Frederick W. Spiers, Ph. D., Professor of Economics and History, Drexel Institute, Philadelphia. Cloth. 129 pp. Published by the Johns Hopkins Press, Baltimore. Price, $1.

This is a unique and most interesting study of a great street railway system, and like all in the Johns Hopkins University series of monographs, it is written with a scientific care and attempt at accuracy which is worthy of much praise. The author takes up the beginnings of local transportation in Philadelphia, and recalls a number of episodes in the early street railway history of that city, which will doubtless be of much interest, especially to Philadelphians, such as the contest over Sunday cars, and the admission of negroes to street cars. He then treats of the "Evolution of Monopoly," showing how the various combinations of companies were made in Philadelphia, and the necessary legislation obtained, and passes to the financial aspects of the railway system and the price of franchise privileges. He then describes the nature of the limited control which the city exercises over its street railway system, and discusses in a separate chapter municipal ownership, explaining certain provisions in the charters of the Philadelphia companies, which he believes to be open to the interpretation that the city can take over a number of the properties by paying the original cost of the roadbed and equipment. A significant and searching chapter, entitled "Corporate Influence in State and Municipal Government," and another on "Railways and Their Employes," close the book.

Trade Catalogues.

TAUNTON SNOW PLOWS. Published at the Taunton Locomotive Works. Sixteen pages. Illustrated.

BIG BOILERS. Published by the Cahall Sales Department, Pittsburgh, Pa. Twenty pages. Illustrated.

BRAKE SHOES. Published by the Composite Brake Shoe Company, Boston, Mass. Eight pages. Illustrated.

CAR BRAKES. Published by the Christensen Engineering Company, Michigan, Wis. Twenty-eight pages. Illustrated.

CATALOGUE OF SWITCHES. Published by the Western Electric Company, Chicago and New York. Seventy-nine pages. Illustrated.

WESTINGHOUSE GAS ENGINES. Published by the Westinghouse Machine Company, Pittsburgh, Pa. Twenty-seven pages. Illustrated.

WORTHINGTON CONDENSERS: Jet Surface, Self-cooling. Published by Henry R. Worthington, New York. Sixty-eight pages. Illustrated.

SWITCHES, SWITCHBOARDS AND LIGHTNING ARRESTERS. Published by A. & J. M. Anderson Manufacturing Company, Boston. Eighteen pages. Illustrated.

List of Street Railway Patents.

U. S. PATENTS ISSUED JUNE 22, TO JULY 13, 1897, INCLUSIVE.

JUNE 22.

TROLLEY.—Wm. J. Smith, Gloucester City, and Wm. G. Johnston, Woodbury, N. J. No. 584,831.

In this invention the fork is provided with a shank fitting in the trolley pole and held in place by a latch.

CONTROLLER FOR ELECTRIC MOTORS.—Harry P. Davis, Pittsburgh, Pa. No. 584,856.

The combination with an electric circuit and a resistance normally included therein, of a switch and an actuating-magnet for gradually reducing the amount of said resistance in circuit, means for short-circuiting said magnet when the minimum resistance is secured, and a second magnet for maintaining said last-named condition until the circuit is interrupted.

ELECTRIC RAILWAY.—Frederic W. Hunter, Cranford, N. J. No. 584,873.

ELECTRIC RAILWAY SYSTEM.—George W. Westinghouse, Jr., Pittsburgh, Pa. No. 584,911.

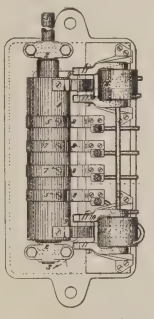
In an electric railway system, the combination of a continuous trolley wire, a contact cylinder having a plurality of grooves and making uninterrupted engagement with said wire, a fixed vertical support for said contact cylinder, a car on which said support is mounted, and yielding supports for said trolley wire each consisting of a centrally supported sustaining wire, and attachments between the ends of said sustaining wire and said trolley wire.

ELECTRICAL RAILWAY TROLLEY.—Edward M. Bentley, New York, N. Y. No. 584,918.

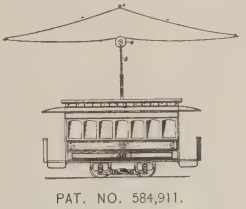
This invention relates to an improved trolley pole having a pivoted spring actuated end section, whereby the trolley wheel will bear upon the wire under spring tension.

SAFETY DEVICE FOR STREET RAILWAY CARS.—Albert W. Fuller, Lynn, Mass. No. 584,930.

A safety device for street railway cars, consisting of a swinging frame extending below the car, a pair of brake shoes supported above the track and roadbed in front of the forward wheels, a buffer or scoop extending from shoe to shoe and carried by said shoes and mechanism set in operation by the rearward motion of the frame, acting to bring said shoes in contact with the wheels and said buffer or scoop in contact, or nearly so, with the roadbed or track.



PAT. NO. 584,856.



PAT. NO. 584,911.

PAT. NO. 585,120

CONDUCTOR FOR UUDERGROUND ELECTRIC RAILWAYS.—Charles Peterson, San Francisco, Cal. No. 585,047.

ELECTRIC LOCOMOTIVE.—Louis T. Pyott, Philadelphia, Pa. No. 585,120.

An electric locomotive having driving wheels and axles therefor, a framework supported thereby, removable means upon the framework for supporting a motor case and a motor centrally disposed between said axles and having its armature shaft parallel thereto, a spur pinion upon the armature shaft, a double train of spur gears engaging therewith and moving radially held axle gears and driving wheels in the same direction as the armature pinion, removable casings over the axle gears and means to secure the axle-gear casings radially yielding to the motor casing.

JUNE 29, 1897.

CAR BRAKE.—William A. McGuire and Moses G. Hubbard, Jr., Chicago, Ill. No. 585,223.

In a car brake, the combination with a brake beam, of an arm secured to said brake beam, a sleeve trunnioned on said arm, and a brake rod adapted to pass through said sleeve.

ELECTRIC TROLLEY DEVICE.—Alfred J. Gairing, Johnstown, Pa. No. 585,267.

Consists of a base, having transverse pins secured thereto, and having a number of converging arms pivoted in their lower ends about each of said pins and constituting sides of a lazy tongs.

CAR FENDER.—Walter H. Knight, New Brighton, N. Y. No 585,340.

This invention relates to a car fender having suitable springs for elevating it normally above the track and provided with means whereby it will be automatically lowered to pick up an obstruction when struck thereby.

TROLLEY GUARD.—Wallace C. Dunham, Indianapolis, Ind. No. 585,380.

This invention relates to a trolley arm and wheel and an automatic wire catching and restoring device.

CAR SIGN HOLDER.—George H. Huber, Easton, Pa. No. 585,475.

This invention relates to a bracket secured to the end of a street car roof, and a reversible sign containing the names of different streets on opposite sides, and so connected with the bracket that it can be readily reversed, when necessary.

JULY 6.

CAR FENDER.—James N. Weikly, Jersey City, N. J. No. 585,729.

ELECTRIC CONTROLLER.—Alexander F. MacDonald, Schenectady, N. Y. No. 585,772.

In an electric controller the combination of a single set of moving contacts, two sets of brushes mounted for dissimultaneous engagement therewith, the two sets of brushes establishing different circuit combinations of the dynamo-electric machines, and means for changing the relation between the contacts and sets of brushes

VEHICLE FENDER.—Wm. H. Gregg, St. Louis, Mo. No. 585,862.

This invention consists in a fender made of solid rubber.

CAR FENDER.—Nicholas Kohler, Paterson, N. J. No. 585,871.

Beneath the netting on this device, the fender is provided with rotatable brushes, operated through the medium of the car wheels, to remove obstructions from the track.

GRIP FOR CABLE RAILWAYS.—Charles B. Martin, Brooklyn, N. Y. No. 585,873.

In a grip for cable railways, the combination with the gripping jaws and mechanism for manually adjusting them in one of two or more positions, of gripping portions carried by said jaws and capable of an outward yielding movement independently of the jaws, adapted to release the cable when the downward pull becomes excessive without changing the position of the jaws.

ELECTROMAGNETIC AND MECHANICAL BRAKE.—John E. Parker, Bayonne, N. J. No. 585,937.

In an electromagnetic and mechanical brake, and in combination an electromagnetic brake bar and blocks placed horizontally in juxtaposition to car wheels and a metal frame supporting said bar and blocks, engaging with a shaft placed transversely across the car and having a screw thread at each extremity and controlled by hand.

CAR BRAKE.—John G. Schumann, Pittsburgh, Pa. No. 585,988.

This is an emergency brake which can be used on street cars, and when operated the brake is applied to both the wheel and rail.

JULY 13.

AIR COMPRESSOR.—Walter H. Knight, New Brighton, N. Y. No. 586,100.

In an air compressor, the combination of an air compressing chamber or cylinder, a hydraulic pump communicating with said air compressing chamber, and means for causing the liquid to circulate through the hydraulic pump and air compressing chamber in contradistinction to moving to and fro into and out of the air compressing chamber.

AIR MOTOR.—Joseph H. Hoadley, New York, N. Y. No. 586,127.

The combination of a piston, a cylinder with admission ports and exhaust ports with a main valve controlling said ports, and operated by fluid pressure from the source of fluid pressure supply, and cut-off valves operated by fluid compressed at the end of the stroke by the piston to throw the said cut-off valves open, and by fluid pressure from the cylinder through cut-off ports, to throw the said cut-off valves closed.

COMBINED AUTOMATIC FENDER AND BRAKE.—James J. Dougherty, Philadelphia, Pa. No. 586,166.

In this patent the brakes are automatically applied when the fender meets with an obstruction.

CAR BRAKE—John M. Reeves, Plymouth, Pa. No. 586,204.

In a car brake two legs connected together in a manner to allow relative lateral movement, a connection between said legs and a car to allow a longitudinal movement thereof, a brake shoe on the lower ends of said legs, and devices for moving said legs longitudinally and for spreading them apart.

CAR FENDER.—Timothy A. Remsen, Brooklyn, N. Y. No. 586,290.

TAKE-UP DEVICE FOR TROLLEY CARS.—Albert J. Wood, Springfield, Mass. No. 586,302.

The purpose of this invention is to provide an improved construction of the trolley pole, which carries the trolley wheel.

ELECTRIC RAILWAY SYSTEM.—Lawrence K. Devlin, Havre, Mont. No. 586,422.

In a conduit for electric and other railways, the combination of a slot rail constructed in sections having overhanging upper portions forming one side of the slotted top of the conduit, and track boxes located between the ends of the slot rail sections, and provided with overhanging movable extensions corresponding to the overhanging upper portions of the slot rail, said track boxes being also provided with hinged covers.

CAR FENDER.—Charles S. Meyers, Sharpsburg, Pa. No. 586,449.

CAR BRAKE.—Richard Ingram, Roanoke, Va. No. 586,496.

The invention relates to a car brake in which the brake shoes are carried by a resilient band passing around a brake wheel secured to the axles, and provided with operating cords, so that all the brake shoes are applied simultaneously.

We will send copies of specifications and drawings complete of any of the above patents to any address upon receipt of fifteen cents. Give date and number of patent desired. THE STREET RAILWAY PUBLISHING COMPANY, HAVEMEYER BUILDING, NEW YORK.

A Few Press Comments on "American Street Railway Investments."

It is a most complete record of street railways.—Boston *News Bureau.*

It is a valuable work for investors.—New York *Commercial Advertiser.*

It will be found of value by those interested in street railway properties.—*Financial Chronicle.*

The authenticity of its information is well established.—*Journal of Commerce and Commercial Bulletin.*

It is probably the most comprehensive volume of information on this important field of investment yet published.—Springfield *Daily Republican.*

The 1897 edition of AMERICAN STREET RAILWAY INVESTMENTS, published by the STREET RAILWAY JOURNAL, is fully up to previous efforts in the same line. Among the many good things to be found therein, the review of the year and gross receipts in 1895-6 will be found of especial value.—New York *Mail and Express.*

The financial supplement called AMERICAN STREET RAILWAY INVESTMENTS has been issued, containing a review of the year, table of gross receipts in 1895 and 1896, a large number of valuable maps, statistics and balance sheets, making, as a whole, one of the most complete records, and a book which all dealers in street railway securities should possess.— *Wall Street Journal.*

The STREET RAILWAY JOURNAL has issued a supplement entitled AMERICAN STREET RAILWAY INVESTMENTS, which will be found of interest and value to investors and students of financial subjects. The volume contains a mass of information with regard to the traction system of the cities and towns of any importance in the United States which cannot be found in any other publication. —New York *News Bureau.*

The STREET RAILWAY JOURNAL issues annually a supplement which must prove of inestimable value to all whose interests are in any way allied to the street railway industry, its progress and financial history. The "Red Book," as it is called, for 1897, like the subject of which it treats, shows up as of more importance than ever before. Tables and an enlarged series of most valuable maps are given in the book to facilitate inquiry, while the reports all bear the mark of authenticity.—*The Daily Stockholder.*

The STREET RAILWAY JOURNAL has just issued the most valuable of all its series of annual "Red Books" for the guidance of investors in street railway bonds. * * * The special features of arrangement, which have given this a prominent place among financial manuals, are found this year as usual, and include the tabular presentation of gross receipts, operating expenses and balance sheets for from three to five years, by means of which a company's complete financial statements may be examined for surreptitious concealment of expenses or profits.—*The Bond Buyer.*

AMERICAN STREET RAILWAY INVESTMENTS, a Supplement to the STREET RAILWAY JOURNAL, is a very elaborate and useful publication in its issue of 1897. The STREET RAILWAY JOURNAL, published in New York, is a class of paper of high quality and reputation, and consequently the statistics of the annual just referred to should command confidence as to accuracy. There are 1262 reports, covering about all the street railroad companies in the United States, and it would appear, from a somewhat careful examination of the work, that it has been done with great fidelity. All the statistics that anybody could get from these companies appear to have been obtained, and they are presented in a systematic way. The names of the towns are placed in alphabetical order throughout the book, which is a convenient arrangement. Gross receipts, operating expenses and balance sheets for three to five years are given in many cases, and the summary at the beginning of the book presents valuable statistics, as well as a sketch of interesting events which have occurred in the street railway field during the past year. The table of gross receipts in 1895 and 1896 throws light on the relative condition of the industry during those two years. There are a number of maps in the publication. The book is of great value to anybody who is interested in street railway property outside of his own city and beyond the limits of his own personal knowledge.—*The Economist.*

DIGEST OF CONTENTS.—AUGUST, 1897.

Abkürzung des Inhalts—August 1897.

Das elektrische Transportations-System vom Fairmount Park, Philadelphia . . . . . [Seite 459.]

Beschreibung einer Trolley-Linie, welche im Fairmount Park, Philadelphia, dem grössten Stadtpark der Welt, welcher eine Fläche von 5500 km. bedeckt, angelegt wurde. Die Linie hat eine Länge von 14 km. und wurde gebaut, um die weitgelegenen Theile des Parkes erreichen zu können. Die Linie wurde so gebaut, dass die Schönheiten des Parkes nicht geschädigt wurden und ist daher so unsichtbar wie möglich angelegt. Der Raum zwischen den Geleisen ist mit Gras bewachsen und sind dadurch blos die oberen Theile des Geleises und die Pfähle sichtbar. Die Linie ist so angelegt, dass sie so viel wie möglich an den natürlichen Anhöhen entlang läuft, um dadurch alle Einschnitte der Erhöchungen zu verhindern. Die Kraftstation und das Carhaus sind so gebaut dass sie dem blossen Auge nicht sichtbar sind und die Dampfkessel haben ein besonderes Drucksystem, wodurch ein Kamin unnöthig gemacht wurde. Eine genaue Beschreibung der Einzelheiten der Station ist ebenfalls angegeben

Substantionnelle Eisenbahn-Konstruktion . . [Seite 465.]

Beschreibung eines Theiles eines elektrischen Geleises zwischen Washington und Baltimore, in welchem Trolley-Draht von 107 mm² Sektion angewendet ist.

Betrieb.

Elektrische Eisenbahn-Motoren, von G. T. Hanchett [Seite 466.]

Das Thema von "Armature Windings" wird in dieser Ausgabe besprochen.

Finanzielle Resultate der in Amerika in Betrieb befindlichen Kabel- und Elektrischen-Bahnen . . . . . [Seite 468.]

Vierte Serie von Artikeln über dieses Thema; sie behandeln zwei Systeme für Fabrikstädte von 60,000 und 90,000 Einwohnern.

Beiträge über die elektrische Ausrüstung der Metropolitan Hochbahn in Chicago, von M. H. Gerry, Jr. . . [Seite 470.]

Diese Hochbahn, welche eine Länge von 60 km. beträgt, ist mit 180 Wagen ausgerüstet, die in Zügen von zwei, drei und vier Wagen, je nach der Stärke des Verkehrs, befördert werden. Die Wagen haben eine Länge von 15 m. die Lokomotiven wiegen 28,000 kg. bei voller Belastung und die Anhängewagen 21,000 kg. Es gehen täglich ungefähr 1200 Züge von dem Haupterminus aus Die Stationen sind durchschnittlich ungefähr 2000 Fuss von einander entfernt. Der Strom wird durch das dreischienige System den Zügen zugeführt. De Kraft-Station enthält zwei 1500 kw. und zwei 800 kw. Generatoren. Die Motoren wiegen je 635 kg., und es werden Tabellen angegeben welche deren Geschwindigkeit, so wie deren horizontale und rechnerische Wirksamkeit unter verschiedenen Verhältnisse zeigen. Die durch die Züge während der Bescheunigung auf Steigungen und auf ebenen Strecken verbrauchte Kraft, so wie die Wirksamkeit der Stromleitung unter verschiedenen Belastungen, sind sorgfältig erörtert. Die durchschnittliche Anzahl von Kilowatt-Stunden pro Wagenmeile in acht angegebenen Fällen beträgt zwischen 1.44 und 1.81.

Die Kosten von Dampfkraft, von H. A. Foster . [Seite 474.]

Eine sorgfältige Diskussion über die Kosten der Produzirung von Elektricität für elektrische Trambahnen unter verschiedenen Verhältnissen. Etwa 20 Tabellen sind vorhanden, welche die Resultate, die bei einer grossen Anzahl von Systemen in Amerika erzielt wurden ergeben.

Briefe und Mittheilungen von Sachverständigen.

Die richtige Behandlung der Controlleuren, von S. H. Short und S. T. Dodd . . . . . [Seite 479.]

In diesem Beitrage werden Krafts- und Geschwindigkeitstabellen für verschiedenen Verhältnissen von Beschleunigung gegeben, und wird bewiesen dass unter den angegebenen Umständen der Kraftverbrauch nach einer Fahrt von 450 m. der nämliche bleibt, ob ein langsamer oder schneller Antrieb stattfand, und dass infolge dessen die Ersparniss bei einem Schnellen Antrieb grösser ist.

Grosse Terminal-Station in Boston . . . . [Seite 478.]

Beschreibung einer grossen Union-Eisenbahnstation, welche von den Trunk-Linien die in Boston von Süden und Westen einlaufen benutzt wird.

Transferirungs-Billete in Paris, von A. N. Connett [Seite 481.]

Beschreibung der Methode der Passagier-Transferirung, die in Paris in Gebrauch ist.

"Rechtswesen." . . . . . [Seite 482.]

Leitartikeln.

Konvention der Amerikanischen Strassenbahn-Gesellschaften [Seite 484.]

Konventionen der Staats-Gesellschaften . . . [Seite 484.]

Dritte Bahn-Operationen mit überflutheten Geleisen [Seite 484.]

Statistiken über Versuchs-Pläne . . . . [Seite 484.]

Zusammengesetzte Schienen in Europa und Amerika [Seite 485.]

Vortheilhafte Eintheilung der Einnahmen und Ausgaben von Strassenbahnen . . . . . [Seite 486.]

Angabe für eine Methode zur Veroffentlichung der allgemeinen Einnahmen und Eintheilung der Betriebs-Ausgaben, in welcher alle Vortheile der New Yorker, Massachusetts und interstaatlichen kommerziellen Classificationen zusammengezogen sind, mit Empfehlungen für Berücksichtigung des Strassenbahn-Rechenmeistersvereins von Amerika bei ihrer Konvention in October.

Oberbau.

Luftdruckmotoren . . . . . [Seite 487.]

Beschreibung einer neuen Gattung von Luftdruckwagen welche durch die "Compressed Air Power Company" gebaut wurde. Es werden vier Motoren für jeden Wagen gebraucht, wovon zwei Hochdruck- und zwei Niederdruck-Zilindern für jede Achse gebraucht werden. Die Motoren sind vollständig durch eine Eisenhülle beschützt, und an einem Ende mit der Achse verbunden. Es werden keine Transversalstangen verwendet, und das Motor-Untergestell der Wagenkörper und die Räder sind gleich denen welche in dem elektrischen Betrieb benutz werden.

Die Luftzilindern sind unter den Sitzen aufgebracht, und enthalten einen Luftdruck von 140.6 kg. pro cm². Dies wird zu 14 kg. pro cm.² reduzirt, bevor die Zilindern durch warmes Wasser geheitzt werden. Die Fabrikanten schätzen die Kosten auf ungefähr ein Cent pro Wagenmeile. Das Luftdruck-Apparat ist, ebenfalls von einer neuen Gattung, und es werden manche Tabellen gegeben, besonders über die Zusammendrückung und Ausdehnung, so wie Tabellen und Querschnitten des Apparates.

Luftleitungsbau in Kansas City . . . . [Seite 492.]

Beschreibung einer 5 km. langen Bahn mit schwerem Luftleitungsbau. Es werden Drahtseile mit einem Durchschnittsriss von 500 qmm. verwendet, welche an den Isolatoren vermittels in Beton gesetzten Ankern befestigt werden. Das Senken der Drähte übersteigt nicht 12 mm. zwischen den Trägern.

Unvergleichbar schneller Bau einer Strassenbahnstrecke. [Seite 493.]

Beschreibung einer Methode um gesetzlichen Interlocuten vorzubeugen, vermittels welcher eine Strecke von Strassenbahnoberbau in kurzer Frist in Chicago, gelegt wurde. Es wurden 1600 m. Bahnstrecke, für den Betrieb gänzlich bereit, in zwölf Stunden und dreiundfünfzig Minuten gelegt. Dieselbe Strecke von Luftleitung wurde in zehn Stunden und fünfundzwanzig Minuten verfertigt.

Diagramm von Berechnungen der Kosten für Kohlen pro Pferdekraft pro Jahr . . . . . [Seite 498.]

Praktische Uebersicht gestützt auf Zahlen, gesammelt von H. A. Foster.

Wissenschaft. — Baukunst. — Erfindungen.

Oberbau-Walze . . . . . [Seite 500.]

Beschreibung einer Oberbau Walze, welche in Springfield, Mass., verwendet wird, und so beschaffen ist, dass sie durch einen Motorwagen gezogen werden kann. Die Walze ist auf einem Wagen-Untergestell aufgebracht, und kann von der Oberfläche der Bahn erhoben werden.

Elektrische Lokomotive für Trolley-Konstruktions-Arbeiten [Seite 500.]

Beschreibung über den Gebrauch von elektrischen Lokomotiven für den Bau von Trolley-Bahnen im Vergleich mit den Kosten von Dampf-Lokomotiven.

"Bicycle-Haken" für Strassenbahnen . . . [Seite 500.]

Eine Erfindung welche an den Rückwänden der Platformen der Strassenbahn-Wagen angebracht ist, um Bicycles zu transportiren und welche in San Francisco sehr viel im Gebrauch ist.

Oel Filtrirung . . . . . [Seite 501.]

Klampe für überirdische Leitungshähte . . . [Seite 501.]

Beschreibung einer neuen Gattung von Klampe, deren Griffe über den oberen Theil eines 8-förmigen oder runden Drahtes gedruckt werden, und in dieser Weise jegliche Abnutzung zwischen den Griffen und dem Stromabnehmer vermeiden.

Attraktive Vorstadt-Wagen . . . . . [Seite 502.]

Beschreibung von 40 Fuss Doppelbahn-Wagon welche in der Nähe von Cleveland in Gebrauch sind.

Neurer elektrische Heizer . . . . . [Seite 502.]

Der Widerstand in diesem Heizer ist 10 an der Zahl, jede auf 50 Volten gewunden. Die Drähte sind auf senkrechten Röhren.

Graphite Trolley Bushings . . . . . [Seite 502.]

Beschreibung von selbstölenden Bushings für Trolleys.

Neue Schienenlasche . . . . . [Seite 502.]

Beschreibung einer Lasche bei welcher keine Bolzen verwendet werden, die Schienen werden in einem Rahmen vermittelst zwei Schlüssel festgehalten, welche durch einen Schmiedehammer in Stelle getrieben werden.

"Mittheilungen von England" . . . . [Seite 505.]

Wagen-Heizer . . . . . [Seite 506.]

Beschreibungen von Heisswasser- und Luftheizer gespeist mit Brenn-material.

Table des Matières—Août 1897.

Système de transport électrique de Fairmount Park, Philadelphie. [Page 459.]

Description d'une ligne de ceinture à trôlet construite dans le parc de Fairmount, à Philadelphie, l'un des plus grands parcs d'enceinte du monde entier, couvrant une superficie de 5500 hectares. La ligne a une longueur de 14 kilomètres, et a pour but de donner accès aux parties les plus eloignées l'une de l'autre. La construction de la ligne a été l'objet des plus grands soins, de façon à ne pas détruire l'effet du paysage et à passer inaperçue autant que possible, ce qui lui donne un intérêt tout particulier. La voie et les côtés sont recouverts d'herbe, de telle manière qu'il n'existe aucune partie saillante au-dessus de la surface, sauf les rails et les poteaux. La construction aérienne est très légère, et la ligne suit exactement le contour du terrain, rendant inutiles les passages à niveau, l'empiétement sur les parc, etc. La station de force motrice et les hangars sont cachés par des monticules, et l'emploi d'un système mécanique de décharge rend inutile l'usage d'une cheminée.

Il est donné une description minutieuse d'un certain nombre de détails intéressants de la station centrale.

Construction de voie solide . . . . . [Page 465.]

Description d'une section de voie entre Washington et Baltimore, avec emploi d'un fil de trôlet de 107 mm. de diamètre.

Service.

Moteurs de chemins de fer électriques.—II, par G. T. Hanchett. [Page 466.]

Cet article s'occupe de l'envidement d'inducteurs.

Résultats financiers de l'exploitation de tramways électriques et funiculaires en Amérique . . . . . [Page 469.]

C'est le quatrième article d'un série sur ce sujet; il traite de ces deux systèmes pour des villes manufacturières de 60,000 à 90,000 habitants.

Notes sur l'équipement électrique du Métropolitain de Chicago, par M. H. Gerry, Jr. . . . . [Page 470.]

Ce chemin de fer élevé, d'une longueur de 60 kilomètres, a 180 voitures en mouvement, accouplées par deux, trois et quatre, suivant les besoins du trafic. Les voitures son de 15 mètres de longueur, les voitures motrices pèsent 28,000 kg., et les voitures de remorque 21,000 kg. Il part environ 1200 trains par jour du terminus principal. Les stations se trouvent à une moyenne de 650 mètres l'une de l'autre. Le courant est transmis aux trains par le système du troisième rail. La centrale se compose de deux générateurs de 1500 kilowatts, et de deux autres de 500 kilowatts. Les moteurs pèsent 635 kg. chaque, et il est donné des tracés indiquant leur vitesse horizontale et leur rendement commercial sous differentes conditions. L'auteur passe en revue d'une manière minutieuse la puissance absorbée par les trains en gravissant les rampes ainsi que sur les surfaces planes, de même que l'efficacité de transmission sous des charges différentes. La moyenne de kilowatt heures par mille voiture à la station, telle qu'elle est indiquée dans huit cas differents, est de 1.44 à 1.81.

Le coût de la force motrice à la vapeur, por H. A. Fosrer. [Page 474.]

Discussion approfondie de ce que coûte la production de l'electricité pour les tramways électriques dans différentes conditions. Environ vingt tableaux donnent les résultats obtenus sur un grand nombre de lignes aux Etats-Unis.

Grand terminus à Boston . . . . . [Page 478.]

Description d'une station im ortante formant le terminus d'un réseau de chemins de fer se centralisant à Boston du sud et de l'ouest.

Lettres et Communications Diverses.

Sur la propre manière de faire usage du contrôleur, par L. H. Parker . . . . . [Page 479.]

Réponse à une lettre publiée dans le dernier numéro, dans laquelle il est soutenu que l'économie dans la consommation d'énergie est plus grande lorsque la vitesse d'un car électrique est moins rapide. L'auteur maintient qu'avec des voitures à grande vitesse il y aura un minimum de watt-heures par tonne-mille, si les moteurs sont lancés au point de glissement des roues, et appuie son dire sur les essais de la "General Electric Co.;" ce qui revient à dire que quand un train ou une voiture a à parcourir une certaine distance en un temps déterminé, il y a plus d'économie dans la consommation d'énergie en raison de la vitesse initiale du départ. Il est aussi démontré que les lois d'accélération peuvent être déterminées minutieusement sur un parcours sans arrêts.

Sur la propre manière de faire usage du contrôleur, par S. H. Short et S. T. Dodd . . . . . [Page 479.]

Dans cet article il est publié des tracés indiquant l'énergie et la vitesse pour différents degrés d'accélération, et démontrant que dans les conditions données, l'énergie consommée, après que 450 mètres ont été parcourus, est la même, lorsque le départ se fait lentement ou rapidement; par consequent qu'il y a plus d'économie avec un départ brusque.

Le système de correspondance à Paris, par A. N. Connett. [Page 481.]

Description du système employé à Paris pour établir la correspondance d'une ligne à l'autre.

Jurisprudence. . . . . . [Page 482.]

Articles de Fond.

Statistiques de construction et d'opération . . [Page 484.]

Réunion de l'Association des Tramways Américains. [Page 484.]

Réunions des associations d'état . . . . [Page 484.]

Opération du troisième rail sur des voies inondées . [Page 484.]

Rails composites en Europe et en Amérique . . [Page 485.]

Distribution modèle des recettes et dépenses d'un tramway. [Page 486.]

Ceci est une suggestion pour un système à l'effet de présenter le compte général des recettes; dans ce système, les traits les plus saillants des classifications commerciales pour les Etats de New York et du Massachusetts, et d'Etat à Etat, sont réunis par ordre. Nous conseillons à la "Street Railway Accountants' Association" d'en faire l'examen à sa convention d'Octobre.

Construction.

Moteurs à air comprimé . . . . . [Page 487.]

Description d'un nouveau type de tramway à air comprimé, construit par la "Compressed Air Power Company." Il est fait usage de quatre moteurs par voiture, deux cylindres à haute pression étant attachés à l'un des essieux, et deux cylindres à basse pression à l'autre. Les moteurs sont complètement entourés d'une armature de fer, et chacun d'eux repose par un bout sur l'essieu, auquel il est assujetti par son arbre. Il n'est pas fait usage de barres transversales, et le truck, le corps de voiture et les roues sont les mêmes que ceux en usage pour le service de tramways électriques. Les réservoirs d'air se trouvent sous les banquettes, et sont chargés à une pression de 140.6 kg. par centimètre carré. Cette pression peut être réduite à 14 kg. par centimètre carré avant de placer les cylindres dans le surchauffeur, d'où il est transféré au moteur. Les constructeurs ne croient pas que l'entretien revienne à plus de 5 centimes par mille-voiture. Les voitures demandent un voltage d'un peu plus de trois chevaux par heure et par mille-voiture qui peut être produit au prix de 9 centimes. Le comprimeur est aussi d'un type nouveau. Il est donné un certain nombre d'illustrations y compris le tracé de la force pendant la compression et la dilatation, des diagrammes d'indicateur de moteurs et des coupes et élévations de l'appareil.

Construction aérienne à Kansas City . . . [Page 492.]

Description d'une ligne de 5 kilomètres à construction aérienne. Il est fait usage de câbles en sections de 500 mm²., qui sont ancrés á chaque courbe à des supports cimentés et attachés aux isolateurs. Les fils ont un relâchement de moins de 12 cm. entre les supports.

Construction de voie rapide . . . . . [Page 493.]

Description d'une méthode par laquelle, dans le but d'éviter les effets d'une opposition légale, une section de ligne à trolley fut dernièrement posée à Chicago. Une longueur de voie de 1600 mètres fut posée, prête à être ouverte à l'exploitation, en douze heures et cinquante trois minutes, et 1600 mètres de fil aérien furent tendus en dix heures et vingt cinq minutes.

L'électricité comme force motrice sur les chemins de fer élevés, par S. H. Short . . . . . [Page 494.]

Cet article passe en revue l'énergie consommée et les meilleures méthodes employées pour la traction de chemins de fer élevés au moyen de l'électricité. Il est donné des dessins de trucks spéciaux pour des moteurs de 200, 125 et 66 chevaux, avec des feuilles de contrôle des trains et des tracés de vitesse et d'effort horizontal des moteurs. Il est fait une description du moteur le mieux adapté au service de chemin de fer élevé, dont le système magnétique est symétrique est d'une grande surface de section, afin d'assurer un contrôle rapide. L'anneau magnétique a un diamètre très-large, et l'essieu passe dans l'anneau entre les champs magnétiques. Il est donné des tableaux indiquant l'effort horizontal dans l'accélération et dans la marche à grande vitesse, la durée requise dans l'accélération, le poids du train. etc., d'après trois essais faits avec des trains de trois, deux et une voiture chaque.

Tracé indiquant le prix du charbon par cheval-vapeur par année. [Page 498.]

Résumé de différents essais récapitulés par H. A. Foster.

Science — Génie — Inventions.

Rouleau de voie . . . . . [Page 500.]

Description d'un rouleau de voie employé à Springfield, Mass., et construit de manière à être remorqué par une voiture motrice. Le rouleau est monté sur un truck et peut être soulevé de la surface de la voie.

Crochets pour bicyclettes sur tramways . . . [Page 500.]

Dispositif aménagé sur le devant de voitures de tramways afin de transporter les bicyclettes. Ce système est employé à San Francisco.

Locomotives électriques employés pour la construction aérienne. [Page 500.]

Description d'un nouveau système pour l'usage d'une voiture électrique locomotive indépendante dans la construction de ligues de trôlet, avec comparaison des dépenses de la traction à la vapeur

Hauban pour les fils de trôlet . . . . . [Page 501.]

Description d'un nouveau type de hauban pour fil de trôlet dont les mâchoires sont comprimées sur la partie supérieure du fil en 8 ou du fil rond, supprimant de cette façon l'usure entre le hauban et le trôlet.

Filtrage d'huile . . . . . [Page 501.]

Nouveau réchauffeur électrique . . . . [Page 502.]

Il y a dix resistances de 50 volts chaque dans ce réchauffeur. Le fils sont placés dans des tubes verticaux.

Voitures de banlieue pour excursions . . . [Page 502.]

D'escription d'un nouveau genre de voitures de 15 mètres de longueur, à bogie, en usage dans les environs de Cleveland.

Nouveau joint de rails . . . . . [Page 502.]

Description d'un joint sans boulons; les rails sont maintenus rigidement dans une éclisse au moyen de deux clés forcées en position par un marteau de forge.

Nouveau système à trois fils . . . . . [Page 502.]

Il est question dans le Colorado d'appliquer le système à trois fils à un chemin de fer de longue distance, l'un des côtés du système ayant 800 volts et l'autre 1200 volts. Cet arrangement permet l'emploi de six voltages différents, sans qu'il soit fait usage de rhéostats.

Tubes de graphite pour les roues de trôlet . . [Page 502.]

Description de tubes à huilage automatique pour tramways électriques.

Notes d'Angleterre . . . . . [Page 505]

Chauffage de tramways . . . . . [Page 506.]

Description de réchauffeurs d'air et d'eau au moyen de combustible.

Lista de Materias—Agosto 1897.

Sistema de transportación eléctrica de Fairmount Park, Philadelphia. [Pág. 459.]

Descripción de un sistema de tranvía á trolley construido en forma de presilla en el parque de Fairmount, Philadelphia, el cual tiene una sobrefaz de 2740 acres y es uno de los parques urbanos más largos en el mundo. El desarollo de la línea es de 14 kilómetros, y fué construida para facilitar el acceso de las partes más distantes del parque. Ha sido tomado grán esmero en la construcción de la línea, para evitar daño al pasaje, y en ese punto es la línea de interés especial.

La vía y los lados son cubiertos de yerba, de modo que nadie proyecta de la sobrefaz de la tierra, sino los carriles y los apoyos. El sistema aéreo está ligero, y por lo tanto que la línea sigue estrechamente el contorno del terreno, son descartados los cruceros, cortaduras y complementos.

La estación de potencia y la cochera de carruajes son escondidos de vista por medio de terraplenes, y el empleo de un sistema de operación mecánica hace sin necesidad el uso de una chimenea.

Se describen con esmero varias novedades de interés colocadas en la estación de potencia motriz.

Construcción de ferrocarril sólida. . . . . [Pág. 465.]

Descripción de una sección de vía eléctrica en re Washington y Baltimore, en la cual se usa alambre aéreo eléctrico de 107 mm².

Operación.

Resultado financiero de las operaciones de tranvías de cable y eléctricos en América . . . . . [Pág. 469.]

Este es el cuarto artículo de una serie sobre este asunto, y trata de estos dos sistemas en ciudades manufactureras de 60,000 y 90,000 habitantes.

Motores eléctricos para ferrocarril, por G. T. Hanchett. [Pág. 466.]

En este numero se discute el asunto de las armaduras de inducción.

Notas sobre el apresto eléctrico del ferrocarril aéreo "Metropolitan" de Chicago, por M. H. Gerry, Jr. . . [Pág. 470.]

Este ferrocarril aéreo, cuyo desarrollo es de 60 km. de longitud, tiene 180 carros, circulando en trenes de dos, tres y cuatro coches cada uno, segun el trafico. Los coches tienen 15 metros de longitud, los carros motores pesan cargados 28,000 kg., y los coches de remolque 21,000 kg. Circulán diariamente cerca de 1200 trenes saliendo del termino principal. Las estaciones son colocadas á una distancia media de 650 metros. La corriente está transmitida á los trenes por medio del sistema de tres carriles. En la estación de potencia motriz funcionan dos generadores de 1500 kw. y dos de 800 kw. Los motores pesan 635 kg. cada uno, y son dados gráficos indicando su velocidad, y su eficacia horizontal y comercial soto diferentes condiciones. El consumo de potencia por los trenes durante la aceleración en

pendientes y á nivel es discurrido con esmero, así como la eficacia de transmisión soto diferentes cargas. El medio de kw. horas por milla de carro á la estación, en ocho diferentes casos indicados, varía de 1.44 á 1.81.

Costo de la fuerza motriz por el vapor, por H. A. Foster. [Pág. 474.]

Discusión del costo de la producción eléctrica para tranvías eléctricos bajo diferentes condiciones. Se dan como veinte tablas mostrando los resultados obtenidos en un gran número de sistemas en América.

Gran termino á Boston . . . . . [Pág. 478.]

Descripción de una estación importante formando el termino de una red de ferrocarriles concentrandose en Boston del sur y del oeste.

Varias Comunicaciones.

Sobre el propio modo de manejar contralores, por L. H. Parker. [Pág. 479.]

Eso es una contestación á una carta publicada en el número precedente, en la cual fué afirmado que la economía en consumo de potencia está mayor cuando la velocidad de un coche eléctrico es menos rápida. Mr. Parker asegura que en el caso de coches de gran velocidad las watt-horas por milla de tonelada son á lo mínimo cuando los coches son lanzados casi al punto de resbalón de las ruedas, eso facto siendo demostrado por las pruebas de la "General Electric Company;" por consecuencia, cuando un coche ó tren debe hacer un curso de cierta distancia, lo más rápida la volocidad al principio, lo menos será el consumo total de potencia.

Sobre el propio modo de manejar contralores, por S. H. Short y S. T. Dodd . . . . . [Pág. 479.]

En este informe son dados gráficos de potencia y de velocidad para diferentes grados de aceleración, demostrando que soto condiciones indicadas, el consumo de potencia es lo mismo despues que 450 metros han sido recorridos, sea el principio lento ó rápido, y que por consecuencia la economía está mayor con un principio rápido.

Jurisprudencia. . . . . . [Pág. 482.]

Billetes de correspondencia en Paris, por A. N. Connett. [Pág. 481.]

Descripción de un método en uso en Paris para transportar pasajeros de una línea á otra.

Artículos de la Redacción.

Reunión de la Asociación de Tranvías Americanos . [Pág. 484.]

Reuniones de las asociaciones del estado . . [Pág. 484.]

Operación de un tercer riel sobre vías inundadas . [Pág. 484.]

Rieles compuestos en Europa y en América . . [Pág. 484.]

Estadísticas de construcción y de operación . . [Pág. 484.]

Distribución modelo de las entradas y gastos de un tranvía. [Pág. 486.]

Esta es una sugestión para el modo de presentar la cuenta general de entradas y distribución de gastos de operación, en la cual se reunen los mejores característicos de las clasificaciones comerciales de los Estados de New York y Massachusetts, así como de los Estados entre sí, y se hacen recomendaciones para la consideración de la Asociación de "Street Railway Accountants" de América, cuya convención tendrá lugar en Octubre.

Construcción.

Motores de aire comprimido . . . . . [Pág. 487.]

Descripción de un nuevo tipo de tranvía de aire comprimido, construido por la "Compressed Air Power Company." Son usados cuatro motores por carro, dos cilindros de alta presión siendo conexionados con un eje, y dos de baja presión con el otro eje. Los motores son completamente encerrados en una envolvente de hierro, y cada uno está colocado á su extremidad sobre el eje por medio de su vara. No son usadas varas de conexión, y el carretón motor, el cuerpo del carro y las ruedas son semejantes á los empleados en el servicio de ferrocarriles eléctricos.

Los cilindros de aire son colocados soto las sillas, y cargados á una presión de 140.6 kilógramos por cm². Esa carga puede ser reducida á 14 kilógramos por cm². antes de la admisión en el calentador de agua caliente de cuyo el cilindro pasa al motor. Los fabricantes estiman el costo por milla de carro á no más de un centavo (5 centimos.) Los carros requirien un voltaje de poco más de tres caballos por hora y milla de carro, que puede ser producido al coste de 8 centavos. El compresor también es de un nuevo tipo. Son dadas numerosas ilustraciones, incluyendo un gráfico de la potencia durante la compresión y la dilatación, diagramas del motor indicador, así como secciones y vistas del aparato.

Construcción aérea en Kansas City . . . . [Pág. 492.]

Descripción de una línea de construcción aérea pesada de 5 kilómetros en longitud. Se empleán cables de 500 mm². de sección, colocados en aisladores por medio de retenidas. El alambre no afloja más de 125 mm. entre apoyos.

Construcción rápida de ferrocarril . . . . [Pág. 493.]

Descripción de un método empleado para evitar un mandato legal, por medio de cuyo una sección de tranvía de trolley fué colocada á Chicago en breve tiempo. Fueron colocados 1600 metros de vía, en disposición para el tráfico, en 12 horas cincuenta y tres minutos, y fué sospendida la misma longitud de conductores aéreos en diez horas veinticinco minutos.

La electricidad como potencia motriz sobre ferrocarriles aéreos, por S H. Short . . . . . [Pág. 494.]

Eso es una discusión del consumo de potencia motriz y de los mejores métodos para operar ferrocarriles aéreos por medio de electricidad. Son dados diagramas de carretones para motores de 200, 125 y 60 caballos, con cuadros gráficos de la operación de los trenes, y de la velocidad y esfuerzo horizontal de los motores. Está descrito el motor mejor adaptado para el servicio de ferrocarriles aéreos, en el cual el sistema magnético del motor está simetrico, y de larga sobrefaz seccional para proveer por aceleración rápida. El anillo magnético es de gran diametro, y el eje pasa al interior del anillo entre los centros magneticos, de manera que la distancia entre los centros está estrecha. Son dadas tablas indicando el esfuerzo horizontal en aceleración y recorriendo á velocidad completa, el tiempo requirido en aceleración, el peso del tren, etc., en tres casos con trenes de tres, dos y un carro cado uno.

Diagrama para computar el costo anual de carbón por caballo de fuerza . . . . . [Pág. 498.]

Un diagram muy útil basado en cifras compila'as por H. A. Foster.

Ciencia. — Ingenieria. — Invenciones.

Cilindro de vía . . . . . [Pág. 500.]

Descripción de un cilindro de vía en uso á Springfield, Mass., y movido por un carro motor. El cilindro está montado sobre un carretón de coche, y puede ser levantado de la sobrefaz de la vía.

Locomotoras eléctricas en la construcción de conductores aéreos eléctricos . . . . . [Pág. 500.]

Descripción del uso de una locomotora eléctrica independiente en la construcción de líneas aéreas eléctricas comparada con el costo de una máquina de vapor.

Soporta-bicicletas para tranvías . . . . [Pág. 500.]

Aparato que va en la testera de los tranvías y que sirve para llevar bicicletas, el cual se viene usando extensamente en San Francisco.

Pieza de soporte para alambres de trolley . . [Pág. 501.]

Descripción de un nuevo tipo de soporte para alambre de trolley, cuyos bordes son comprimidos sobre la parte superior de una figura 8 ó un alambre redondo, en modo de evitar cualquier uso entre el soporte y el contacto del trolley.

Filtración de aceite . . . . . [Pág. 501.]

Nuevo sistema á tres alambres . . . . [Pág. 502.]

Se propone en Colorado de aplicar el sistema de tres alambres á un ferrocarril de gran desarrollo, aunque con 800 volts á un lado del sistema y 1200 volts al otro lado. Esta disposición permite seis diferentes voltajes sin empleo de reostatos.

Nuevo junto de carril . . . . . [Pág. 502.]

Descripción de un junto sin remaches, el carril siendo mantenido con rigidez en una forma por medio de dos llaves cruzadas en posición por un macho.

Tubos de grafito para ruedas de trolley . . . [Pág. 502.]

Descripción de tubos lubricadores automáticos para ruedas de trolley.

Tranvías atractivos de los suburbios . . . [Pág. 502.]

Descripción de algunos tranvías de doble carretón de 40 piés, que vienen usándose en Cleveland.

Nuevo calorífero eléctrico . . . . . [Pág. 502.]

Las resistencias en este calorífero son diez cada una devanada por cincuenta voltas. Los alambres están sobre tubos verticales.

Notas de Inglaterra. . . . . . [Pág. 505.]

Caloríferos para tranvías . . . . . [Pág. 506.]

Descripción de caloríferos de agua y aire caliente y que se sirven de combustible.

Financial Notes.

Albany, N. Y.—At the monthly meeting of the Albany Railway, the regular 1½ per cent quarterly and an extra 1 per cent dividend on the stock, both payable Aug. 2 to stockholders of record July 22, was declared.

Atlanta, Ga.—It is stated that a deal is on foot whereby the Atlanta Electric Railway will be sold to a Baltimore and New York syndicate, which will greatly improve and extend the system. D. H. Livermore, of Atlanta, is the present owner of the road.

Brockton, Mass.—The Brockton, Bridgewater & Taunton Street Railway Company has been granted permission to issue $200,000 5 per cent twenty year bonds, to build and equip the road.

Brooklyn, N. Y.—It is rumored that the Brooklyn Rapid Transit Company is about to absorb a number of rival street railway systems in Brooklyn.

Burlington, Vt.—At a meeting of the promoters of the proposed electric railway in Burlington, held recently in the office of Dillingham, Huse & Howland, the following officers were elected: President, J. S. Pierson of Burlington; vice-president, J. J. Flynn of Burlington; treasurer, A. O. Humphrey of Burlington; assistant treasurer, George Butman of Boston; clerk, H. K. Bush of Barre, Vt.

Cambridge, Pa.—An application will be made by A. F. Brown, W. D. Rider, Jr., J. C. Rider, Jno. Runnette and E. Y. Breck for a charter for the Cambridge Springs Street Railway Company, the object of which is to construct, equip, maintain and operate a street railway upon certain streets in the borough of Cambridge Springs, Pa.

Cripple Creek, Col.—A mortgage has been filed by the Cripple Creek District Railroad Company to secure the payment of $500,000 bonds to the Central Trust Company, of New York. The bonds are in gold, and bear 5 per cent interest. The money thus obtained is to construct a trolley railroad through the Cripple Creek gold districts.

Jersey City, N. J.—It is announced that the Northern Railroad of New Jersey has been sold to the Erie Railroad which was formerly the lessee of the Northern Railroad. In view of this sale the electrical equipment of the Northern Railroad will probably be postponed indefinitely.

Los Angeles, Cal.—The reorganization of the Pasadena & Los Angeles Electric Railway Company has been practically completed. C. W. Smith, late receiver of the Atlantic & Pacific, has been formally elected president of the company, succeeding P. M. Green, who was made vice-president. The bondholders will be called upon at once to furnish funds for the construction of local lines in Pasadena.

Montoursville, Pa.—J. W. Cramp, of Montoursville, superintendent of the Montoursville Passenger Railway Company, writes us that the construction work on this road has been commenced. The road will be about 5 miles long, and will operate six cars. All contracts have been awarded. The Tennis Construction Company, E. A. Tennis, president, has the contract for building and equipping the road.

Neenah, Wis.—Henry C. Payne, of Milwaukee, has purchased the Neenah & Menasha Street Railway.

Newburgh, N. Y.—A certificate of the consolidation of the Newburgh Electric Railway Company, Walden & Orange Lake Railroad Company, and the Newburgh & Orange Lake Railroad Company into a single corporation, to be known as the Newburgh Electric Railway Company, has been filed with the Secretary of State. The capital stock of the new company is $150,000, and the directors are Benjamin Norton, Silas B. Dutcher, William H. Pouch, Alfred J. Pouch, Frederick H. Pouch, Alden S. Swan, William H. Tobias, S. Stewart Whitehouse and Charles N. Finch.

New York, N. Y.—It is stated that the franchise of the Union Railway Company, of New York, has been sold to P. A. B. Widener, W. L. Elkins and Thomas Dolan, of Philadelphia. It is understood that this syndicate is also the purchaser of the New York, Elmsford & White Plains Railway Company and the Port Chester Electric Railway Company.

THOMAS F. RYAN, a large stockholder in the Metropolitan Traction Company, denies emphatically the newspaper reports that there have been any negotiations looking to the consolidation of the Metropolitan Traction Company with the Brooklyn Rapid Transit Company.

THE Metropolitan Street Railway Company announces an issue of $12,500,000 5 per cent gold general mortgage bonds for improvement purposes.

THE Metropolitan Traction Company will build a large new power house at First Avenue and Ninety-fifth Street, to cost $350,000.

Palmer, Mass.—A meeting of the incorporators of the Palmer and Monson Street Railway Company was held recently in the rooms of the Palmer Business and Social Club. H. E. W. Clark was chosen chairman of the meeting, and C. F. Grosvenor, clerk. It was voted to accept the charter recently granted by the Legislature,

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and a committee composed of C. F. Grosvenor, C. H. Hobbs and Rufus Flynt was appointed to solicit subscriptions for building the road.

Philadelphia, Pa.—The Hestonville, Mantua & Fairmount Park Passenger Railway Company has declared a semi-annual dividend of 3 per cent ($1.50 per share) on the preferred stock and 2½ per cent ($1.25 per share) on the common stock.

Pittsburgh, Pa.—Charters have been granted in Harrisburg for three new traction companies to operate lines in the suburban parts of Allegheny. The new companies are said to be controlled by the United Traction Company, of Pittsburgh. One charter is for the Greentree Electric Railway Company; its capital stock is $30,000, and it will construct a railway from the junction of Perrysville Avenue and East Street along Perrysville Avenue to Ross Township and return; one is for the Northern Electric Railway Company, capitalized at $24,000; it will build from the intersection of the old Franklin road and Perrysville plank road in Ross Township, along the Franklin road to the Perrysville plank road, and along the latter to Perrysville, a distance of 4 miles; the other is for the Ross Electric Street Railway Company to build a line from a point on the Perrysville plank road to the intersection of the Perrysville and Franklin roads. The capital stock is $4,500. M. K. McMillen is president of the three companies.

The United Traction Company, of Pittsburgh, has issued $4,000,000 in bonds. This issue is part of an authorized issue of general mortgage 5 per cent gold bonds, authorized, $10,000,000, issued, $4,000,000; in escrow to retire prior liens $5,275,000, in treasury for future betterments, improvements and extensions, $725,000; dated July 1, 1897, due 1997; denomination $1000; interest payable January and July; trustee of mortgage Maryland Trust Company, of Baltimore.

It is stated that preliminaries have been arranged for building a street railway from New Kensington to Greensburg. Colonel. M.

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D. Weyman, of the Nesbit Foundry & Machine Company, is at the head of the enterprise.

Racine, Wis.—The Belle City Street Railway has been sold by Receiver Smith. It was purchased by Frank J. Miller, who represented the bondholders of the road, for $150,000. At the time the line went into the hands of the receiver there was a bonded indebtedness of $300,000. A new company will be organized to take charge of the line.

Randolph, Mass.—The Railroad Commissioners have issued an order approving the purchase of the Randolph Street Railway by the Braintree Street Railway Company. An increase of $35,000 in the capital of the latter company is authorized, with which to make the purchase.

Saratoga, N. Y.—The Saratoga Lake Railroad Company has been leased to the Saratoga Traction Company. These two companies are the successors to the Saratoga Union Electric Railway which went into the hands of a receiver some time ago.

Sycamore, Ill.—We have just received word that surveys are in progress for the proposed Streator & Lake Geneva Electric Railroad. John B. Whalen, of Sycamore, Ill., is interested in the road. L. B. Merriam, of De Kalb, Ill., is chief engineer.

Uniontown, Pa.—The new owners of the Uniontown Street Railway Company have elected H. L. Robinson president of the company, and R. F. Hopwood, secretary. The line will be extended to Brownfield, a distance of three miles.

Waco, Tex.—An application has been filed by Eugene Early in Judge Surratt's court for a receiver for the Electric Railway & Light Company. This reopens the old litigation involving this road, which was in the hands of a receiver for several years. The receiver was discharged some time ago and the property turned over to the purchaser, the Citizens' Railway Company.

White Plains, N. Y.—The New York, Elmsford & White Plains Railway Company has been sold to a syndicate of Philadelphia capitalists, who, as soon as the details of the purchase are per-

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We have issued a folder containing sample colors of Alcatraz Asphalt Paints, which tells briefly of their points of superiority. Will be sent to any one interested upon application, together with any other information desired.
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fected, will proceed to carry out the plan of the local company, which is to connect White Plains with Tarrytown, on the Hudson, and Mamaroneck and Rye on Long Island Sound. The same syndicate, it is reported, has bought out the Port Chester Railway Company.

Worcester, Mass.—A letter just received states that the franchises and charter for the Worcester & Clinton Street Railway Company are being obtained; but, as it is so late in the season, the road will not be constructed until early next spring. Contracts will be made this fall and winter for construction and equipment. Charles E. Dresser, Leominster, Mass., secretary, may be addressed.

Visitors to Lincoln Park in Chicago

will be delighted with the souvenir book of this beautiful spot now being distributed by the Chicago, Milwaukee & St. Paul Railway Company. It is a magnificent publication of 96 pages full, to overflowing with dilicious half tone pictures of one of Creation's most charming places of resort for citizens of the Great Republic.

No stranger visiting Chicago should be without a copy of the "Souvenir of Lincoln Park." It can only be procured by enclosing twenty-five (25) cents in coin or postage stamps, to Geo. H. Heafford, general passenger agent, 410 Old Colony Building, Chicago, Ill. ***

Items.

The B. & O. S. W. will begin laying 5000 tons of 75 lb. steel rail next month. About half is to be placed in the Mississippi division tracks and the rest between Parkersburg and Chillicothe. ***

D. B. Martin, Manager of Passenger Traffic of the Baltimore & Ohio Railroad, is a firm believer in artistic advertising for railroads, and is already taking steps to place the B. & O. at the top in this respect. He is going to take full advantage of the scenic beauties of the line, and probably an entirely new series of photographs will be secured. ***

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ACT AS TRANSFER AGENTS FOR CORPORATIONS.

ELECTRICAL ENGINEERING DEPARTMENT
University of Illinois.

Street Railway Journal.

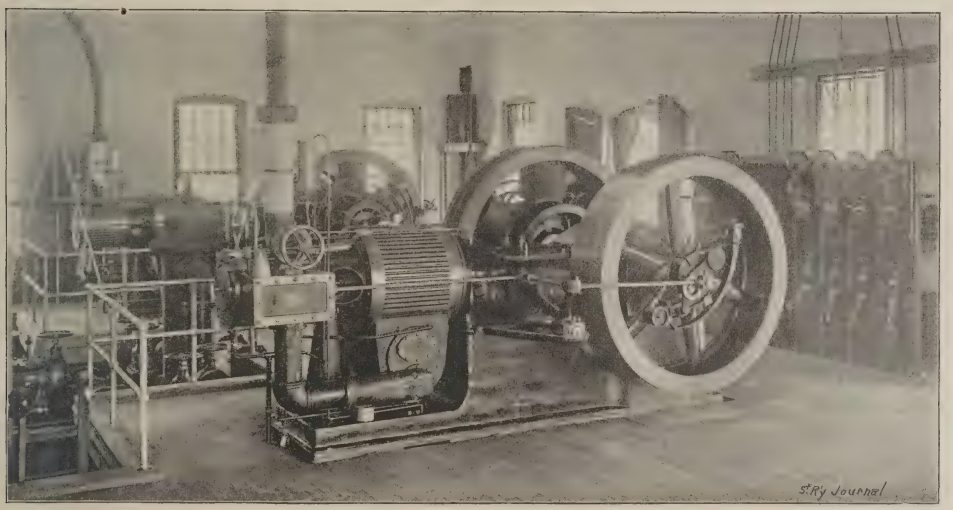
Vol. XIII. *NEW YORK AND CHICAGO, SEPTEMBER, 1897.* *No. 9.*

ELECTRIC RAILWAYS IN CHARLESTON.

For several years past, the city of Charleston, in the state of South Carolina, has enjoyed the curious distinction of being the only city in the United States of 35,000 inhabitants or over which has not within its borders a single mile of electric railway. Horse railways it has had, and that too from a very early period, the older of the two local companies claiming to be the primeval street railway of the United States—even antedating the New York & Harlem Railroad organized in 1832. But, although many efforts have been made to bring about a consolidation of these two systems and their equipment by electricity, the prices asked for the properties have been considered by capitalists too high, and until the past twelve months all these efforts at consolidation have been fruitless. Individually, the companies appear to have been unwilling to venture into paths to them unknown, but have been contented with moderate returns on invested capital. The result of this conservative policy is seen in the extremely small area in which the population of Charleston resides, and the lack of local expansive energy tending to bring about increase of population and of business. It may not be entirely due to poor internal transportation facilities, but it is certainly significant that the population of the city by the census of 1890 was but 54,955, as against a population thirty years before of 40,522, and in 1880 of 49,984—a relatively small increase in population as compared with other cities. It is not hard to predict that electric traction will materially brighten up the city and put new life into its commercial and business relations.

It has often been said that Charleston is a miniature New York City in certain physical characteristics, and the resemblance will be clearly seen in the accompanying map. In the first place, the city is a long and narrow peninsula, with its main streets running lengthwise of this peninsula. Two rivers, the Ashley and Cooper, wash its eastern and western shores and meet at the "Battery," otherwise known as White Point Garden, which is almost as much a popular place of promenade as is New York's famous Battery, though with a difference, since in Charleston the exclusive and aristocratic residential section is around this beautiful tip end of the peninsula, while the business sections are well inland.

In Charleston harbor are three forts, Castle Pinckney, Fort Sumter and Fort Moultrie, each on islands in the harbor, and the harbor is further protected by a sand bar extending across its mouth, through which are two entrances, one of 18 ft. depth at low water.



INTERIOR OF POWER STATION.

The surface of the city is but 9 ft. above the sea level at high tide, and for the larger buildings piling has to be resorted to. The streets are wide and beautifully shaded, while there is infinite variety in the residences and public buildings. Three railroads have terminals in Charleston, and on the water front are excellent warehouses and terminal facilities recently obtained.

The Charleston Street Railway Company, which controls the entire city system, was chartered in 1896 to build new lines paralleling almost all the old ones in such a way as to practically force consolidation upon the latter upon terms less favorable to the old companies than had previously been demanded. As a result of this combination, it has been found possible to abandon certain portions of the track, and to lay out the lines of the new electric sys-

tem to somewhat better advantage than if the new mileage contemplated had actually been built in addition to the old. The new system is shown in the map, from which it will be seen that there is but one line at present running outside the city limits, this line going about 5 miles into the country past many negro settlements and through large truck farms to the phosphate mills at Ashley River.

On Sullivan's Island is a small line of 2½ miles, which is not a part of the consolidated system. This island has a summer population of from 3000 to 4000, drawn almost entirely from Charleston proper.

Roadbed.—The present track is not uniform in type and weight of rail, but is made up of several different sections, including both T and girder.

The best roadbed construction is of 9 in. girder rail, of which nearly 5 miles is already laid, including much of the special work. There is also about 8 miles of 7 in. girder rail, 5 miles of 6 in. girder rail, and between 7 and 8 miles of 4¼ in. T rail. The rails were furnished by the Cambria Iron Company, the Johnson Company and the Pennsylvania Steel Company, the latter furnishing nearly all the special work. The distribution of this track and the general arrangement of double and single track, turnouts, feed wire, etc., is shown in the diagram, page 520. The present system consists of about 24.5 miles of track, and an addition is now building to Chicord, a distance of about 1¾ miles.

The illustrations of track work during construction given herewith, show also in a very interesting way the varying character of buildings in Charleston and the peculiarities of the surrounding country.

Cars.—The traffic on the system is carried on at present with seventeen closed cars, eight open cars and one special car. All are of the center aisle, cross seat type and are proving very popular in Charleston, partly because of the pleasure in riding forward, and partly because this type of car lends itself better to the peculiar race conditions found in Charleston than the side seat cars. The closed cars and the special car were purchased from the Laclede Car Company and the open cars from the American Car Company. Peckham Excelsior, 7 C trucks are used with 7 ft. wheel base and 33 in. wheels.

Car House.—The car house is located on a lot 184 ft. × 312 ft., at the corner of Meeting and Pointset Streets. It is built of brick and its outside dimensions are 68 ft. × 256 ft. An office building 17 ft. × 71 ft. is built alongside the car house. The distance from top of rails to under side of roof trusses is 18 ft. The car room is 65 ft. × 209 ft., and there are armature and store rooms and a repair shop at the rear end of the building. The main car room contains three pits, each 100 ft. long, and the repair shop contains two pits 26 ft. long.

The floor of the car house is 11.5 ft. above low tide. On excavating for foundations water was encountered a few feet below the surface, and the ground was found to be a fine sand, mixed with loam, and of very little supporting power. To avoid piling, the foundations were not carried more than 2½ ft. to 3 ft. below the surface. Test pits, excavated to a depth of 6 ft., led to the conclusion that shallow foundations would be likely to cause less trouble from settlement than deep ones. Under all the exterior walls there is laid a footing of Portland cement concrete 3 ft. 4 ins. wide and 2 ft. thick. On this concrete footing the brick footings are laid and the structure completed in the usual manner, no other precautions being taken to prevent settlement or cracking of walls. Below the ground line all brick work is laid in cement mortar, and above the ground line in lime mortar. All interior partition walls are brick and rest upon concrete footings, similar to those under the exterior walls. The walls of pits are of brick, laid in cement mortar, and all pits have concrete bottoms.

The floor of the car room and the floor of the paint shop are concrete, with a finishing coat of Portland cement mortar, troweled smooth and flush with tops of rails. All exterior walls are 12 ins. thick in panels, and are 20 ins. thick at pilasters. The roof trusses are of steel and the roof covering is No. 20 corrugated iron. A monitor 27 ft. wide extends the whole length of the building, and all sashes are arranged to be opened and closed from the floor. The interior walls are kalsomined, and the trusses and under side of corrugated covering are painted a light color.

The car house contains five tracks, 11 ft. × 6 ins.

apart between centers, and the center of one side track is 12 ft. from side wall of building to allow room for convenient handling of repair parts and to form a passage way to rear of car room.

The office building contains superintendent's office, conductors' and locker room and shower baths. Basins and shower baths have been liberally provided for the purpose of encouraging personal cleanliness on the part of the employes.

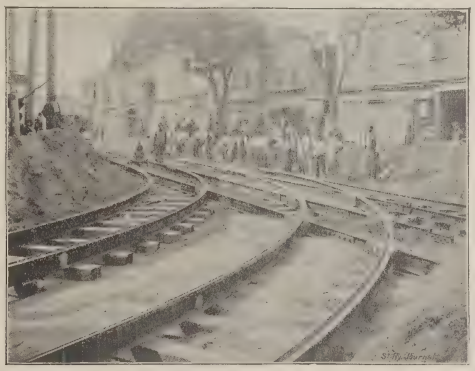
Power Station.—The power station is located on a lot 300 ft × 355 ft. fronting on Meeting Street and directly opposite the lot on which the car house is built. About half the lot is under water.

In designing the power plant the object aimed at was to secure a thoroughly substantial and reliable plant, with the least possible expenditure of money. The building is a plain, substantial brick structure, designed for the sole purpose of housing the machinery. It is 68 ft. × 85 ft., and contains a boiler room 45 ft. × 65 ft. and an engine room 36 ft. × 65 ft. The exterior walls are of brick 16 ins. thick in panels, and 20 ins. thick in pilasters. The foundations and concrete footings are similar to those of the car house. The partition wall between the boiler and engine rooms is of brick 12 ins thick, with pilasters 16 ins. thick. The clear height between floor of boiler room and under side of roof trusses is 22 ft. The engine room floor is 4 ft. 6 ins. above the boiler room floor. The roof trusses are steel, and the roof covering is No. 20 corrugated iron. The roof is continuous over both engine and boiler rooms and a monitor 27 ft. wide extends nearly the entire length of building.

The floor of the engine room is constructed of 10 in. × 12 in. joists on brick piers; the under floor is of 4 in. thick plank, and the top floor is of 1 in. maple. The floor of the boiler room is brick, laid on edge on a 4 in. bed of concrete, and grouted flush.

All interior walls are rubbed smooth and kalsomined in a light color. That part of the roof over the engine room is ceiled with hard pine, nailed to spiking pieces, which are bolted to the steel purlins, and the ceiling has a hard oil finish.

The boiler room contains two 200 h.p. Babcock & Wilcox boilers, set in one battery, and one 200 h. p. boiler in a separate setting. Provision has been made for two 300 h. p. Babcock & Wilcox boilers, which will be installed later. There are two Deane 7½ in. × 4½ in. × 10 in. duplex boiler feed pumps, and one 7½ in. × 6 in. × 10 in. duplex tank pump. The engine room contains two Ball & Wood 14 in. × 27 in. × 16 in. tandem compound condensing engines, and two direct connected 200 k. w. General Electric generators, running at 200 revolutions.



VIEWS IN CHARLESTON, SHOWING TRACK WORK DURING CONSTRUCTION.

The foundations for engines are carried on piles, about 3 ft. apart, and driven to refusal. Piles were also driven for foundation for a 500 h. p. engine to be installed later. The heads of piles under each engine are encased in a bed of Portland cement concrete, 3 ft. thick, forming footings on which to commence the brick foundations proper. The footings for the partition wall between engine and boiler room are carried about 8 ft. below floor of boiler room, and form one wall of the condenser pit in engine room.

The walls of the condenser pit are of brick laid in Portland cement mortar, and the bottom is Portland cement concrete 18 ins. thick. Owing to the bottom of the con-

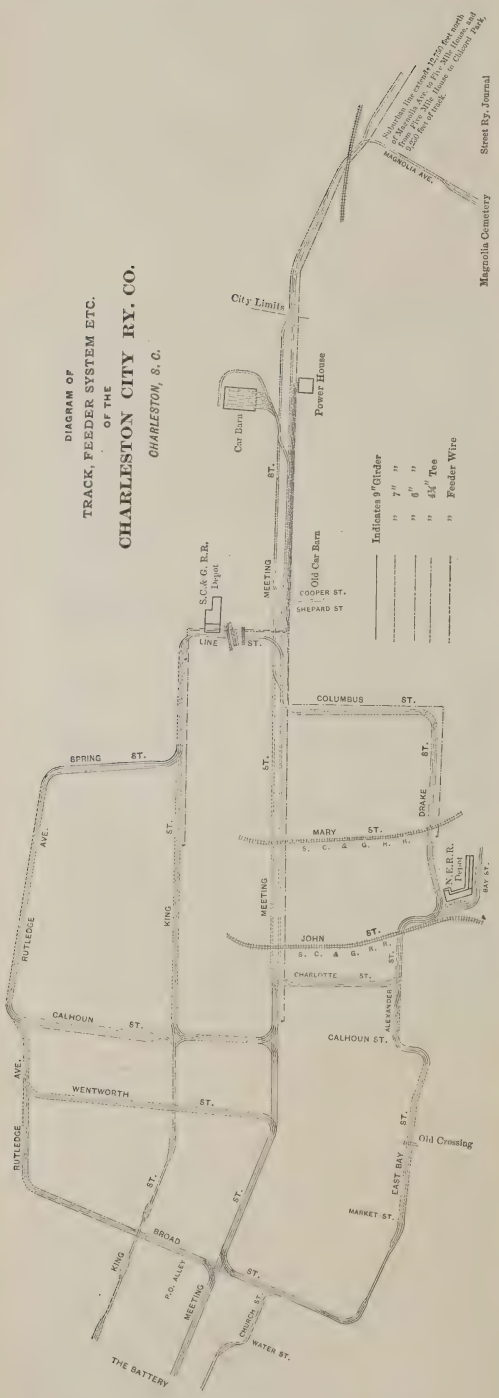


FIG. 1.—DIAGRAM OF TRACKS, SHOWING CHARACTER OF RAILS AND SPECIAL WORK.

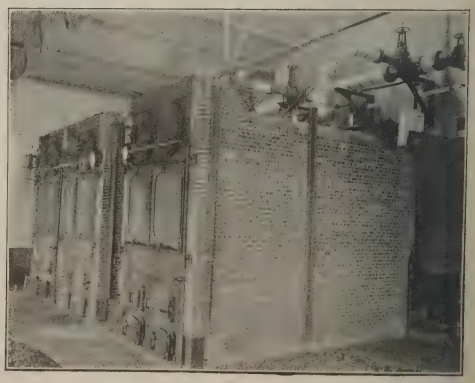
denser pit being level with high tide, and at least 3 ft. below ground water level, it was necessary to construct it watertight and to provide a steam ejector for removing any water which might escape from pumps and condenser. The walls of the pit are independent of engine foundations. The Deane vacuum pump and condenser size, 12 in. × 22 in. × 24 in. is used, with the Deane exhaust relief valve. The boilers, piping, engines and auxiliaries were designed

CAR HOUSE.

to be operated under 175 lbs. steam pressure. All piping is full weight standard pipe, or extra heavy, and all steam fittings, larger than 2½ ins. are gun iron, having a tensile strength of not less than 29,000 lbs.

Stratton separators are used on steam pipes to engines, not so much to take care of condensation as for protection against possible priming due to bad water.

There is one 600 h. p. vertical Goubert feedwater heater in the condenser pit, and the exhaust piping from engines is arranged so that exhaust may be passed through the primary heater and condenser, or through the primary heater to the atmospheric exhaust, or directly to the condenser, or directly to the atmospheric exhaust. The injection water inlet to the condenser is 19 ft. above the supply. A 4 in. priming pipe connects with the general



BOILER ROOM.

water supply system, and enables the condenser to be readily started.

A bridge spans the condenser pit at the point at which valves in the injection, priming and steam pipes are located. The steam supply to the condenser is led around so that all the valves controlling the operation of the condenser are located within easy reach of the operator when standing on the bridge referred to. A valve is also placed in the steam pipe close to the condenser, so that its operation may be controlled from the floor of the pit.

The exhausts from the condenser, and from all pumps,

discharge into an auxiliary exhaust pipe which connects with a 600 h. p. vertical Goubert supplementary heater set in boiler room and with the atmospheric exhaust. The main atmospheric exhaust pipe is 14 ins. in diameter and extends above the roof of power house, where it terminates in a condenser head.

All drips from the high pressure steam system are led to a Deane receiver and duplex plunger pump, which automatically returns to the boilers the water of condensation. The feedwater piping is 3 in. extra heavy and is arranged to pass the feedwater through the primary and supplementary heaters, or through either of them, or directly to the boilers. Owing to the fact that the best feedwater obtainable contains a large amount of salt and scale forming impurities, provision has been made for installing a feedwater purifier later, if it should be found necessary to do so.

In the engine room there is a gage board, having steam and vacuum, needle and recording gages.

There is a steel chimney 125 ft. high and 7 ft. diameter at top erected on one side of boiler room, about 5 ft. from building, and a plate iron breeching connects the boiler settings with the chimney. The main damper in the breeching is controlled by a Spencer automatic damper regulator, placed in the engine room. The steel chimney is lined throughout, and the flaring bottom section is filled in solidly to increase stability. The chimney foundation consists of piles, capped with a bed of concrete, 21 ft. square, supporting the brick base, as shown in Fig. 2.

A 30,000 gal. wooden tank, erected on a wooden tower, 20 ft. high, alongside the power house, supplies feedwater for the boilers. A 30,000 gal. wooden tank, erected on a steel tower, 39 ft. high, alongside the car house, furnishes the water supply for car washing and fire protection. Two and one-half inch hose valves are located in the car house and in the power house, at the points shown in Fig. 4. The discharges from the three pumps in the boiler room are so arranged that any one, or all of the pumps, can be used to feed the boilers or to pump into either of the tanks and the fire protection system of piping. The tank on the 39 ft. tower alongside car house is supplied through the general fire protection system of piping. The 6 in. rising pipe, shown in the manhole, connects directly with the bottom of the tank alongside the car house. The 2½ in. general supply passes through the bottom and terminates about 8 ft. above the bottom of this tank. This 2½ in. general supply supplies water for car washing and other purposes, and the object in carrying it 8 ft. above the bottom of the tank was to prevent the possibility of the tank being emptied through this pipe, leaving no water for use in case of fire. In order to obtain for fire purposes a head of water due to a 100 ft. tank tower, and at the same time, save the difference in cost between

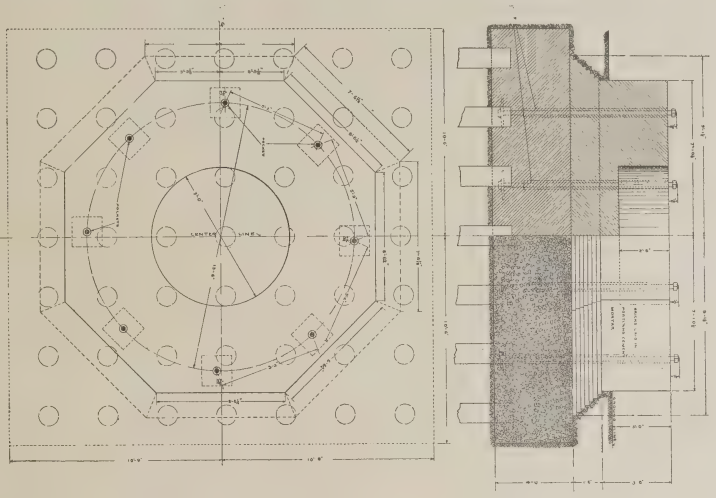


FIG. 2.—PLAN AND ELEVATION OF STACK FOUNDATION.

EXTERIOR OF POWER STATION AND CAR HOUSE.

a tank on a 100 ft. tower and one on a 39 ft. tower, the arrangement of piping shown in the manhole was devised. With all hose valves closed the pumps deliver into the fire protection system of piping until the pressure reaches 50 lbs., at which pressure the automatic relief valve opens and the water passes through it and into the tank, through the 6 in. rising pipe. In case of fire occurring at a time when the pumps are not delivering into the fire protection system of piping, on opening any of the hose valves, water will be supplied from the tank, through the 6 in. horizontal swinging check valve shown, until the pumps are started and deliver more water than can be discharged through the hose, when the horizontal swinging check will close, the pressure will rise to 50 lbs. and the surplus water will pass through the relief valve to the tank. In case of accident to pumps during a fire, the horizontal

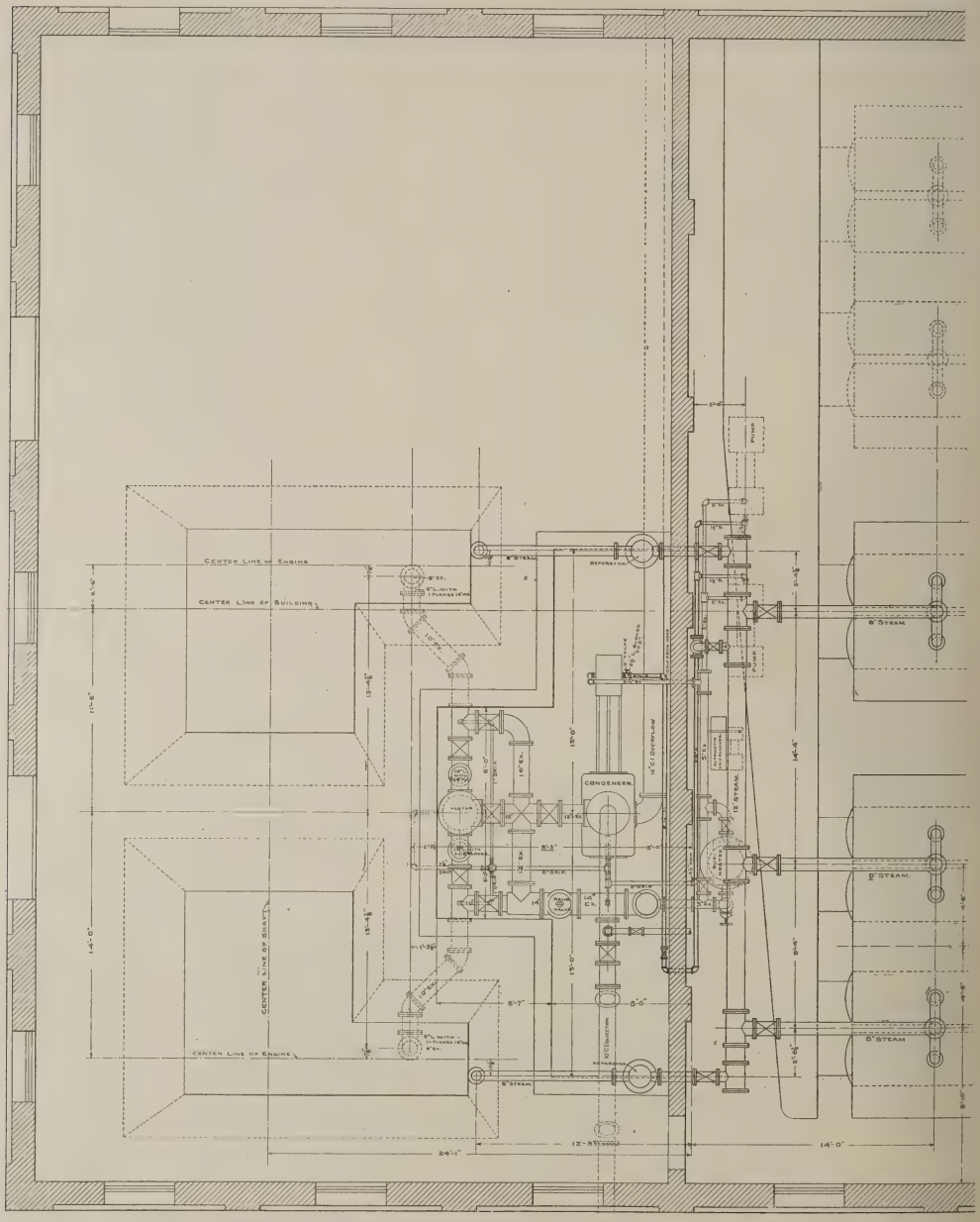


FIG. 3.—PLAN OF STATION PIPING.

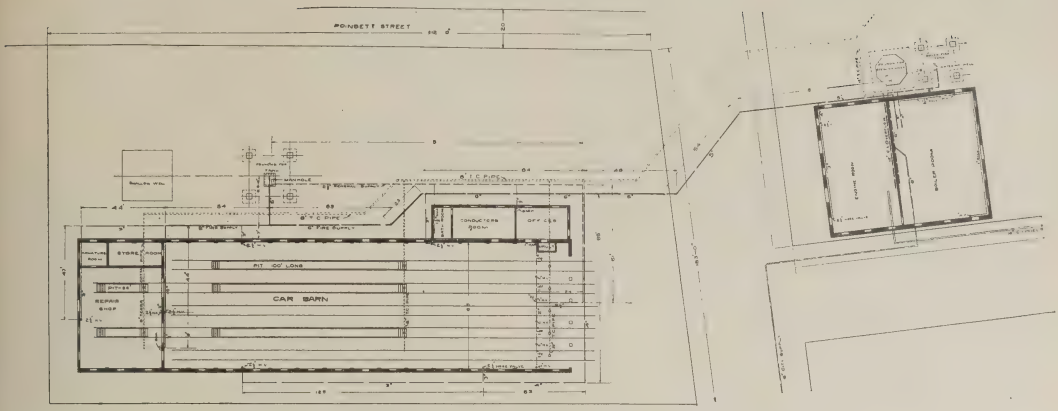


FIG. 4.—PLAN OF CAR HOUSE AND POWER STATION,

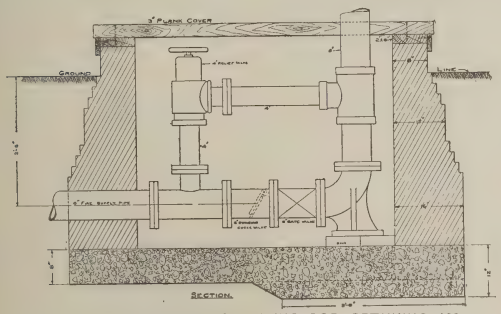


FIG. 5.—ARRANGEMENT OF PIPING FOR OBTAINING 100 FT. HEAD WITH 39 FT. TANK.

swinging check valve will render all the water in the tank available, but under reduced pressure. Each hose valve is provided with 100 ft. of 2½ in. hose and a 1 in. nozzle, with the exception of the two hose valves in the engine room, which turn down and discharge directly on the floor. A base about 4 ins. high has been constructed around the condenser pit to support the railing and to act as a dam in case it should be necessary to flood the floor of the engine room on account of fire. The floor of the engine room being the only combustible part, provision was made for flooding it, and the hose was excluded.

It is interesting to note that the problem of designing and building the power station was given to J. G. White & Company, the general engineers and contractors, on Feb. 1, 1897, and on July 1 the station was put in operation —an extremely rapid piece of construction work.

The contract for steam piping was sublet by J. G. White & Company to Basshor & Company, and a very creditable piece of work has been done.

The officers of the company are: president, P. H. Gadsden; secretary and treasurer, F. D. McEowen; auditor, P. J. Balaguer; general superintendent, Theodore W. Passailaigue. Among the directors are a number of well known Northern men, including Trainor L. Park and F. B. Jennings.

THE Meadville (Pa.) Traction Company, whose proposed line runs from Meadville to Erie, has let the contract for construction of its road from Meadville to Edinboro, 22 miles, to the Walker Engineering & Construction Company, of Philadelphia, Pa. Its bond issue of $300,000 was placed by C. Townsend Blake with New York capitalists and work upon the construction has already been begun. Geo. D. Trawin is president, and Frank R. Shryock secretary of the company, whose office is at Meadville, Pa.

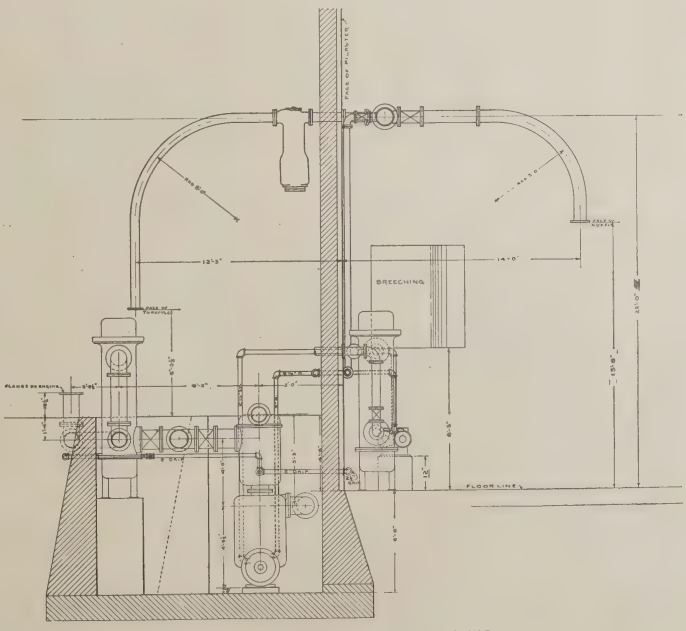


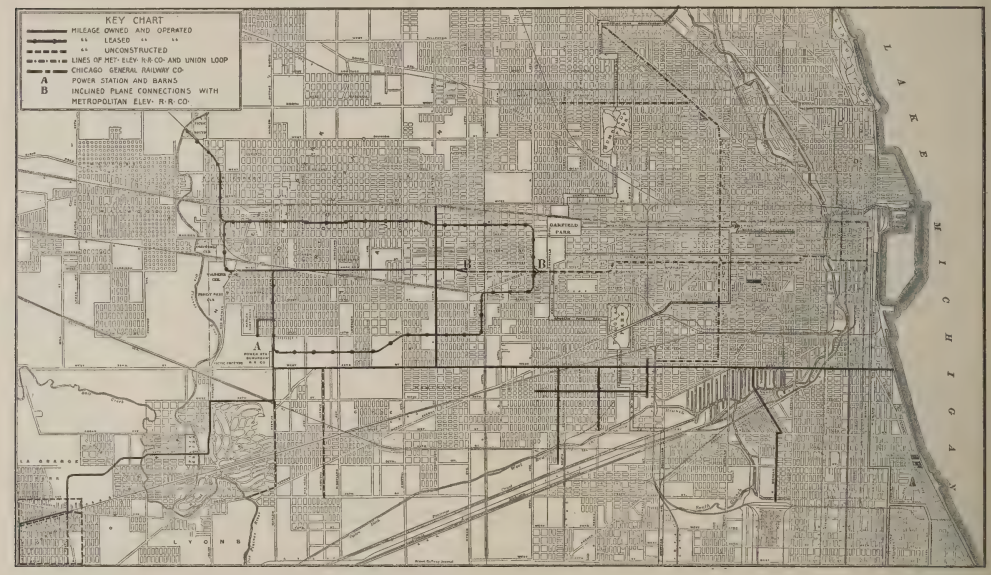
FIG. 6.—ELEVATION OF STATION PIPING.

The Suburban Railroad of Chicago.

Within the past month the Suburban Railroad Company of Chicago began operating the first electric cars over its lines, which are located in the western suburbs of Chicago, and which have been under construction for a year past. A considerable part of this system consists of sections of steam roads equipped for operation by electricity. In all there are 8 miles of single and 23 miles of double track. The sections which were formerly steam roads and which have been equipped electrically are 2 miles of the main line of the Wisconsin Central Railroad and 15 miles of the Chicago & Northern Pacific, 9 miles of which is double track. No changes were made beyond suspending a trolley over the track and bonding the rails. Steam cars will still be operated over a part of these tracks, and on this account special attention was paid to the hanging of the trolley wire. These sections of steam roads are not owned by the Suburban Company, but secured by lease for a period of fifty years.

which it will serve. Along the La Grange line the road reaches the popular Desplaines River and Salt Creek resorts. The villages of Riverside and La Grange are among the most beautiful of Chicago suburbs and will attract large crowds for evening excursions and trolley parties. Altenheim, a famous German resort, is served at its doors. The many cemeteries in the western suburbs of the city including the Waldheim, Forest Home and Concordia are served by the Suburban in a direct air line from the business districts and the time of transit is less than by any other route. A special spur reaches the Harlem race track, and the large crowds attending have already taxed the capacity of the line, while the crowds of Sunday excursionists speak well for the road's future.

It is the intention to establish a graded system of fares. The highest fare will be ten cents, and will take a passenger from La Grange to the city, this fare including a transfer over the Metropolitan Elevated Railroad to the Union Loop. On the Suburban system alone the fare will be



MAP OF THE SUBURBAN RAILROAD LINES—CHICAGO.

Nearly the entire system lies without the city limits and reaches the downtown district over the Lake Street and Metropolitan elevated Railway. It is the intention to build inclines to connect with the Elevated roads and to carry suburban passengers to the city and around the Union Loop without change of cars. Connection is also made with the Chicago General Railway running east and west on Twenty-second Street and crossing all north and south lines of the south side of the city. Should a transfer arrangement be made between the Suburban, the Chicago General and the General Electric Companies (in the event of the building of the last named company's lines), the latter roads would constitute another entrance into the business district.

The population which is accommodated by the Suburban Railroad is understood to be nearly 200,000 people living in the towns of La Grange, Riverside, Grossdale, Oak Park, Hawthorne, Ridgeland, Austin and Harlem. In addition to its regular daily business, it is expected that the road will be patronized by pleasure seekers on account of the scenery along its route and the many picnic grounds

five cents. The Chicago, Burlington & Quincy Railroad charges passengers from La Grange to Chicago fifteen cents on the commutation plan, or forty-two cents for a single trip ticket.

A fifteen minute service is the rule on the Suburban Railroad, but special cars and trains are run whenever the occasion requires.

The power house, located at the intersection of West Twenty-second Street and Harlem Avenue, is almost exactly in the center of a circle whose circumference touches the three extremities of the system. It is 96 ft. × 100 ft., with a solid brick partition separating the engine and boiler rooms. The stack is of steel, 147 ft. high and 8 ft. in diameter inside the brick lining. The base is brick resting on a concrete foundation. No trouble was experienced with foundations, as a bed of dense blue clay lies a few feet below the surface. Everything has been arranged with a view to largely increasing the capacity of the power house, there being room for two additional engines and several extra boilers.

The engines are tandem, compound condensing, of

540 h. p. and 260 h. p. respectively, and direct connected to 400 k. w. and 250 k. w. Walker generators designed to run at 100 r. p. m. Three 250 h. p. Stirling boilers are at present installed, two furnaces being fitted with Meisner automatic stokers.

The power house is situated at a long distance from the city water mains, and even if water were near, the surported by a single span fastened directly to the poles; half way between the poles the trolley wire is attached by a hanger to this second and parallel wire, thus making a support every 55 ft. In putting up the overhead work the Patton motor was used almost exclusively. Chicago and Atkinson bonds are used.

The feeders are all carried overhead and are 350,000

SCENES ON THE SUBURBAN RAILROAD—CHICAGO.

rounding territory is so level as to make the disposition of condensing water a serious problem. For this reason, a pool 100 ft. × 200 ft. was excavated to blue clay, which forms a watertight floor; the sides are walled with brick. The condensing water is supplied to this reservoir from an 8 in. well 185 ft. deep, the water being raised by compressed air.

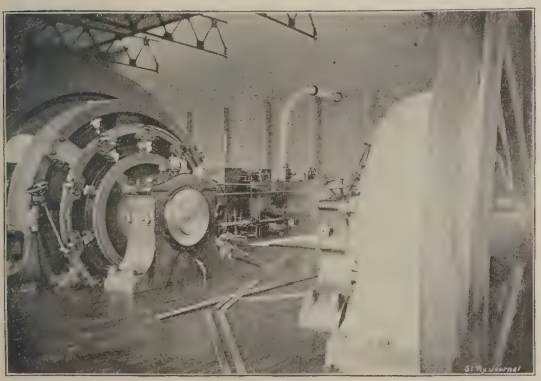
After the water has passed through the condensers it is returned to the pool and poured upon a cooling table, which is 30 ft. wide, by 182 ft. long and has three shelves, one above the other and sloping in opposite directions. The water runs the full length of each before it falls back again into the reservoir. The condensing water strikes the table at a temperature of about 100 degs. F., and is reduced to about 70 degs. F.; this reduction will, of course, be exceeded in winter. The capacity of the reservoir is such that the water is used but once in eighty hours.

and 500,000 c. m. in diameter. The pressure at the generator terminals is 650 volts.

All new track is laid with 70 lb., 7 in., 60 ft. T rails.

The car house, located within a short distance from the power station, is 114 ft. × 225 ft., containing ten tracks, also offices to which employes report, and repair shops.

The rolling stock consists at present of fourteen motor cars and ten trailers. These are all of Pullman manufacture, are 42½ ft. long and have vestibules at both ends. All are fitted with Van Dorn automatic couplers, McGuire trucks, Hale & Kilburn rattan seats, Gold hot water heaters, New Haven registers, Stanwood steel steps and



INTERIOR OF POWER STATION—CHICAGO.

EXTERIOR OF POWER STATION.

The overhead construction does not differ materially from that in ordinary use except over those portions where steam cars will still be run as well as electric. Here a special effort has been made to guard against a falling wire. The poles are cedar, set 110 ft. apart and 8½ ft. from the track center. Each pole has a cross arm which supports two span wires 18 ins. apart and each having a separate connection with the trolley wire. Two feet above the trolley wire and parallel with it is a steel wire sup-

Christensen air brakes. The air compressors, with one exception, are driven from the axle and are giving good results. The air pressure is maintained at 80 lbs. and falls less than 2 lbs. in making a stop from full speed. One car is fitted with a motor compressor. Each car has two trolleys, the rear one only being used. The seating capacity of the cars is forty-eight persons. The two 50 h. p. motors on each car are of Walker manufacture, designed for a speed of 40 miles an hour. In a recent test a 40 ton

train starting from rest at the beginning and coming to rest at the end of 1 mile, covered the distance in two minutes and twenty seconds, showing the high accelerative power of the motors.

The Suburban Railroad Company was incorporated in 1895 with a capital stock of $1,250,000. The construction was undertaken by the Suburban Construction Company which in turn let the contract to Naugle, Holcomb & Company, who contracted to build and equip the road and operate it for two years. George Weston, manager of the construction department, has had charge of the entire work, including not only the design, but equipment and operation as well. He has been assisted by Chas. Chapman in charge of the design and construction of the power house, W. H. Holcomb, assistant superintendent, and I. B Walker, electrical engineer.

European Electric Railway Notes.

(*Special Correspondence of the Street Railway Journal.*)

The rapid demand for electrical installations in Europe has increased at a rate which renders it almost impossible for some classes of non-electrical manufacturers interested in such work to keep up with it. While boiler makers, and the furnishers of steel tubes for railway poles, cables, car bodies and trucks have increased their capacity, the builders of steam engines, for example, seem to have kept behind. It is almost impossible to get steam engines for power stations from any of the better makers within twelve months, as they are all overcrowded. American steam engine builders who want to take advantage of this situation should not content themselves with merely sending offers to Europe, or giving agencies to houses unacquainted with their special systems, but should come over themselves and see just what the Europeans want, and endeavor to suit the special conditions here. In fact, there are a great many European electric firms who would place orders in America from very necessity, if they knew what they would get there. There are American firms who have sent a good many engines to Europe, but who have never taken the trouble to look up their customers on the spot.

Recent articles, for instance, one in *Harper's Magazine*, for May, and the *North American Review* for last January, on the subject of the American export trade, have brought out very clearly the one point which English and German exporters never forget, namely, the necessity of personal contact with their customers. The fact that Americans have still very much to do in this direction is also fully recognized by American consuls abroad.

Experience abroad teaches one that American firms, as a rule, pay but little attention to proper packing and the best facilities of transport. Tramp steamers and insignificant lines should be avoided, because they frequently reship and the goods lie at intermediate ports, causing disastrous delays.

The Society of German Street Railway Managers met at Hamburg from Aug. 3 to 9. An interesting feature of this meeting was an exhibition, which was more largely contributed to than ever by firms installing electric railways. The Hamburg Street Railway Company (the manager of which is also president of this society) excited a great deal of interest among visiting delegates, inasmuch as it has the most extensive electric railway system in Europe, with over 400 cars in operation, to which additions are being made continually. The Hamburg Company, which is a model of good organization, has, for some time, built its own car bodies, and has of late been furnishing car bodies for a great many other street railway companies, thereby taking profitable advantage of its shops and technical corps.

As is already well known, the Berlin Tramway Company, after a long fight with the city authorities, has now settled upon its new contract. This prolonged discussion was not due, by any means, to a disinclination on the part of the company nor the public to introduce electric traction. Three electric lines have been running in Berlin for a year, with about 200 cars altogether, partly on the overhead system and partly on the underground conduit system, and the public are very anxious for a general introduction of electric traction. The Tramway Company practically agreed over a year ago to use the mixed system of accumulators and trolley, so that the cars would run in the better portions of the city without the trolley. But the fight has been chiefly over a number of points of advantage which the city tried to secure, in compensation for a lengthened franchise which the Tramway Company demanded in view of such extensive outlays of capital for new installations. The discussion was especially severe regarding the distance over which other companies might use the tracks of the larger company, together with the per centage of the gross income (and one-half of all profits over 6 per cent on the new shares and 12 per cent on the old shares), which the Tramway Company has to give to the city.

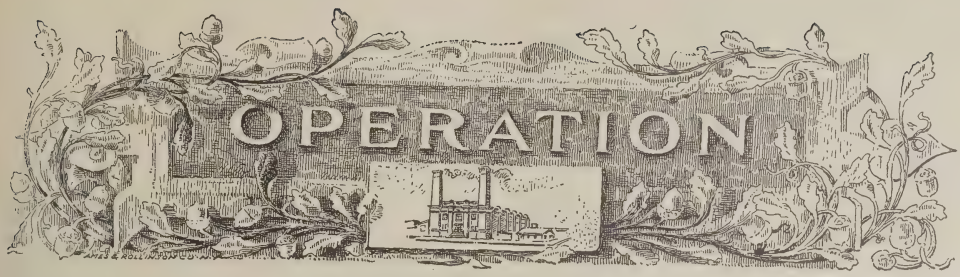
Travelers who perhaps see no other city in Germany besides Berlin, assume that Germany has not yet awakened to the advantages of electric traction. This is, of course, a false conclusion, in view of the extensive electric service in Hamburg, and also in view of the fact that nearly every city and even town of any importance in Germany, either has electric traction or is in active negotiation for its installation.

The great banking groups which stand behind the electric companies, and which have made so much money already in tramway enterprises, have bought out a great many tramway companies, and caused electricity to be introduced. In many cases this method was not necessary, inasmuch as the tramway companies themselves, being managed by wide awake and efficient men, early recognized the advantages of electric traction and purchased their equipments outright.

A notable example of tramway financing is to be found in Vienna. The tramway company there has been at swords' points with the city authorities for many years; a line running across the city was recently installed, and gave the greatest satisfaction to the public, but no arrangement could be arrived at for the general introduction of electricity. Some very lively transactions in the shares of that company have been going on recently, and the German bank in Berlin, which stands behind Messrs. Siemens & Halske, recently purchased the majority of the shares.

The city of Frankfort received tenders from most of the electric firms last spring, but nothing has been decided yet. The Frankfort city fathers are in the habit of giving all such matters due consideration. It will be remembered that in order to settle the question of their electric lighting works some years ago, they organized a grand exhibition, at which most of the German firms made exhibits of an exceedingly imposing nature and at great expense. A long fight ensued over the merits of the various competing systems, and the experts for the town, namely, the city engineer, a man of experience and reputation in matters pertaining to buildings, pavement and city sewage, on one side, and on the other side an experienced electrician, were unable to agree on the correct system for Frankfort, and the result was that a Swiss firm carried off the order. The electric lighting station of Frankfort is one of the best planned and most economically operated plants on the continent, and is managed for the city by an American engineer.

The evident success of the mixed system of trolley and accumulators (whereby the latter are charged whilst the car is running on the outlying trolley line) at Hanover and Dresden, and the adoption for the same arrangement for Berlin, has given rise to great activity in the manufacture of accumulators, and several new lines are to be constructed on this principle. Nobody has as yet been able to show a safe and sure closed conduit system. A recent experiment in this direction in Munich, made according to the Benack idea, resulted in an abject failure, as the necessary precautions pertaining to systems of this kind seem to have been overlooked in its development.



Electric Cars, Car Houses and Car Repairs in San Francisco.

By S. L. Foster.

The work done by the Market Street Railway Company during the years 1894, 1895 and 1896 in building electric roads in San Francisco has been referred to by the writer in previous numbers of the Street Railway Journal. In the following a brief account will be given of the cars and the system of car maintenance practiced by this company, more particularly with reference to the electrical features of the subject.

The first lot of cars built by the Market Street Company were partly double truck and partly single truck. Both were open front, and of each type there were some all open, as well as partly open and partly closed cars. The limits of this article will not permit of a discussion of the double truck versus the single truck car. Suffice it to say the Market Street Company needed but one short month's experience to learn all the points in the discussion unfavorable to the double truck—the extra weight, extra current, extra repairs, extra inertia, extra lights, extra difficulty in ascending grades from reduced traction, extra accidents, and last, and not by any means least, the liability of extra fares lost. The good features of double truck cars—the superior smoothness of their running on rough track and lesser wear on curve rails—were not appreciated, because the roadbed was most solidly constructed on a rock foundation and was free from low joints, and because there were no curves of a less radius than 60 ft. The difference of wear between the wheels of double and single truck cars was thus not noticable.

FIG. 1.—STANDARD SINGLE TRUCK COMBINATION CAR—SAN FRANCISCO.

The futility of running all open cars was also soon shown, and a middle section of the open cars was enclosed. In San Francisco the mornings are usually pleasant and the evenings almost always cool, from the fact that the city is situated on a peninsula and surrounded on three sides by cold sea water. During the summer afternoons there is usually a strong wind from the ocean, and occasionally fog in the evenings. The results of these meteorological conditions are that most of the passengers want to ride outside in the morning and inside at night. There is a class of fresh air enthusiasts who want to ride outside all the time, and a class of weak lunged people who always ride inside, but at no time does everyone want to ride outside or everyone inside.

In the Eastern states it is customary to use all open cars in summer and all closed cars in winter, having half as many trucks and motor equipments as car bodies and trading bodies as the seasons change. In San Francisco it is a question of how to have all open cars in the morning and all closed cars at night, with a half and half arrangement for afternoons. The plan of trading car bodies being out of the question, a combination or compromise car was devised, consisting of a closed section in the middle and an open section at each end. The advantages of a glass front to protect the motorman, controller and sand boxes as well as smokers and other open air riders, had been shown in the East and on some local roads, and this feature was added. The whole was then put on a single truck and the company had a standard electric car which has been adhered to in the construction of the last 150 cars.

Bumpers were put at either end of the car to protect the glass front in cases of collision with wagons or other cars. Electric headlights were used on the hoods because the wiring was simpler than if the headlight had been put below; the headlight was safer and with a 32 c. p. lamp in it, as is the company's practice, the light was found to be sufficient. The car lighting was entirely electric, as it was found that where kerosene was carried as a safeguard in case of interruption of the current, the oil was never used and the lamp superfluous; besides the wiring in combination lamps was found to cause much trouble.

The lever brake was adopted, partly as a good feature of the cable system that could not be overlooked and partly because in the cramped space between glass front and the backs of car seats no other brake would answer the purpose so well. This was not the only reason for its use, for the lever brake has advantages over all other forms of brake, in that it is quicker, more sensitive, occupies less space for its action and is more effective. When the current is cut off and the motorman's hand is on the lever, absolutely no time is lost in the continuous application of the brake at its full leverage. With any form of rotary brake there are points where the force used is that of the

arm or shoulder muscles only, which is much less than when these muscles are aided by the weight of the body thrown forward or backward. With the lever brake the arm or arms act merely as straps to connect the body to the brake, and from the time the body is thrown back until the limit of the brake is reached, there is no diminution of the pull and all the time it is the maximum pull of which the man is capable. That the rotary brake is sufficient to stop the car is without question, but when a car is going at 9 miles an hour (or 14 ft. per second) and one second is saved by using the lever brake, 14 ft. of advance are saved and this may mean the difference between escape and a heavy damage suit. The favorable comparison between San Francisco and Eastern cities, where rotary brakes are used on electric cars, in the matter of accidents, is to be ascribed in a great measure to the use of the lever brakes in this city. In descending grades a motorman using the lever brake can tell with remarkable accuracy when the wheels are slipping and by the release of a fraction of an inch on the quadrant let them revolve again and prevent their becoming flattened.

Each car is furnished with four sand boxes of the tipping type, two on each end, one for each rail. These are indispensable for climbing and descending the heavy grades that prevail in the city, but are equally necessary on the level on foggy, "greasy" days or in the case of quick stops. This type of box is preferred to others as the sand is always dry, cannot leak out of the box nor fail to feed when needed.

Overhead gongs are used. Foot gongs were tried, but abandoned as inadequate. On some crowded streets the cars have overhead "rotary" or "rattle" gongs reinforced by automatic gongs below. These automatic gongs are actuated by an eccentric on the car axle and the mechanism is thrown into action by the motorman's foot as he approaches the street crossing and thrown out as he passes it. His hands are thus left free for controller and brake, or perhaps an occasional blast from his rotary gong when a teamster is unusually slow.

Stationary registers are used on all cars, the last 150 being equipped with registefs recording both transfer and cash fares.

All but five of the 215 motor cars are equipped with G. E. 800 or W. P. 50 motors and K controllers. Of those five have Westinghouse 12 A equipments and one Walker motors. Thirty inch wheels, steel gears and steel pinions are used on all cars. The trucks are of the latest Peckham and Brill manufacture.

FIG. 3.—ELECTRIC FREIGHT CAR.

Besides the regular passenger cars the company has built several cars for special service. The freight car illustrated in Fig. 3 has two all open and one all closed sections. The closed part is for electrical apparatus that would be injured by rain, while the open parts are used for wheels, brake shoes, barrels of oil, bales of waste, rags, etc. Three mail cars—one electric and two cable were constructed recently and differ little from standard mail cars seen in Eastern cities.

FIG. 2.—STANDARD DOUBLE TRUCK COMBINATION CAR.

The latest special car is the sprinkling car. It is strictly utilitarian. It is for sprinkling and it does it well. It is a 2200 gal. iron tank mounted on a single truck equipped with two 25 h. p. motors. Miller-Knobloek Company sprinklers are used and one load covers 117,000 sq. ft. The company is by law compelled to take care of the paving between the rails and for 2 ft. on each side. This sprinkler by a trip up one track and down the other covers this area very effectively with a water expenditure of about 1 gal. for every 52 sq. ft. The water used is taken from the fire hydrants connected with the city mains and the time occupied in filling is from two to three minutes.

A large number of horse cars have been fitted up as trailers. So far only one trailer per motor car has been used, as several 6, 7, 8 and 11 per cent grades have to be ascended. The results have been quite satisfactory, nearly one extra car being obtained for the expenditure of but one extra man. As a rule it is found that passengers prefer to ride in the combination motor car, and as long as there is any room in this car either inside or outside they will avoid the closed trailers.

The electric cars are distributed among the three car houses—Kentucky and Twenty-third, Turk and Fillmore, Mission and Twenty-ninth Streets.

The Kentucky Street car house is a reconstructed horse car barn and offers nothing novel to comment on. It is all on one floor and has a capacity of about sixty cars.

The Turk Street car house is a fine new one story brick car house 412 ft. × 112 ft. and is capable of holding 120 cars. All the floor space is given up to cars ex-

cept a space in one corner 30 ft. × 50 ft. that is used for offices and men's room. There are three exits from this house, two on Fillmore Street and one on Steiner Street, the next street, the house covering a whole city block in length. The floor is divided into three parts by two transfer table pits running entirely across the building. On each track there are two transfer tables, making four in all. These tables are very rigidly constructed of 50 lb. steel T rail and are equipped with ratchets and locking devices so arranged that one man can move the loaded table forward or backward and can lock or unlock it without leaving his place at the ratchet lever near the center of the table.

The Mission Street car house is a two story brick building, has a capacity of 150 cars and covers an area of 225 ft. × 150 ft. Its upper floor is conveniently reached from a rear street whose grade is level with this floor, thus dispensing with an elevator. The Mission Street house is devoted exclusively to car storage except a small portion devoted to offices and men's room and a few tracks set aside for painters. There is a transfer table track on each floor with two transfer tables on each track.

These car houses are characterised by having pits under all tracks except where space is required for overhauling cars or for offices. These pits are concrete lined, well drained and lighted so that any portion of any pit can be reached by some one of the portable incandescent pit lights. The trolley wire is put high in these houses so that the minimum tension shall be on the trolley base springs. At the Kentucky and Turk Street houses the poles can stand perpendicularly and are so left at night.

For overhauling the cars jib cranes mounted on revolving pillars are used. The upright timber to which a jib crane is attached is furnished with iron trunnions or bearings at top and bottom so as to enable a load on the crane to be swung around a complete circle. The differential chain blocks used are suspended from a traveler

FIG. 4.—INTERIOR OF TURK STREET CAR HOUSE.

that rolls along the lower member of the crane, any point in the circle being thus reached by the lift.

All the overhauling is done on the floor; none in the pits. The trucks are run from under the jacked-up cars and the parts rapidly handled by one or more jib cranes as shown in Fig. 6.

It has always been the custom of the Market Street Company to overhaul all of its electric cars at least once in six weeks. From two to four cars a day are taken up at each house and overhauled so as to cover the whole number of cars during the six weeks. At these periods of overhauling the car body, car truck and car motors are thoroughly gone over. Bolts are tightened up, bearings taken apart, cleaned and changed if necessary, the whole motor carefully wiped out and armatures sent to the shop for test and inspection.

Particular attention is called to the fact that motor armatures from overhauled cars are always sent to the repair shop whether defective or not. The electric freight car goes to all of the car houses every day removing or returning armatures and other supplies. At the electrical repair shop these armatures are tested by the voltmeter method and are not sent out again unless they show an insulation resistance of at least a megohm. If the resistance is less than a megohm the armature is put in the bake oven and baked up to a megohm. If this is found impossible, it is opened and the defective spots located and remedied. If the insulation proves satisfactory, the armature is put in a lathe, the commutator trued up and the diameter of shaft and commutator and condition of the pinion noted and recorded.

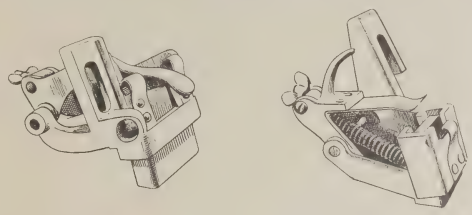


FIG. 5—CONSTANT PRESSURE BRUSH HOLDERS.

For testing high resistances, the voltmeter process is used in the repair shops, but for low resistances a Wheatstone bridge is preferred to the ammeter-voltmeter method on account of its greater accuracy, rapidity and simplicity, its lesser consumption of electrical energy, its fewness of pieces of apparatus and connections and consequent lesser labor required. For rough testing the light circuit answers while the old magneto is not used at all.

That this regular overhauling and test pays is shown by the fact that in a three year old road, the repair shop where is done all the electrical work on 450 armatures and fields, besides work on building commutators, repairs on controller cylinders, overhead switches, fuse boxes, trolley crossings, section insulators, generator repairs, etc., etc., has but six regular men in it—a foreman, four assistants and an apprentice. That the amount of repair work is small is believed to be due to the regular overhauling and inspection the armatures receive. It certainly is not due to the easy treatment they get when in use, because no city operates electric cars over such heavy grades or so many of them as San Francisco.

A few of the numerous deviations from standard Eastern practice, as devised and adopted by the Market Street Company, seem to be worthy of mention in this connection.

All standard railway motor builders, for reasons best known to themselves, abandoned the side contact springs,

so familiar on brush holders of generators, when they designed the brush holders for their railway motors. They also dropped the means of adjusting the pressure of the brush against the commutator. Both these features were considered desirable and have been replaced by the Market Street Company. Where no side contact springs were used on the railway motor brush holders, it was found that the brushes rattled and were worn into quickly by the brush holder. The current also, being carried away almost entirely by the hammer spring, sometimes proved excessive for the ampere capacity of this contact and drew the temper of the spring. Again, lack of means of adjusting the tension on the hammer spring seemed a defect. When the brush is new the tension is almost a maximum, and in proportion as the brush or commutator wears, so does the pressure of the spring decrease, except in the case of the motors, whose brush holder can be moved toward the commutator, and even this is a slow means of reaching the desired end, and useless in the case of brush wear only.

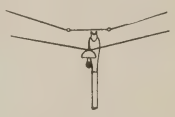


FIG. 7.—POSITION OF TROLLEY AFTER LEAVING WIRE.

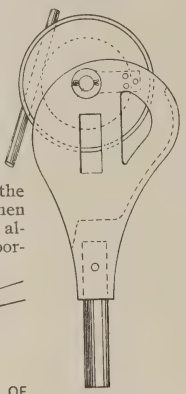


FIG. 8.—IMPROVED TROLLEY HEAD.

Frequently motors "buck." This phenomenon means that the current has jumped from the brush holder or commutator to the motor frame. It is almost always due to insufficient brush pressure, and the remedy is usually the change to new brushes, which really amounts to increasing the pressure of the brush on the commutator.

All the brush holders of the Market Street Company have been improved to allow of adjustment, so that as the brush or commutator wears the tension can be increased, and when a new brush or commutator is put in, the tension can be decreased, thus keeping the brush-to-commutator pressure constant at all times. Instead of a hexagon nut, as on the generator brush holder, a thumb or wing nut is used. By these changes, excessive wear or excessive spark burning on brushes and commutators are both reduced and "bucking" prevented. Two forms of these brush holders are illustrated in Fig. 5.

The car axle bearings in the motors are designed on most of the Market Street Company's motors to be lubricated with oil from below and with compound from above. Arguing that if the oil is sufficient, the compound is unnecessary, the latter has been abandoned with the best results. This feature is not experimental at all, but has been standard practice for over two years on this road.

If oil be a better and a cheaper lubricant than compound on the slow running car axle why should it not be better on the fast running armature shaft? was next asked. Oil is used on engines and on generators; it is used on locomotives and shafting; Why should it be necessary to use compound or grease on motors? The theory of lubrication is that there intervenes between the shaft and the bearing a film of lubricant which keeps the two metals from coming in actual contact and rubbing, to their mutual loss.

Compound always comes away from a bearing black, because it does not lubricate as it should and form this protecting film. Oil comes away only slightly colored unless the bearing has become heated. The same explanation is believed to account for the fact that the bearing lubricated with compound wears only half as long as the one lubricated with oil and the fact that the motor shaft wears so much faster than the car axle. On this logic, one motor of a heavy double truck car was equipped with oil lubrication and the other motor left with compound. At the end of ten days it was found that the first motor had used one pint of oil and the other 1.6 lbs. of compound, or at the rate of one cent to thirteen cents in favor of the oil. This test was made in the summer time. The result of another test of two weeks in the same car in the winter with an oil costing twice as much as the one used on the first test gave a result of one to six in favor of the oil. These facts are new in print only, if even there, for the new G. E. 1000 motor is designed to use oil on the armature bearings, showing that there is a demand somewhere for facilities for oil lubrication on the armature bearings.

Besides the gain in cost of lubricants it was found that the brasses run with oil wore nearly twice as long as those run with compound. There undoubtedly was less power used on the smooth running bearings than on the harder running ones, but this feature was not looked into. This W. P. 50 motor under a 10 ton, heavily patronized, double truck car has run uninterruptedly without any trouble at the oil lubricated armature bearings for over a year with an oil consumption of 3 pints per month—⅜ gal.

When the system of lubrication is changed from grease to oil on all the cars, the only grease bought will be for the gear cases. The same oil will be used on the journals, the motor axle bearings, the armature shaft bearings, the trolley stands and trolley wheels. If the same saving can be realized on each motor, the change will mean a reduction of $10 per year per car in the item of motor lubrication. Besides this there will be a substantial saving in bearings, motor shafts and current.

The oil cup used consisted only of a box of brass of such dimensions as could be set into the present grease cup cavity. This box had a hole bored in the bottom and in this hole a vertical tube was soldered. The oil was fed

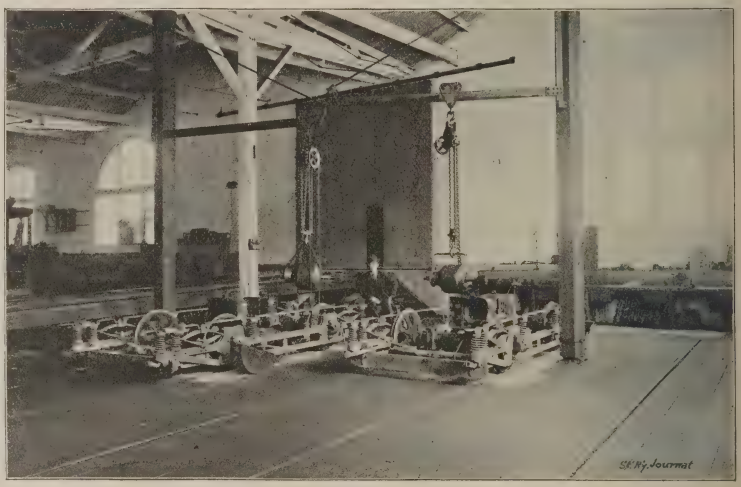


FIG. 6.—REVOLVING JIB CRANES FOR REMOVING ARMATURES.

by a wick, capillary attraction raising the oil up and over into the tube. The capacity was made exactly half a pint. This lasts ten days, thus necessitating refilling not oftener than once a week. With grease great care had to be exerted lest dust or grit should get into the cup, as it was sure to work down and into the bearing. With the oil, even if grit fall into this cup when refilling, it can do no harm to the bearing. It merely settles to the bottom of the oil and remains there, not being fed upward by the wick with the oil.

With all the forms of trolley heads offered the Market Street Company there was found a common defect. The following experiment will make clear this defect. Let the trolley pole stand vertically and lie closely beside the trolley wire. Now let the trolley rope be pulled upon directly downward until the wheel reaches the wire and the wheel will lodge on the top of the wire in every case until some lateral pull on the rope is made. Now, in case the pole came off when the conductor was not convenient and the car in motion and this lodging took place at the span wire, either the trolley head would have to come off the pole, the pole be pulled out of the stand, the stand torn off the car roof, the trolley wire broken or the span wire broken. Usually one of the last two occurred, causing frequent calls for the emergency wagons.

The company has now adopted a head that is free from this worst feature of the others and has some good ones of its own besides. It is closed below and has so gradual a tapering curved section that it is impossible for it to lodge. It is free from projecting cheeks or cotter pins to catch guard wires, the cotter pin being concealed in the head. The head is of malleable iron, has heavy bosses at points of bearing for the trolley pin, thus ensuring long life, and it uses a contact spring only 2 ins. long instead of the usual 3 in. or 4 in. spring, thus reducing the expense of repairs. As this contact spring begins and ends inside the flange of the trolley wheel, it can not be cut through by the wheel as some of the old forms were. Finally, it weighs no more than other heads. It is shown in Fig. 8.

The chief items of expense for repairs on electric cars are armature winding, commutator renewals and wear of bearings. The wear on the commutators has been greatly reduced by the improvement in the brush holders described above. The life of the bearing is expected to be increased largely by the use of oil instead of grease. Finally the work on armature coils has been markedly diminished by a change in the controllers that was made for another purpose.

The cars were all equipped with K controllers. These were entirely satisfactory until it was found that the start was made more smoothly by cars using the later K2 controllers. Again, after a series of tests made on the cars the great advantage of the use of the motors in multiple was so clearly seen that some means of securing the maximum use for this running point was demanded. A way out of both these difficulties was found by taking the shunt resistance off the fields and adding it to the starting resistance. By this change the start was made a more gradual one and the too convenient speed—notch 4—was removed. Being unable to make schedule time on the series notch the next allowable running notch, the multiple notch, had to be used more generally and the second point was gained. Of course, when the shunt was removed notch 7 had to be sacrificed along with notch 4, but little regret was felt over this as it was found on account of time tables and inexperienced men that it was extremely difficult to entirely prevent the illegitimate use of notch 7 on heavy grades and the attendant burned out armatures on the car and opening of circuit breakers at the power house feeder terminals. There being seven notches or points on the dial with but two for use on continuous runs, the fourth and seventh made these the same as the Westinghouse and Walker controllers and rendered uniform the instructions to motormen on the use of the car controllers.

The fuse boxes and main motor switches were also remodelled. They were both designed presumably according to Eastern practice for 100 amps., but as 150 amps. to 200 amps. are often passed through them in climbing heavy grades in San Francisco, it was found advisable to go over this apparatus and enlarge the carrying capacity of contacts, binding posts and windings.

A glimpse at the efficiency of the car house management may be interesting. At one of the car houses two years old, containing sixty-eight regular motor cars, all the day overhauling is done by a crew of six men, consisting of foreman, two machinists, one blacksmith and helper and one carpenter. The night crew consists of five men—the foreman and four assistants. The work of the night crew is confined to lubricating, filling sand boxes, adjusting brakes, oiling controllers and trolleys and changing brushes.

To give some idea of the service it may be stated that there is not a block of level track on any of the lines operated from this house, whereas there are two 14.54 per cent grades, one 14.1 per cent, besides numerous 12, 11 and 10 per cent grades surmounted every trip without outside aid, the cars being heavily loaded evenings and mornings. It is on this division that the two 25 per cent grades are located that are overcome by a counterbalance cable system described in the June, 1895, number of the STREET RAILWAY JOURNAL."

The design of the electric car house equipment has been to make each house an independent unit, except as regards painting, machine work and supplies. For painting, all cars are sent in their turn to the Twenty-ninth Street house. For machine work the houses look to the electrical repair shop or the larger general machine shop that handles in addition all the machine work for the numerous cable lines of the company. This larger shop handles all such work as the manufacture of axles, the rebabbitting of bearings, casting of brasses, trolley wheels and other brass work, grinding of wheels and all forging and heavy truck work beyond the facilities of the car house blacksmith. The company's store house is centrally located and keeps the car houses supplied by the daily trips of the electric freight car.

The general supervision over the cars is divided between the chief car repairer, who looks after all car body and truck work on the electric cars, besides attending to the car repairing on the 600 cable, steam and horse lines and the construction of new cars for the four systems, and the electrical engineer, who looks after the electrical work of the cars, besides attending to the power houses, electrical repair shop, lighting, line and new electrical construction.

Electric Railway Motors.

By GEORGE T. HANCHETT.

III.—Armature Winding Diagrams. (Continued.)

Returning to the original problem, it will be noted in Fig. 3 (page 466, STREET RAILWAY JOURNAL, August, 1897) that there are as many wires carrying current up in front of the north pole as there are carrying currents down in front of the south pole. Now if it were possible to connect these wires in a symmetrical manner we might utilize the up wires on the one side as a return for the down wires on the other side and thus obviate the necessity of any return wires through the center of the armature. Such a winding would be entirely on the outside of the cylinder, and is called a drum winding, and there are many different methods of accomplishing it. One of the simplest is shown in Fig. 7, and tracing out the connections it will be found to fulfill in distribution of current, the conditions set down in Fig. 2. A more detailed description of this winding is appropriate because it is of assistance in understanding others which are similar.

All of the conductors are shown on the surface of the armature and it is supposed that there is just room for them all. This would constitute what is known as a sur-

face wound armature such as was used on the Sprague and F-30 Thomson-Houston motors. It is therefore important that we connect the rear of No. 1 to a conductor carrying current in an appropriate direction, we leave room for the other conductors, so that the result will be symmetrical, for that is the foundation law of windings. Thus if we begin with No. 1 and connect it with No. 7 and continue connecting No. 2 with No. 8 and No. 3 to No. 9, etc., until we reach No. 6 to No. 12 we shall, it is true, have connected the ends together so that the current directions are fulfilled for that single position of the commutator, but as the armature is turned the required conditions are not fulfilled because the winding is unsymmetrical. If we connect No. 1 to No. 6, and then leaving No. 2 as a return for a wire on the other side, connect No. 3 to No. 8 and so on, always an odd number to an even one, we shall proceed around the armature in an entirely symmetrical manner and obtain proper connections at the commutator, so that however the armature is turned the current distribution under the pole pieces will always be the same. Another important point to notice in this winding is that each pair of bars is bridged by an active loop in the armature in the same way as in a ring winding, but with the important difference that for every two active conductors in the armature there is but one bar in the commutator, and thus there are half as many bars as conductors.

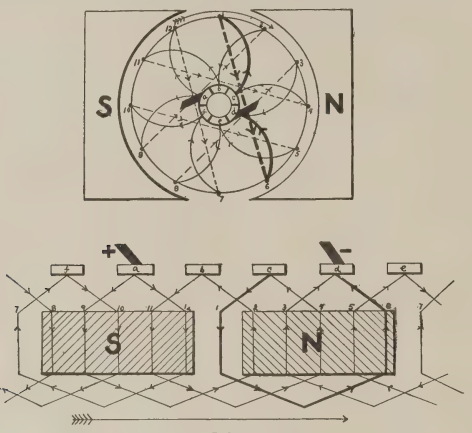


FIG. 7.

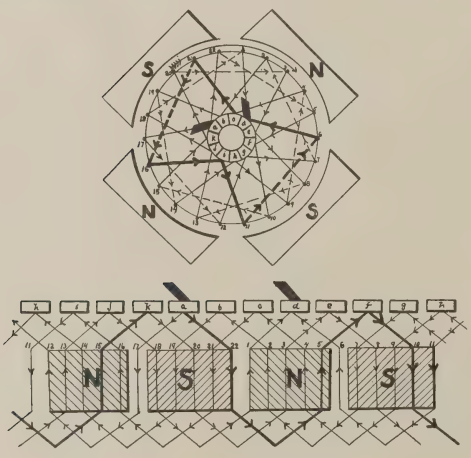


FIG. 9.

Owing to the fact that in a drum winding there is less dead wire than in a ring winding, and further because the construction of the core of a drum armature is much more simple than that of a ring armature, the former has become popular in railway work. An additional reason for this is that most railway motors are four pole, and with a four pole drum winding it is easy to arrange it for two brushes without the device of cross-connecting the commutator. This will presently be shown.

The horizontal development of the drum winding just shown is perfectly symmetrical and therefore can be extended into two, four, six, eight, or any even number of poles in precisely the same way as can be done in the case of a ring winding, the number of brushes being increased in like measure, as shown in Fig. 8. This winding, which is known as a lap winding, has been extensively used in some form for multipolar generators, but because of the multiplicity of brushes necessary this has been abandoned in the case of railway motors for windings of the type shown in Fig. 9. This winding, it will be noted, has important differences from any heretofore shown. The number of conductors in series is largely increased, being, in the case of a four pole motor, twice the number involved in the system of winding shown in Fig. 8. Between ad-

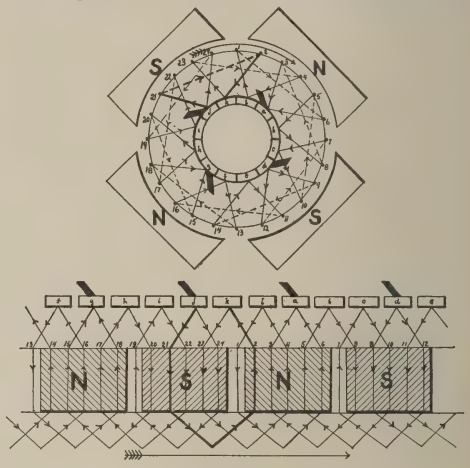


FIG. 8.

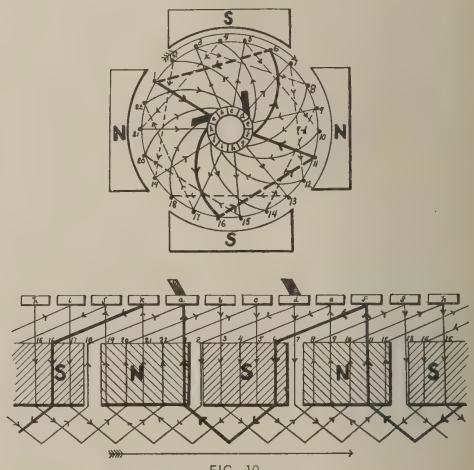


FIG. 10.

jacent bars it will be found by tracing that there are connected two active coils instead of one. The number of bars in the commutator is one-half the number of conductors in the armature, as with the ordinary drum winding, but the number of bars is always an odd number.

The reason for this is best appreciated by the student if he attempts to make such connection on an armature with an even number of commutator bars and a corresponding number of conductors. He will find that the first double coil proceeding around the armature will bring him back to the segment from which he started, thus cutting out the rest of the winding.

This two-circuit winding, for so it is called, will run at one-half the speed that would obtain in the case of the ordinary lap winding. Its simplicity in having but two brushes has caused its univeral adoption in some form in American railway motor practice, and its slow speed has been a no less important factor in conducing to this result. Such a winding is sometimes called a wave winding, for the reason that the coils continue around the armature, rather than return and lap back over their mates. This is accomplished by merely altering the connections to the commutator bars. The mechanical positions of the coils are practically the same as in the lap winding.

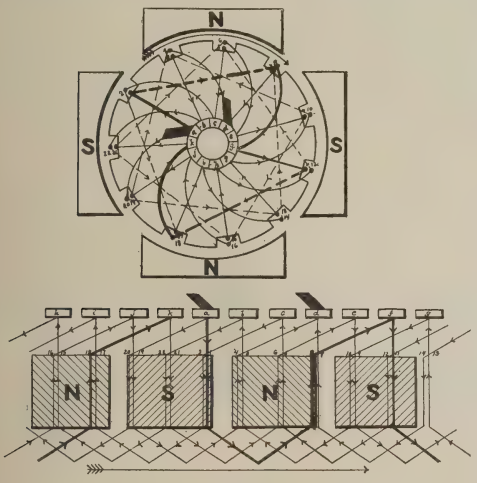


FIG. 11.

The windings which have been illustrated in this article and its predecessor are *typical* of those which are in use to-day and the modifications which have been made are very slight indeed, although the casual view of a winding diagram, such as is used in practice, might present many points of difference and apparent complications. If these are considered singly they will resolve themselves into very simple matters. One of the most confusing of these modifications is a change in the lead of the commutator with regard to the armature. This has the effect of completely altering the general appearance of the connections as shown in the winding diagrams. If we were to consider the leads connecting the commutator to the armature winding as completely elastic and flexible it would be possible to turn the commutator relatively to the armature without disturbing the electrical conditions, provided we made a corresponding adjustment of the brushes. By this device the non-sparking position of the brushes can be so shifted as to bring them into a convenient and accessible location. Thus with an armature whose poles were consequent, as in the G. E. 800 motor, the winding would be arranged as shown in Fig. 10, in order that the brushes should have the convenient upper position depicted. In an armature like the Westinghouse No. 3, or the Walker No. 5 A, or the new G. E. 52, in which the four pole pieces are arranged on the diagonal, the direction of the commutator leads would have to be shifted as shown in Fig 9, in order to secure the same desirable position

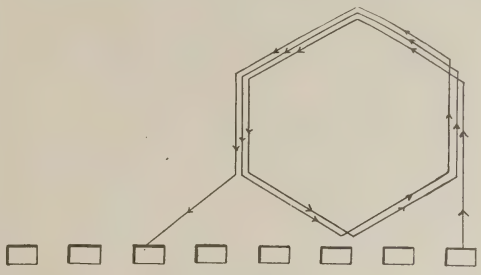


FIG. 12.

for the brushes, and thus it is possible for two windings, which to the novice appear to be entirely different, to be electrically identical. This shifting of the commutator relatively to the armature is much practiced in all types of armature.

The windings shown have assumed a single turn to a coil, but this is true only with the more powerful motors. The smaller motors have a number of turns in series on every coil, and very often it happens that the same motor is wound differently, according to the service it has to perform. Thus, we have the W. P. 50, 9 turn, 12 turn and 13 turn, and a G. E. 800, 3 turn and 4 turn, the last figures having reference to the number of turns in the individual coils on the armature. The armatures with few turns are much speedier on level track, but are deficient in torque, while the motors with the larger number of turns are not so speedy, but have great hauling powers, and are suited for hilly localities.

In the diagrams that have been shown, all of the active conductors have been assumed to be upon the surface of the armature, but this is seldom, if ever, the case with railway motors in use to-day. It is customary to cut deep slots in the surface of the armature core and imbed the conductors therein. If we were to select a core of large enough diameter we could leave spaces between the wires large enough for teeth and imbed each of the conductors in a slot, and in this way we could adopt, without modification, any of the windings shown. Armatures of large diameter are not always desirable, and cutting slots in the core is expensive. Advantage has been taken of the fact that when there are many conductors, neighboring ones carrying currents in the same direction can be bunched together in a single slot. This reduces the number of slots and the labor of insulation. Thus, a single slot often carries many wires, and never less than two on any modern railway motor winding.

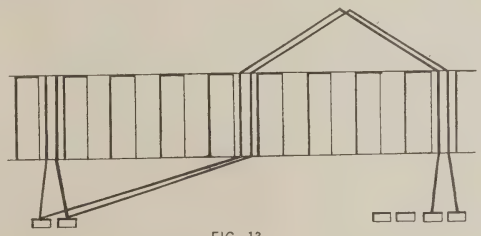


FIG. 13.

If we apply the principle of bunching adjacent conductors to the diagram shown in Fig. 11 we shall find that in no less than three cases conductors carrying currents in opposite directions will occupy the same slot, thus completely neutralizing each others' effect as far as rotative

effort is concerned. Fortunately these places come in the spaces between the pole pieces and are therefore of less importance than if they occurred elsewhere. However, this is a very real difficulty in winding design, and care is taken not to have the neutral slots too numerous. The number of neutral slots is minimized by properly choosing the chord spanned by the coils. If this if either too short or too long there will be many neutral slots. Fig. 11 shows how the number of neutral slots of the modified Fig. 10 winding may be reduced to one, by simply increasing the chord of the coil one space.

The simplest winding is, of course, the case of one turn per coil and one coil per slot as shown in the last figure, and before leaving this branch of the subject it is well to call attention to two modifications thereof. The first, given in Fig. 12, reduces the number of commutator bars and slots relatively to the conductors and is largely used on all of the smaller sizes of motor. The second device shown in Fig. 13 reduces the number of slots only, but preserves the single turn per coil. It is used on the heavier windings.

If the foregoing discussion of theoretical winding diagrams is well understood there will be no difficulty in comprehending the commercial windings that will be shown in subsequent sections.

A Shop Nuisance.

While looking around a prominent street car repair shop recently, it was noticed that the new castings as received at the shop, were all dumped in a heap near the track in a front corner of the building. These castings were those used in the wood working department, in setting up car bodies.

But there they were, rough iron castings and polished brass all thrown together. There is all too much of this kind of work done in some very good shops, usually through sheer neglect of such little matters in the rush of more important ones.

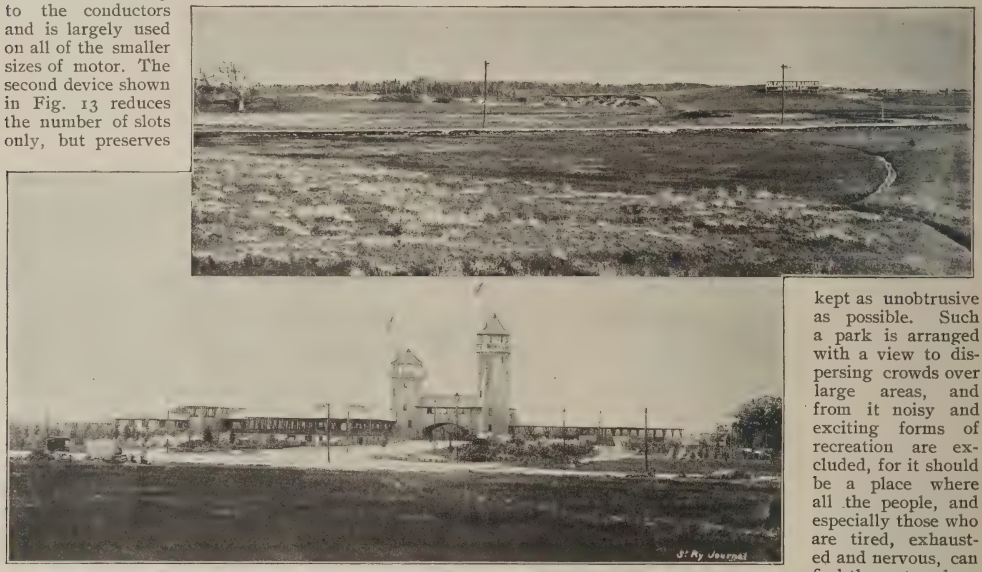
But it will pay a big interest on the small investment if a set of shelves and racks are built for rough and finished castings. The time saved when a man would be hunting the heap over for a particular casting, would more than pay for the necessary shelves, and the time of putting the castings away when they arrived.

Designing Amusement Resorts.

By Warren H. Manning.

The managers of street railway companies who have successfully established amusement grounds have foreseen and wisely taken advantage of the rapidly growing and most healthful tendency among the people to seek pleasure in out-of-door life, and they are providing forms of amusement in these grounds that are not and cannot be supplied properly in public parks.

The leading motive in designing large public parks is to provide and preserve a beautiful landscape, from which the artificial surroundings, the noise, bustle and excitement of town life may be shut out, and in which only the necessary artificial constructions will be introduced, and these kept as unobtrusive as possible. Such a park is arranged with a view to dispersing crowds over large areas, and from it noisy and exciting forms of recreation are excluded, for it should be a place where all the people, and especially those who are tired, exhausted and nervous, can find the rest and refreshment that come from seeing and being surrounded by beautiful and varied natural scenery. Suitable land would be selected in a park system, where it would not interrupt the quiet of the park proper, for sports of a permanent character, such as baseball, out-of-door gymnasia, etc., but it is not considered wise policy for a city or town to make provisions for any passing fancies in amusements, such as roller skating, chutes, roller coasts, etc.



DIGHTON ROCK PARK AREA BEFORE AND AFTER IMPROVEMENTS.

Public parks are not designed to be a direct source of revenue, while on the other hand, street railway amusement grounds are intended to bring an immediate return, chiefly through increased traffic, to the company controlling them, and they should be designed and managed with this in view.

While street railway companies may occasionally make satisfactory temporary arrangements that will lead to increased traffic, by providing, at their own expense, special amusement features in resorts under management other than their own, or in public parks, such arrangements if they prove to be at all advantageous can only be of temporary value, whereas investments judiciously made by the company on property belonging to it are almost certain to be of permanent value. Before deciding to purchase and establish new amusement grounds, however, a careful examination should be made of existing resorts to determine the possibility of guiding their growth and controlling their management in such a way as to make them

serve the purpose to be had in view, and especially with a view to their ultimately coming into the hands of the railroad company at a reasonable price if it is found best to secure them.

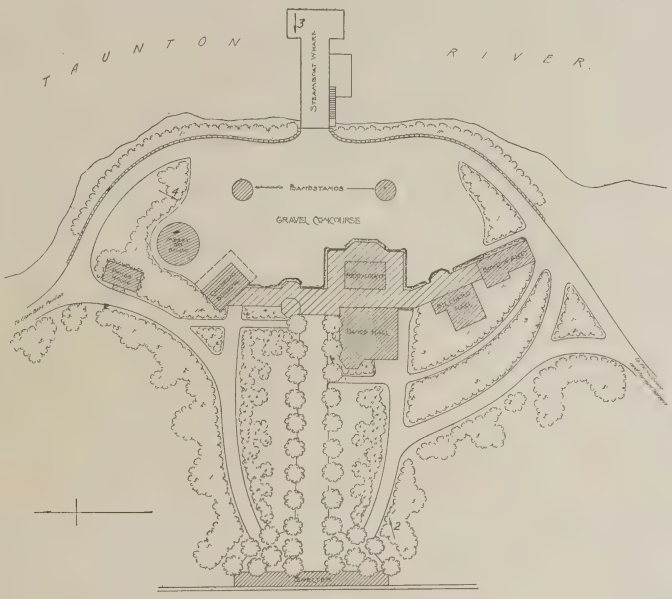
Before selecting land for an amusement resort a definite idea should be secured of the maximum number of people that are likely to be attracted on a special day, also of the character and extent of the amusement features that are to be provided.

Grounds with an attractive landscape, with good woods made up of seedling rather than sprout trees, and with a large body of water, have an immense advantage over those without these features, and if there be sufficient area outside of that required for the special amusement features and administration buildings, for picnic parties or for a quiet stroll, the place will be much more attractive to many people who otherwise would not visit it.

Not infrequently land that is selected on account of its accessibility to existing tracks is of such a character as to make the cost of putting it in suitable condition for use greater than would be the cost of re-locating a portion of the tracks to make a more suitable section accessible. It will sometimes be wiser to make an artificial pond instead of taking advantage of existing bodies of water, for such water may be kept cleaner and at a more nearly uniform level and the land about it may be better adapted for an amusement resort. The value of property as an investment is also to be considered. Not infrequently land is purchased because it is cheap, in a locality where it is not likely to increase in value, whereas more expensive land quite as well adapted to the proposed purposes could be secured in localities where its increase in value alone would make it a good investment.

buildings, so as to make the cost of construction much less than it would be on level ground.

After suitable land has been secured, a topographical survey should be made upon which to determine the position and extent of the main subdivisions of the ground



PLAN OF DIGHTON ROCK PARK, TAUNTON, MASS.

that are required by the principal amusement features, by the service yard, power house, and administration buildings, by picnic grounds, etc., and on which should be studied out in detail the locations and grades of roads, walks, buildings, plantations, and all other details that are at all likely to be required in the future, so that whatever is accomplished will be done with a view to ultimately

FRONT VIEW.

REAR VIEW.

RESTAURANT AND CONNECTING BUILDINGS—DIGHTON ROCK PARK.

Irregular ground is much more attractive from a landscape standpoint and generally more desirable for an amusement resort than flat ground, for the irregularities can frequently be taken advantage of in locating an amphitheatre, toboggans, chutes and roller coasts, and often carrying out this plan. Of course, as the work progresses there will be changes in detail, but the general features will not be modified materially, for if the plan be a well-balanced one a radical modification would make a re-study of the whole scheme necessary. Without preparing in ad-

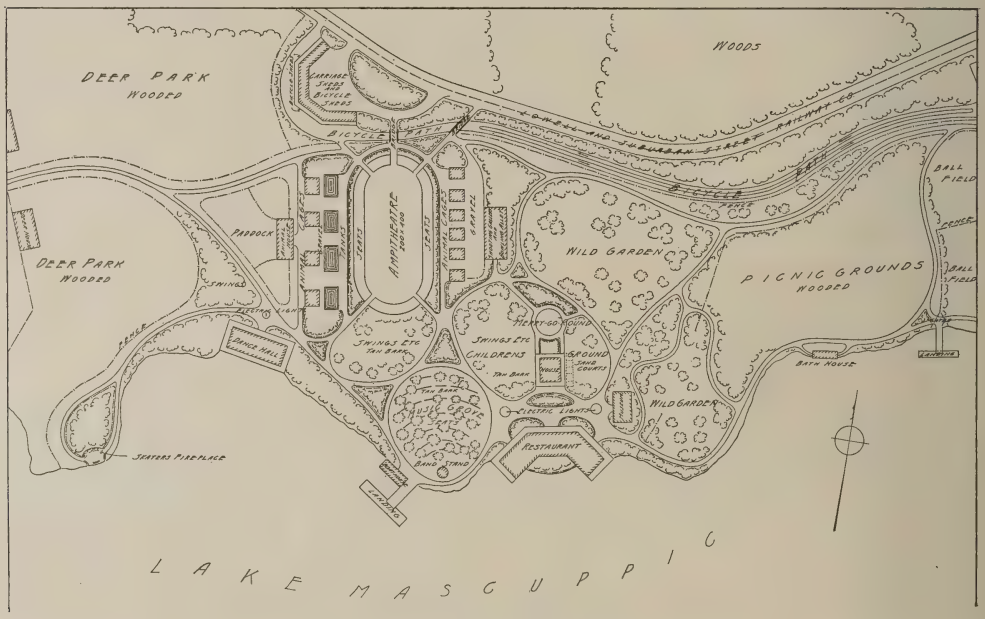
vance such a comprehensive and carefully studied detailed plan, work is almost sure to be done that will have to be undone at a later date, at a considerable expense and inconvenience, to make it fit the new conditions, and such fits at their best are apt to be misfits.

Any reputable form of amusement that will serve to attract crowds of people for a long season is legitimate. In providing this, however, care should be taken not to duplicate, unless it be in a much more attractive way, any features that are provided in competing resorts.

Such permanent buildings as restaurants, dance halls, bowling alleys, etc., should be located and planned so as to provide for future extensions if it is found to be necessary, but buildings for amusements that are not likely to be permanent should be designed so that they may be used for some other purpose if the amusements for which they were originally erected cease to be popular attractions.

tion, should be covered with some such material as gravel or tan bark that will be free from mud, dust and weeds.

At the base of the buildings and other structures surrounding such a concourse, borders of good soil can be provided, in which vines, shrubs and flowering plants to serve as a decoration for the buildings can be grown. Formal flower gardens, with symmetrical beds, walks, fountains, etc., in which a brilliant display of flowers is maintained throughout the summer, will often prove a paying feature. Wild gardens, with great masses of brilliant flowering native or cultivated plants can be established and maintained at small cost on sections of ground that are wet or otherwise unsuited for other purposes. In such a garden the existing undergrowth of trees and shrubs is of the greatest value. All such growth, however weedy it may appear, should be retained on newly purchased land until the general design is completed, for



PLAN OF PARK AT LAKE VIEW, LOWELL, MASS.

There is a tendency to go to so great an expense in providing structures for such amusement features as chutes and roller coasts which cannot be used for any other purpose, that it is difficult to secure an adequate return during the period when such features are popular, whereas less expensive structures would serve the purpose quite as well and pay for themselves during their term of life. It is not good policy, however, to build cheap restaurants, administration and other permanent buildings, for cheap buildings detract from the appearance of the grounds, are more expensive to maintain, and do not serve their purpose as well as substantial structures.

Not infrequently a living collection of the common reptiles, birds and animals native to the region, displayed in enclosures, will be quite as instructive and very much less expensive to secure and maintain than would be a costly collection of exotic animals, and the same principle will apply to other features.

The principal amusement features should be so located as to be readily accessible one from the other, but ample open spaces and passage ways should be provided between and about them for the largest crowds. Such surfaces, which must necessarily be bare of surface vegeta-

it may often be so situated as to provide a screen or a decoration which could not otherwise be secured, excepting at considerable expense and after several years of growth.

It is useless to attempt to give detailed instructions concerning the subdivision of the ground, locations of walks, concourses, buildings, etc., for every affair of this kind is a problem by itself in which there are sure to be controlling features which are not presented in other similar undertakings. As an illustration of this, I present a part of a plan of two amusement resorts where the conditions made it necessary to provide an entirely different plan in each case. The Dighton Rock Park was established on a very long and comparatively narrow strip of land, a large part of which was flooded at extreme high tides and on which there were few trees. Near the center of this strip was the only piece of dry ground of sufficient size to provide room for the necessary structures. On account of the limited area of this ground and of the lack of shade, the landscape architect who was called in to advise with reference to the development of the property, recommended that the buildings be all grouped together and connected by a series of roofs, and also recommended an architect who was specially qualified to design

such a structure successfully. This grouping together of buildings permitted a compact and convenient arrangement of walks and planting that could be maintained in good order at comparatively small expense. Between the buildings and the water where the greatest number of people would congregate to listen to music and witness aquatic and other sports, a large gravel concourse was established. It was assumed in the beginning that 10,000 would be the maximum number of visitors. Between 15,000 and 20,000 people, however, have been accommodated on these grounds and in these buildings as they are arranged without any serious inconvenience. The path to the right on the plan leads to a proposed picnic ground and flower garden and the one on the left to proposed clam bake pavilions.

On the other hand, the grounds owned and controlled by the Lowell & Suburban Street Railway Company at Lake View have a very irregular surface and are almost completely covered with a fine growth of pines and deciduous trees so that it was not necessary or desirable to bring the buildings together under one roof to secure shade, neither would the topography admit of this. There were practically no limitations here as to space, and an arrangement of detached buildings grouped about a central amphitheatre and arranged with some regard to symmetry chiefly with a view of making them readily accessible and easily maintained, was determined upon. Only a portion of these grounds are shown on the accompanying plan. On one side is a second picnic grove, and on the other a deer park.

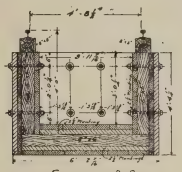
THE Calumet Electric Street Railway Company, of Chicago, is making a strong effort to secure pleasure travel, for which its lines appear to be well adapted, as they pass through twenty-seven suburban towns and villages. The company offers a 40 mile ride for ten cents (round trip rate) and has issued a neat circular.

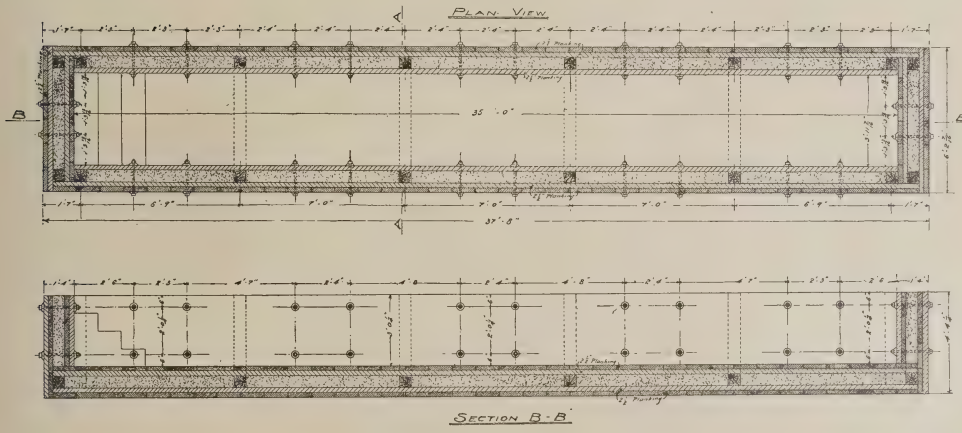
Car Pits in New Orleans.

Car pits, like a great many individuals, are creations of circumstances and environment. In a great many localities, a hole in the ground, as it were, with a nominal lining to act as a retaining wall suffices; while in others, a hole in the water more clearly defines the requirements.

The working part of the most efficient car pit is space with dry linings of low conductivity. To obtain this in ultra wet soils, various forms of construction have been devised with greater or less degree of merit.

The accompanying cut gives in detail the construction of the car pits of the Canal & Claiborne Railroad Company, of New Orleans, La., designed with a view to effectually withstanding the marked characteristic of this city, of anti-dryness both below as well as above grade. These pits, the details of which are shown in the engraving, are 37 ft. 8 ins. in length × 6 ft. $2\frac{7}{8}$ ins. in width × 4 ft. $4\frac{1}{4}$ ins. in height over all dimensions. They are constructed of cypress planking and cement concrete, being furnished with eight upright 6 in. × 6 in. posts resting on 6 in. × 6 in. floor joists, the posts and floor joists being lined on the outside with two layers of $2\frac{1}{2}$ in. No. 1 cypress planking, finished on one side and edges and placed firmly in contact by means of white leaded and overlapping joints. The inner lining of these pits consists of a single layer of cypress planking, firmly bolted to the outer lining by means of $\frac{3}{4}$ in. bolts spaced 2 ft. 4 ins. × 2 ft. $0\frac{1}{4}$ in. between uprights, excepting, however, at the ends and bottom where also the cypress planking is placed in a double layer similar to the outside construction. Being thus firmly secured together and previous to the laying of the inner floor of the pit, there is placed inside of and between the planking of both sides, ends and bottom of pit, cement concrete, special precaution being taken to tamp this thoroughly into all interstices.





The advantages resulting from this form of construction are watertightness, a dry non-conducting working lining and sufficient weight to retain the pit in position against the upward pressure of the water in the soil.

The persistency of this pressure is more clearly realized when it is stated that the largest safety deposit vault in New Orleans, of steel construction, which was duly placed in the excavation prepared for it, without, however, proper anchorage, was found on the following morning floating at grade on the surface of the, by-that-time, water filled excavation.

LETTERS AND HINTS FROM PRACTICAL MEN.

Proper Handling of Controllers.

CHICAGO CITY RAILWAY COMPANY,
CHICAGO, JULY 26, 1897.

EDITORS STREET RAILWAY JOURNAL:

The reason for making the tests referred to in Mr. Cravath's letter published in the STREET RAILWAY JOURNAL for July, was as follows: at the beginning of our operation by electricity we had but a few miles of electrically equipped road. The motormen were carefully taught and drilled in the proper manner of handling their controllers and the current in the motors. Electricity was new to the motormen of that time and produced a sort of awe inspiring effect, they believing that should they depart in the least from carrying out the instructions as given them, there certainly would follow disastrous results to the motors and controlling apparatus. There were but a comparatively small number of motor operators, consequently it was possible to watch them in their operations and see that they observed the instructions given them.

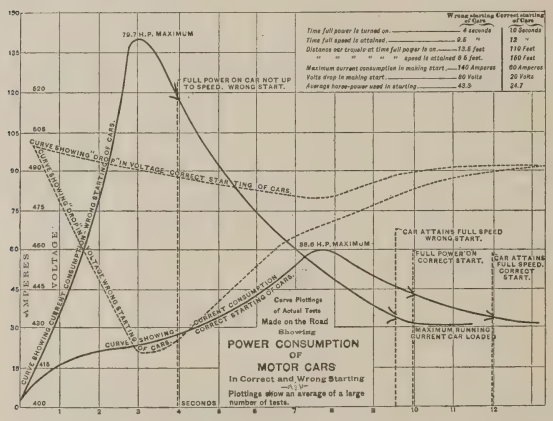
As time went on the number of operators increased, making it more difficult to instruct and watch them in their work, and one of the old adages began to manifest itself, in that "A little learning is a dangerous thing," for they commenced the practice of experimenting in methods of handling the motors and controlling devices, according to their own peculiar ideas. They found that by throwing the controlling handle around from "off" to "on" position rapidly, no bad results were experienced immediately—that is, the motor did not burn out—and by so manipulating the controller it saved them the monotonous worry of gaging the correct time of pausing at the notches. They believed also—and I see "there are others"—that there is time gained in acceleration of the car by thus crowding the current through the motors.

Being desirous of knowing just what might be expected from an electrically equipped road (the management having in view the equipping of the balance of the system electrically, should everything work satisfactorily), careful watch was kept from the start of current consumption. We knew that there were roads operating at 16, 18, and even more amperes per car at the station. It pleased us to be able to report to the management that we were operating on from 7 to 8 amps. per car, the average including trailers, and from 10 to 12 amps. per car with motor cars alone.

About the time when this experimental, self-educating plan was going on among the motormen, a wail came from the power station to the effect that the load was steadily growing heavier, and not in proportion to the increased number of cars and haulage, and it was true that the average amperes per car were crawling up to the 14, 16 and 18 mark. Then it was that I began chasing out over the system for "leaks." I believed then (and do still) that I found the "leak," but it was not on either overhead line or the return.

By taking many trips with our "electrical engineering" motormen—they not being aware of my presence—I was enabled to see them operate their controllers in what we termed "the ice cream freezer" fashion, and hear the wheels on a motor which was pulling a trailer spin, when the rail was a little damp, and even when there was a dry rail. I also noticed the grumbling of the passengers about the fluctuation of lights, while the motors were sending forth overworked "groanings" that resembled the roaring of an ore crushing machine.

Knowing that these abuses were taking place it was then that I attempted to determine the results of such practices by taking one of our regular cars out on the line and making a series of tests. I selected a man who was thoroughly conversant with the manner in which the operators of the motors were applying the power, and instructed him to work the controller exactly as did the motormen who were feeding too fast. In the meantime I carefully noted the readings of the instruments, while a third man kept account of distances, etc. We made a number of these tests and in making up our curves took as nearly as possible the average of the whole number made. We ran an open car, weighing about 7 tons, without any load. The rail was dry and in good condition.


79.7 H.P. MAXIMUM
FULL POWER ON CAR NOT UP TO SPEED. WRONG START.
88.6 H.P. MAXIMUM
CAR ATTAINS FULL SPEED WRONG START.
FULL POWER ON CORRECT START.
CAR ATTAINS FULL SPEED. CORRECT START.
MAXIMUM RUNNING CURRENT CAR LOADED
CURVE SHOWING CURRENT CONSUMPTION WRONG STARTING OF CARS.
CURVE SHOWING "DROP" IN VOLTAGE WRONG STARTING OF CARS.
CURVE SHOWING "DROP" IN VOLTAGE CORRECT STARTING OF CARS.
CURVE SHOWING CURRENT CONSUMPTION CORRECT STARTING OF CARS.
Curve Plottings of Actual Tests Made on the Road Showing
POWER CONSUMPTION OF MOTOR CARS
In Correct and Wrong Starting
Plottings show an average of a large number of tests.
AMPERES
VOLTAGE
SECONDS
Wrong starting of Cars. Correct starting of Cars.
Time full power is turned on. 4 seconds 10 Seconds
Time full speed is attained 9.5 " 12 "
Distance car travels at time full power is on 13.5 feet 110 Feet
" " " " " speed is attained 86 feet. 160 Feet
Maximum current consumption in making start 140 Amperes 60 Amperes
Volts drop in making start 60 Volts 20 Volts
Average horse-power used in starting 43.9 24.7

FOR MOTORMEN.

The method employed in making these tests was, I know, rather crude to expect data from which to work out exact calculations, but I consider it near enough within the range of accuracy to give them a commercial value for the purposes for which they were intended. I made them without any idea of their being a new discovery. They were in no wise intended for publication, but rather for practical demonstrations whereby it was expected a benefit might be obtained for our system, and they were given to the public only after urgent solicitation.

I know full well that the various theories advanced relative to economy in feeding current freely may be correct, and it is possible to make tests substantiating their correctness, but taking into consideration the conditions as found in every-day practice, I fully believe it will be demonstrated that tests made on lines similar to our own will produce like results.

We do know this, that following the placing of the "Correct and Wrong Starting Sheets" at the barns with instructions to the motormen, and the subsequent discipline necessary for an observation of their results, a very decided relief was experienced at the power station in the way of getting down near to our initial ampere per car record.

Conditions such as wet or dry rail, weight of motors, car, etc., will alter entirely the results to be obtained from a test similar to the one referred to. For instance, with a heavy equipment like the one used on Mr. Heft's road there would be, perhaps, less slipping of car wheels, consequently less loss of power by feeding the current rapidly, than with a lighter equipment. I seriously question, though, the advisability of accelerating a car by crowding the current through the motors. When we consider the

waste of power, this factor as mentioned by Mr. Cravath would not enter into cases under Mr. Heft's system, a suburban road with long runs, few starts, etc., as largely as it does on heavy city lines, where it is necessary to start the car on an average about every 1¾ to 2 minutes. What *does* signify, however, is the undue strain on the motors mechanically and electrically, it being understood that this surging of heavy currents through the windings hastens the breaking down of the insulation. Also it is impossible to think of running out enough feeders (owing to the tremendous cost it would entail) to keep the drop on line within the limits generally aimed at and estimated upon.

Another very important matter to consider in connection with the applying of power so quickly in starting the car is the tendency to increase the number of accident cases. From 65 per cent to 70 per cent of the accidents to passengers on street railways are caused at the time of leaving and entering the cars. It is easy to understand why this occurs since the sudden application of power causes lunging of the car.

Now with regard to the waste in power in the free use of the current, by referring to the tests made in accelerating the car in 9½ seconds we find that we covered 85 ft., consuming something like 307,176 watt seconds, and by accelerating the car in 12 seconds we made 150 ft., with a consumption of 221,676 watt seconds.

The power expended by the slipping of the car wheels is lost sight of by many, I believe, and to this cause we may attribute much, and perhaps the most, of the waste of energy in the fast feeding of the current. One of the many points brought out by Elmer H. Sperry in his paper on "Traction and Street Railway Trucks," read before the American Street Railway Association in October, 1893, is the fact that the values of traction are tremendously reduced by the slipping of the wheels. The slipping of wheels caused by applying the power too quickly may take place to only a slight degree, perhaps hardly perceptible to the eye, yet it all in time goes to make up an enormous waste of energy. Were the molecular teeth, mentioned by Mr. Sperry, more pronounced on wheels and rail there would be but little waste from slipping of wheels.

But to again refer to the tests made; we find that in the case of turning power on rapidly the car accelerated at the rate of 107 ins. per second, while in the case of applying power more slowly the acceleration was at the rate of 150 ins. per second, showing there was considerable slipping of the wheels taking place. I do not mean to say in carrying out the calculation in accordance with these figures, that where the rate of 107 ins. per second was made, the car would in all cases go but 1284 ins. in 12 seconds, for this reason: there is, of course, a time when the wheels stop slipping and attain a grip on the rail. Then the car proceeds to gain its speed in the regular way. Just when this slipping begins and ends depends wholly upon the manner of applying the power and the condition of the track. But I conclusively demonstrated in my own mind, at the time of making the first tests and others since, that, as a whole, by the free use of the current, the time gained, if any, is so infinitely small, it is accomplished at such sacrifice of power and strain on machinery, and the question of gain of whatsoever nature is so completely offset by opposing factors mentioned, that it makes this free use of current the worst kind of practice to follow, at least with the present style of equipment and manner of application.

I am just in receipt of information from a street railway in this city, which has lately taken measures to stop the fast feeding of the current, and what the management has to say in reference to it is substantially as follows: since the current recorders were put in use on the cars of the road a series of ten-second readings was taken at the power station, and there was shown to be a saving by the use of the device of at least 9 per cent in the average power required to operate the road. Upon looking into the coal consumption since that time they find considerably more saving than at first, owing, they believe, to the fact that the motormen have been constantly improving in their methods of handling the controllers. Comparing the coal consumption the past three months with that of similar months when they were running the same number of cars under about the same conditions, the saving in coal consumption due to the recorders is (with an increase of 8.5 per cent in car miles run) 21.1 per cent and the decrease in coal used per car mile is 27.3 per cent. This may be considered a remarkably good showing for economy, and demonstrates that a moderate method of applying the current to the motor is the best practice.

In conclusion let me say that we are so well satisfied on this road with the results obtained in practicing what we term "Correct Feeding of Current" that we are now perfecting an arrangement whereby it will be impossible for a motorman to feed the current into his motors too fast.

Yours truly,

G. W. KNOX.

CHICAGO, Aug. 9, 1897.

EDITORS STREET RAILWAY JOURNAL:

I see on page 479 of the August issue of the JOURNAL that L. H. Parker, of the General Electric Company, criticises my "attempt" to question a paragraph in the article which appeared in the June issue under Colonel Heft's name, in which a rapid turning on of the controller in starting a car is claimed to be economical of power. With your permission I will make another attempt to question both the original statement in Colonel Heft's article and Mr. Parker's defense of it.

Before beginning, however, I wish to say that I take exception not so much to the theoretical accuracy of the statements made by Mr. Heft and Mr. Parker as to the bad practical results (aside from repairs) to which a blind following out of their conclusions would lead, although I notice that Colonel Heft states that he does not in practice attempt to have his motormen get the quick acceleration that theoretically would be the most economical.

The whole question under discussion is as to how we can most economically operate a car a given distance in a given time, making the usual stops necessary in service, and under the conditions that prevail in service.

Mr. Parker makes the very good point (and one that is not always considered) that for any service where a given distance must be covered in a given time it is more economical of energy to employ a motor having a low maximum speed and accelerate quickly than to use a motor that will run up to a higher maximum speed and accelerate more slowly. The theoretical soundness of this position I do not question as far as power applied at the rail is concerned, but it leaves out of account so many things that enter into the problem in practice as to be very misleading. We are obliged ordinarily to operate cars at a somewhat lower speed than they can be made to operate, in order to allow for making up time lost in delays and irregularities of traffic. In other words we can not usually operate cars under the ideal conditions outlined by Mr. Parker, because if we use quick acceleration and low maximum speed in common service with medium traffic there is nothing to fall back on when there are delays. No one would think of making a time table without some little allowance for delays.

The question of the proper speed of the motors is, therefore, already settled for us by the practical considerations just mentioned and the important thing for the electric railway manager to decide is whether rapid acceleration is to be attempted in ordinary service, in the interests of power house economy, considering the fact that the scheduled speed is somewhat below what the cars are able in emergencies to make, and considering the results that usually attend attempts at quick acceleration in practice.

Let us look into this matter and see what usually happens when quick acceleration is attempted on the road. When we get through we will have a number of items charged up against attempted quick acceleration and they will read about as follows:

1. Motormen will throw from series to multiple before much speed has been attained on series notches. Motors give twice the horizontal effort per ampere in series that they do when in multiple, and consequently their efficiency as car accelerators is temporarily reduced one half by throwing in multiple too soon.

2. The line loss being according to the square of the current, the high maximum current required with quick acceleration causes a loss of more energy than the lower maximum required for a longer time with slower acceleration The line loss is not very small on a majority of roads. The points brought out in (1) and (3) aggravate this case still further.

3. Where shunted fields are used motormen will throw in the shunt too soon, weakening the fields and, consequently, the horizontal effort per ampere and accelerating efficiency of the motors.

4. The heat generated in the motor windings varies as the square of the current. Consequently the loss due to the internal resistance of the motors (just as in the line) is greater with the high maximum starting currents than where an equal amount of electrical energy flows at a slower rate. This case is made still worse by the fact that as the motors get hot their efficiency drops, which in turn tends to heat them still more. This is a very important item, as many managers know, aside from the question of repairs.

5. When motormen are instructed to accelerate as quickly as possible, the usual result is that they slip the wheels more or less nearly every start they make. This is a good way to grind off "flats" but it can dissipate a large amount of energy that should be used for accelerating.

6. It takes more generating machinery to operate a road where quick acceleration is attempted than where it is not, consequently the power house efficiency is lowered.

These things taken altogether make a very large item, as Mr. Knox's tests and others I have in my possession show.

The tests published by Colonel Heft, over which this controvery arose do not by any means show what Mr. Parker claims they show. While, as I said before, I do not question the theoretical soundness of the statement of Mr. Parker that a quick acceleration and low maximum speed is the most economical, the tests in question show, if anything, just the opposite. We find on an inspection of the speed curves in those tests (see inset, page 336 June issue of JOURNAL) that the run which took the most energy was made at a fairly uniform speed and that the maximum speed was low, while in the run that took the least energy the train was a number of times accelerated up to a very high speed and allowed to slow down several times just as Mr. Parker says. It was certainly to be expected from the well known mechanical formula given by Mr. Parker that the slower run made at a fairly uniform speed would take the least energy, and from the fact that this is not the case one is forced is believe that some factor enters into the tests that has not been considered or that all the conditions are not apparent on the face of the tests. They surely fail most decidedly to show what is claimed for them.

J. R. CRAVATH.

Heavy Electric Train Operation in Ohio.

THE AKRON, BEDFORD & CLEVELAND RAILROAD CO.
CUYAHOGA FALLS, O., Aug. 10, 1897.

EDITORS STREET RAILWAY JOURNAL:

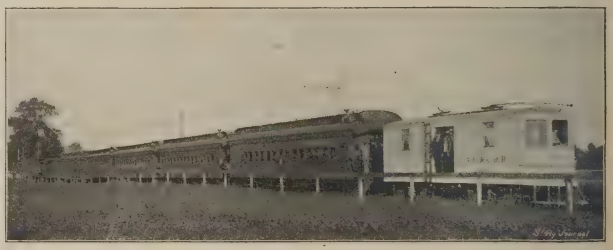
The accompanying illustration shows our large motor attached to nine coaches, which we use in shifting the excursion trains from the various steam roads.

This heavy motor was built for a snow plow, with the view of using it during the summer months for shifting freight cars and the above mentioned steam road excursion trains. Up to the present time we have shifted about twenty excursion trains, varying from six coaches to thirteen, loaded with excursionists from various parts of Ohio and Pennsylvania.

This car, which may be classed as a locomotive, is equipped with automatic air generated from a Christensen independent air compressor having a capacity of 22 cu. ft. per minute. The electrical equipment of this locomotive consists of four No. 38 Westinghouse motors; however, we do most of the shifting with three motors when we have up to eleven coaches—when more than eleven we cut in the fourth motor. The controllers are of the rheostat type and were built by the Akron, Bedford & Cleveland Railroad Company. The maximum current used in starting this machine when pulling eleven loaded coaches is about 400 amps.

A great deal of interest has been taken in this large motor by the hundreds of excursionists who have already been taken to Silver Lake pleasure resort in the modern way over the Akron, Bedford & Cleveland road, and it is quite interesting to see an excursion train of from nine to thirteen coaches pulled into our yards by a large ten-wheel locomotive, puffing and making plenty of noise and then to see the motor pick up this train almost noiselessly and do the same work as satisfactorily and in less time than it takes the ordinary steam locomotive.

As previously stated, the motor is equipped with automatic air, the apparatus of which was furnished by the Christensen Engineering Company, of Milwaukee. We very frequently receive a train of coaches without any air in reservoirs. In less than five minutes we can pump up a train of eight coaches, which is less time than it takes the ordinary locomotive to do the same work.



Very truly yours,

F. J. J. SLOAT, Supt.

Cost of Electromotive Power in Schenectady.

SCHENECTADY RAILWAY COMPANY,
SCHENECTADY, N. Y., July 28, 1897.

EDITORS STREET RAILWAY JOURNAL:

Referring to the article "Cost of Electromotive Power in New York and Massachusetts," on page 344 of your June issue, my attention has been called to the fact that the cost per car mile of this road, as shown in the tabulation in the article, was extraordinarily high, being nearly double that of the next highest on the list.

On examination I find that, in the table, our mileage for the year is given as *70,000*, which gives a cost per car mile of $.1138. This is an error on the part of someone; our mileage for the year was *170,000*, which would give car mile cost as $.049—quite a difference! Will you kindly publish this correction, as—while we know we have a costly road to operate, on account of topography—we do not want to be held up as a "terrible example" in two states.

Very truly yours,

H. S. COOPER,
Superintendent.

[The error referred to by Mr. Cooper is in the official report for 1896 of the New York Board of Railroad Commissioners, in which the mileage of the Schenectady Railway Company is given as 70,000.—EDS.]

Gear and Pinion Records in Omaha.

OMAHA & COUNCIL BLUFFS RAILWAY & BRIDGE COMPANY.

COUNCIL BLUFFS, IA., Aug. 19, 1897.

EDITORS STREET RAILWAY JOURNAL:

My attention was attracted to General Manager M. R. Adoo's report of motor gear and pinion mileage in the July Journal from the fact that the mileage is very very low as compared with the mileage upon this road.

I enclose data regarding our practice, hoping that others will give their records for the information of Journal readers. The length of car is 42 ft., its weight 24,000 lbs. without passengers, its daily mileage 171 miles and its monthly mileage about 5000 when in regular service. Steel gears and pinions are used and are enclosed and run in grease. "Type C" Steel motors are used.

The gears are about half worn out. The additional life of the pinions will be short.

NUMBER CLOSED CAR.	NUMBER OPEN CAR.	DATE IN SERVICE.	MILEAGE TO AUG. 1ST, 1897.
51	75	September 25th, 1895	62,434
53	77	November 16th, "	74,136
55	79	October 4th, "	84,508
57	81	" 18th, "	89,366
59	83	November 5th, "	76,335
61	85	" 4th, 1894	86,088
63	87	March 18th, 1896	47,127
Total Mileage 519,994. Average 74,284			

Yours truly,

W. B. TARKINGTON.

Car Wheel Records in Chester.

WILMINGTON DEL., Aug. 21, 1897.

EDITORS STREET RAILWAY JOURNAL:

We have on several occasions had some correspondence with your paper regarding the mileage of motor wheels, and we notice in one of your late issues, the publication of some mileage reports from Paterson Railway Company. As I know you have interested yourself with street railway managers to have them keep accurate wheel mileage, I naturally suppose you are interested in obtaining such data, and I enclose a letter from the Chester Traction Company, received a few days ago, on this subject that may interest you. While the mileage is not phenomenal, it shows a very fair result for 20 in., 30 in. and 33 in. wheels.

Yours truly, WM. W. LOBDELL.

CHESTER TRACTION COMPANY,
CHESTER, PA., Aug. 16, 1897.

LOBDELL CAR WHEEL COMPANY,
WILMINGTON, DEL.

GENTLEMEN: In looking over the July number of the STREET RAILWAY JOURNAL, I find an article on the "Life of Wheels, Gears and Pinions."

We have kept a correct yearly mileage record of your wheels, and find our average to be nearly 47,000 miles, including 20 in., 30 in. and 33 in., or nearly as high as the maximum of the Paterson Railway Company.

Thinking this might be of some interest to you, I take the pleasure of forwarding you this brief extract. Yours respectfully,

JOHN MACFAYDEN, Gen. Supt.

Recognition of Services by Employers.

SALT LAKE CITY RAILROAD COMPANY,
SALT LAKE CITY, UTAH, Aug. 18, 1897.

EDITORS STREET RAILWAY JOURNAL:

I herewith enclose you a copy of a letter that we gave to each one of our employes to-day as a token of our appreciation for the valuable and efficient services that they rendered during the fiftieth anniversary of Utah, which was celebrated here, commencing on July 20, and lasting until July 24, inclusive. During this time, we had an enormous traffic, there being a gathering of thousands of people in our city from our own and adjoining states, crowding our cars to their fullest capacity.

With our small system of about forty-nine motor cars and seven trailers, we carried some days upwards of 62,000 passengers without an accident. We think we did remarkably well.

We write you these few lines, thinking that it might be of some interest to you to hear of the "Far West" and to let you know that we are still alive, and yesterday was the eighth anniversary of our electric street railway system.

Yours truly,

W. P. READ, Supt.

[The enclosure referred to in the above letter reads as follows.—Eds.]

TO OUR EMPLOYES:

Now that the rush of business done by our company incident to the pioneer jubilee held in our city last month, is over and we have sufficient time to reflect upon the things of the past and consider the successful manner in which the cars were operated by our employes through the crowded streets, and realize the immense throngs of people we carried in all directions without injury or damage to either person or property, we desire to congratulate you and extend to you our heartfelt thanks for the labor rendered by you as an employe of this company, and we take pleasure in enclosing herewith a fifty fare ticket book for the use of yourself and family as a token of our appreciation of your services.

Very respectfully yours,

SALT LAKE CITY RAILROAD COMPANY.
W. P. READ, Supt.

Power Station Records in Philadelphia.

The accompanying table is a very interesting record, made at the power station of the Hestonville, Mantua & Fairmount Passenger Railroad Company, of Philadelphia, for the six months ending June 30, 1897. The power station of this company was described in full in the STREET RAILWAY JOURNAL for October, 1894. It contains four Greene tandem compound condensing engines, directly connected to four General Electric 400 k. w. generators, running at one hundred revolutions per minute. There are eight Babcock and Wilcox water tube boilers, of 250 h. p. each. Coal is received at a wharf adjoining the company's station, and is conveyed by coal handling machinery to the boiler room. The cars are equipped with electric heaters.

	Watt Hours	Elec. h. p. Hours	Car Mileage	Tons of Coal	Gallons of Cylinder Oil	Gallons of Engine Oil	Pounds of Waste	COST												
								Engineers	Oilers	Firemen	Helpers	Repairs of Engines	Repairs of Boilers	Repairs of Elec. Equip.	Repairs of Piping	Repairs of Pumps	Fuel	Oil, Waste and Packing	Watts per Car Mile	Cost per Car Mile
January ...	427,830,000	573,499	295,986	833	170.0	182.5	372	$607	$209	$420	$132	$	$	$	$	$	$1,623	$152	1445.4	$1.06
February..	366,030,100	490,617	265,944	715	152.5	164.5	348	485	168	336	106	56	6	20	9	11	1,394	137	1377.0	1.03
March.....	400,020,000	536,233	293,804	780	167.5	177.0	372	483	164	336	100	7	3		10	1	1,521	149	1361.5	0.94
April	326,770,000	438,347	283,672	642	167.5	177.0	360	609	210	420	131					1	1,252	148	1151.9	1.00
May	334,540,000	448,445	306,330	655	171.6	171.6	372	476	168	336	99	16	21		26	1	1,277	149	1091.9	0.83
June.....	311,670,000	417,788	301,846	608	165.0	165.0	360	483	168	336	100		2		2		1,186	144	1032.5	0.80
Total	2,166,860,100	2,904,929	1,747,582	4,233	994.1	1,037.6	2,184	$3,143	$1,087	$2,184	$668	$79	$32	$20	$47	$14	$8,253	$879	1239.9 Av.	$0.94 Av.

LEGAL NOTES AND COMMENTS.*

Edited by J. Aspinwall Hodge, Jr., and George L. Shearer, of the New York Bar.

"Stop, Look and Listen."

The rights and the duties of a person crossing the tracks of a railroad are, with few exceptions, the same, whether the person is on foot, on horseback, driving in a wagon or carriage, or upon a bicycle or other vehicle. For the sake of brevity, therefore, we shall use the word pedestrian, always with the understanding that what is said applies with equal force to the other classes mentioned.

The courts in England and throughout this country have been unanimous in affirming and maintaining the rule that the pedestrian approaching a steam railroad, whether he is upon the highway or not, must "stop, look and listen."

The reasons for the rule are obvious. The most convincing of them emerge from the fact that the train has the right of way, not the pedestrian. It is the latter who must stop, not the former. The engineer may see that if he keeps up his rate of speed and the pedestrian does likewise a collision will occur, yet his duty is performed when he blows his whistle and rings his bell—he has the right to count upon the pedestrian seeing or hearing him and stopping. The rule could not be otherwise in the very nature of things.

Efforts have been constantly made ever since the introduction of horse cars in the streets, by the counsel of the companies operating them to impose a like duty upon the pedestrian crossing the street car track and with varying success. The great weight of authority, however, has maintained the proposition that there is no such duty and for the reason that street car and pedestrian when they meet at right angles have equal rights upon the street. It is as much the duty of the horse car driver to slow up for the pedestrian to cross in front of him as it is for the pedestrian to stop to allow the car to pass. It was further argued that, if the rule were otherwise, since each of the parties to a possible collision have a right to assume that the other will fulfill the duties imposed upon him, the horse car driver would have a right to expect every one to stop, look and listen, while he drove on through a crowded street, slowing up and stopping only for passengers.

The driver of the street car is given certain rights over the drivers of other vehicles when not meeting them at right angles, because he cannot turn out of the car tracks; but otherwise the various users of the street have always been held to have equal rights therein and to be subject to the same duties.

At first sight it would appear that the introduction of electric and cable cars would not change this rule, but, at least in one state, it has been announced by the court of last resort that the rule which requires the pedestrian approaching the track of a steam railroad to "stop, look and hasten" applies to an electric road operated along the public highway. (*Hoelzel* v. *Crescent City R. R.*, *22 So. Rep. 330, 49 La. Ann.*; *Snider v. R. R. 18 So. Rep. 695, 48 La. Ann. 12.*)

It is manifest that if this duty is to be imposed upon the pedestrian who crosses the street car track it must be for some other, and less cogent reason, than that which caused the adoption of the rule in the case of the steam railroad; and so the decisions we have quoted do not intimate that the rule is based upon any alleged right of way which the street car possesses. In the first cited case the Louisiana court says, "when street cars ran slowly and "could be stopped within a distance of a few feet the rule for "the pedestrian to stop, look and listen did not apply as it "does to electric cars."

This is all the light given to us for the reason of the extension of the rule.

It remains therefore to consider whether that is a sufficient basis for the conclusion reached in that case and, if insufficient, whether there are other reasons which are sufficient, although they, necessarily, fall far short of the cogent reason already discussed which applies to the steam railroad.

The mere increase of the speed at which the cars are allowed to run would not seem to demand the universal application of the rule, and except in wet weather it is to be doubted whether with the latest appliances an electric or a cable car cannot be stopped in even shorter order than the ancient horse car.

But on the other hand, the pedestrian must in crossing any street use his faculties in a reasonable way and if he is given notice that a cable or trolley road is in the street by the presence of tracks with a slot or trolley poles he must remember that a higher rate of speed is maintained, that the continuous jingle of bells on the collars of horses while moving will not give him warning, and that a car may be directly upon him without announcing its coming by the approach of the heads of a pair of horses some 15 or 20 ft. in front of the dashboard. In place of horses who instinctively swerve out of the way for a person on the track, there is only a fender (and not always that) and at night a headlight.

There seems to be no other difference or distinction between the old horse car and the new motor cars. The rule that the operator of the street car is called upon to slow up equally with the pedestrian would seem still to apply in theory, however it is in practice. But practice, i. e., custom, sometimes makes the law, and the relative ease with which two persons, whether one or both are on cars or other vehicles, can avoid each other determines the practice and the custom, and so in the end the law.

Hence, while we anticipate the rejection by most of our courts of last resort of the Louisiana doctrine in its broad form, which would practically give the street car the right of way over other vehicles and street users, we see a tendency to adopt a less stringent rule, which would impose additional duties upon the pedestrian, duties amounting, in some instances, especially in crowded thoroughfares and in the night-time when the car is lighted (and he, presumably, is not), to the obligation which heads this paper, and in other cases to no greater duty than was imposed upon him by the older decisions which deal with his rights and duties when crossing a horse car track.

In other words, the duty to "stop, look and listen" is always obligatory upon the user of the highway when crossing a steam railroad, and would seem, oftentimes, but not always, to be imposed upon him when crossing a street car line, and the instances when the circumstances make it obligatory are more apt to be numerous where the car is operated by some other power than horse. (*Smith vs. Met. St. Ry. 7 App. Div. 253.*) H.

United States Patent Decision.

An opinion has been handed down by Judge Putnam in the United States Circuit Court in the case of the American Street Car Advertising Company, v. Newton Street Railway Company et al., ordering the dismissal of the bill against Messrs. Coffin and Smith, officers of the company, and directing the filing of a decree against the Newton Company for an injunction and an accounting. This is a bill in equity for alleged infringement of patents for an improve-

*Communications relating to this department may be addressed to the editors, Johnston Building, 30 Broad Street, New York.

ment in advertising racks. The complainant in its bill asked that the company and its officers, Winthrop Coffin, president, and Charles W. Smith, treasurer, be ordered to make an accounting and pay the complainants for all gains and profits accruing by reason of the employment of the racks on the company's cars, and also that an injunction be issued to prevent further manufacture of the racks under the patents granted the petitioners.

The Right of the City of Atlanta to Compel Transfers, Denied.

U. S. COURT.—The United States Circuit Court for the Eastern District of Georgia has recently handed down a decision in the case of Trust Company vs. The City of Atlanta, denying the right of the city to compel the Atlanta Consolidated Street Railway Company to issue transfers between all connecting lines operated by it. The ground of the decision is that the city had no power to fix the rate of fare to be charged by the street railway. In concluding, the court questions whether, if the city had authority to fix the rate of fare, such authority would enable it to compel the issuance of transfers.

The official report of the decision has not yet come to hand, but the full text of the opinion may be found in the Atlanta *Constitution* of July 24, 1897.

Abstract of Decisions.

FRANCHISES, ORDINANCES, ETC.

MICHIGAN.—Where a street railway franchise provided that on the company's failure to pay the cost of paving between its tracks, the city might forfeit the franchise, a forfeiture would not be enjoined because, from insufficiency of earnings, the company had become insolvent and unable to pay such cost.

Nor was the company's right to an injunction affected by the amount of the cost of the plant and of a mortgage thereon.

When a street railway franchise provided that, on breach of condition, the city might forfeit the franchise, it was not necessary to a forfeiture that there should be a judicial determination that the breach warranted a forfeiture.—(Union St. Ry. Co. v. Snow 71 N. W. Rep. 1073.)

NEW JERSEY.—The city council of Cape May by an ordinance granted permission to a railway company to lay its tracks on certain streets (naming them), and also to construct all necessary switches and turnouts. *Held*, that turnouts built in pursuance of such authority, unless it clearly appears that the authority has been exceeded, are not such an obstruction of the streets as to warrant their summary and forcible removal by police intervention without notice or a hearing.

Notice either actual or constructive, should be given to all who are interested, before the adoption of an ordinance which affects and practically adjudicates property rights. An unreasonable ordinance will not be sustained.

A resolution by a city council declaring the turnout of a street railway to be an unlawful obstruction, and directing the street committee to employ counsel and take legal measures to remove it, is not objectionable.—(City of Cape May v. Cape May, etc. R. Co., 37 At. Rep. 892.)

PENNSYLVANIA.—Where a street railway company is by statute granted a right of way, with a provision that, in the construction of its tracks, it shall conform to the grade of the street as established, or thereafter to be established, it cannot recover damages from the city for an impediment to travel caused by a change of grade made in the street by the city, and delay in the work, where the delay was not willful and not unnecessary, apart from a mere mistake of judgment by the city as to the best manner of doing the work.—(Ridge Ave. Pass. Ry. v. City of Phila., 37 At. Rep. 910.)

NEW JERSEY.—Under the act of Mar. 22, 1895 (2 Gen. St. p. 2717), the chancellor cannot impose upon the company whose steam railroad is to be crossed at grade by an electric railroad the duty and responsibility of operating a derailing switch in the line of the electric railroad.

Deque, Lippincott, Ludlow, and Bogart, JJ., dissenting.—(N. Y. & L. B. R. Co. v. At. Highlands, etc., El. Ry., 37 At. Rep. 736.)

NEW YORK.—In determining the proportion of property bounded on a street, the owners of which have given their consent, pursuant to Laws 1890, c. 565, § 91, to the construction of a street surface railroad, not only property which fronts on such street is to be considered, but also all property bounded on such street, though fronting on another, and the manner of description in the assessment roll is of no moment.—(Tiedemann v. Staten Island M. R. Co., 46 N. Y. Supp. 64.)

MINNESOTA.—The city of Tower, through its Common Council, granted to a street railway, its successors and assigns, the right and privilege of constructing, maintaining and operating a line of street railways on any and all of its streets and public highways for a period of twenty years, the cars on said railway to be propelled by horses, mules, steam, electric or other motor, for the purpose of transporting passengers and freight. The grant was made upon various conditions. The twelfth section of the ordinance reads as follows: "This franchise is granted upon condition that the company faithfully fulfill the requirements herein expressed, and should the company fail therein or willfully abandon such road, and neglect or refuse to operate it, then this franchise to become null and void. Said company agrees that it will forfeit said road to the city of Tower in one year after said company ceases to operate said road." The railway company became insolvent, and neglected and ceased to operate the road for more than one year. *Held*, that the word "road," as used in said section of the ordinance, has the same import as if it read "railroad."

Held, also, that the word "forfeiture," as used in said ordinance, did not signify a non-enforceable penalty nor liquidated damages, but authorized the court, upon default of the conditions of the grant, to declare, in a proper action, an absolute forfeiture of the railway franchises, including rails, ties, roadbed and things granted. Cary, J., dissenting.—(City of Tower v. Tower & S. St. Ry., 71 N. W. Rep. 691.)

U. S. COURT.—An agreement between rival applicants for a street railway franchise to combine in order to prevent competition between themselves or by others in procuring the franchise, and to avoid the imposition of conditions by the municipal authorities, is void as against public policy; and equity will not interfere to compel one of the parties to share with the others the fruits of their combination.

Brawley, District Judge, dissenting.—(Hyer v. Richmond Tr. Co., 80 Fed. Rep. 840.)

NEW YORK.—A city cannot enjoin a street railroad company from removing a crossing over its tracks, constructed by a steam railroad company without authority.—(City of Kingston v. Colonial City Tr. Co., 45 N. Y. Supp. 762.)

ALABAMA.—A railroad upon which electricity is used as the moving power is a railroad, within the provisions of section 1145 of the Code of 1886, providing that, when the tracks of two railroads cross each other, engineers and conductors must cause the trains of which they are in charge to come to a full stop within 100 ft. of such crossing, and not proceed until they know the way to be clear; the train on the railroad having the older right of way being entitled to cross first.—(L. & N. R. Co. v. Anchors, 23 South Rep, 279).

LIABILITY FOR NEGLIGENCE.

NEW YORK.—In an action against a street railway company for personal injuries, it appears that one of the span wires supporting an electric trolley wire, belonging to the defendant, broke, and the end in falling struck the plaintiff as he stood on the sidewalk, and burned out his eye. *Held*, that the doctrine *res ipsa loquitur* applied and that there was a presumption of negligence on the defendant's part, which it was called upon to explain or rebut.—(Jones v. Union Ry. Co., 46 N. Y. Supp. 321.)

LOUISIANA.—The rule that one before attempting to cross the track, should "stop, look and listen," applies to a street railway moved by electricity.—(Hoelzel v. Crescent City R. Co., 22 South Rep. 330.)

NEW JERSEY.—Escape of electricity from a street railway to the injury of a horse being driven on a public street, is presumptive proof of negligence in the operation of the railway. The doctrine *res ipsa loquitur* applies.—(Trenton Pass. Ry. Co. v. Cooper, 37 At. Rep. 730.)

MASSACHUSETTS.—In welding its rails, a street railway company first took up the pavement for 6 ft. in length at the joints, and excavated to the depth of 2½ ft. on each side of the rail, after which the welding engine was driven to the joint, and, when the ends of each rail were heated, they were welded together. The engine was then driven to the next joint, while another gang of men filled up the excavation, and replaced the pavement. Plaintiff, a boy ten years old, in attempting to cross the street, stepped with bare feet on an unguarded rail, which had so far cooled that it was black, and was burned. *Held*, that the question of defendant's liability was for the jury.—(Kane v. West End St. Ry., 47 N. E. Rep. 501.)

ALABAMA.—It is not negligence for a railroad company operating small cars on streets by a dummy not to so guard the cars as to prevent a trespassing child under seven years old from getting on and off the cars while being operated, or for falling or being thrown from such cars.—(Jefferson v. Birmingham Ry. & El. Co., 22 South Rep. 546.)

KENTUCKY.—Where the servant in charge of a street car discovers that a horse attached to a vehicle is frightened at the car and the ringing of the gong, and he can, by reasonable effort, stop the car, but fails to do so, or carelessly or wantonly keeps up the speed of the car and the ringing of the gong, causing the horse to run off and injure the driver, the company is liable.—(Owensboro City Ry. Co. v. Lyddane, 41 S. W. Rep. 578.)

MICHIGAN.—In an action against a street railroad company for injuries, it appeared that plaintiff was driving on the track, and, on hearing the bell, attempted to drive off, but, owing to the slipping of the wheels, the horse did not get the wagon off the track in time, and the car struck the wagon, injuring plaintiff; that plaintiff was seen by the motorman in time to have stopped the car; that the car was reversed a very short distance before it struck the wagon; and that plaintiff had time to drive off the track before the car reached him, had the horse been able to pull the wagon off at once. *Held*, that the questions of negligence and contributory negligence were for the jury.—(Bush v. St. Joseph & B. H. St. Ry., 71 N. W. Rep. 851.)

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IT is a pretty good plan for a street railway company to have it well understood among manufacturers that the words "two per cent discount for cash in ten days," when written on their bills, will bring about quick results in the form of a check in settlement. It is a good plan for the company itself, as the saving may be, in the aggregate, a large one, amounting often, perhaps, to the manager's salary or more. A policy of this kind requires a little extra care on the part of the accounting department, as, for example, the issuing of instructions to all employes who have to handle bills at any stage in their passage through to the treasurer's check book, to "rush" bills containing this discount notice; while the treasurer should be able to fix the responsibility for a loss of the discount privilege by requiring that all these employes shall stamp the date and hour on which bills leave their hands, so that any unnecessary delays may be traced down and the cause ascertained. This system is used, exactly as here described, by one of the largest street railway companies in the country, and has brought about excellent results, the discount privilege being now offered by a large proportion of the company's creditors, who have found out that it means practically cash transactions instead of time payments. The aggregate saving from these discounts alone actually amounts in this case to from $25,000 to $50,000 a year.

THE principal service to the practical railway manager of a good accounting system is to determine the actual cost of operating his system, and whether too much money is being spent in different departments. If the expenditure for clerical help will enable the operator to save more than it amounts to, a distinct gain is secured, and very often a few cents spent in this way will result in many dollars being saved to the company. An instance of this was recently shown on the system of a certain company operating in a town of about 60,000 inhabitants. A new manager found that the repair account for electric equipment and rolling stock was considerably more than that on the road from which he came, and immediately commenced an investigation to learn the cause. No system of repair shop accounts had been previously employed and when any apparatus became defective the car had been simply run into the shops for such repairs as might be thought advisable by the master mechanic. The latter, either through ignorance, carelessness, or a desire to show a high record of amount of repairs performed, had been accustomed when he received a disabled car to renew many parts which had not entirely worn out. As the shop pay roll and the purchasing agent's order book were the only indexes of the amount spent in repairs, the scrap pile was gradually eating up a large part of the earnings of the company. The introduction of shop orders and of a very simple system of two or three books, in which the exact work done at the repair shop was entered and the life of all discarded apparatus was recorded, soon proved where the trouble lay, and it is needless to say that before long half of the repair shop force was discharged, the cost of supplies was materially reduced, and a master mechanic was looking around for a position. The saving to the company amounted to very many times the few hours' work a week required to keep the records, and the stockholders were in like measure benefited. This is only one example of the reforms and economies made possible by a judicious system of bookkeeping.

MUCH more of the success of every street railway line depends upon the conduct of its conductors and motormen than is generally appreciated. These are the only representatives of the company that are brought into direct contact with the traveling public, and the latter usually forms its conception of the character of the railway company on whose cars it rides, upon the treatment received at the hands of its uniformed employes. Even the slightest brusqueness on the part of a conductor in answering questions, or of carelessness by the motorman in running past a street corner is likely to be resented by some passenger, and when such an event occurs the person slighted is apt to attribute to the company an habitual disregard of the public convenience in all matters. On the other hand, it is well recognized that by courteous treatment, a conductor can often make an actual gain in traffic, and on suburban lines where the cars are run under long headway and the runs of certain conductors are known, some will actually attract passengers through a

feeling of safety or comfort in their charge, while the runs of others will be avoided. Much, therefore, depends upon the discipline to which employes are subjected, and even more to the impression made upon them of the fact that their interests, as well as those of the company, lie in attracting, not repelling traffic. While the best conductors are born, not made, yet a great deal can be accomplished in this branch of the service by proper instruction. Rules are, of course, necessary, but they should not be too long or numerous. A few terse instructions are more easily read and remembered by the men than a long and complicated code, and are hence more easily followed. A fact of importance to be borne in mind in issuing instructions to motormen is the possibility of their introduction as evidence by the prosecution in future damage suits. For this reason special attention should be paid to the wording of the instructions. Certain companies have now discontinued the practice of printing their rules in book form and of then distributing them to the employes. Instead, the rules are posted in the different car houses, one object being to make them less accessible to persons wishing to use them to the detriment of the company. More than all else in the line of discipline tending to bring about courteous and patient treatment of the public by street railway employes is a knowledge on their part that all complaints of discourtesy will be rigorously investigated by the company. It is a mistake for a street railway manager to refuse to pay any attention to complaints by his patrons of incivility or bad service, or to uphold his employes, "right or wrong;" for no impression on the public mind is so injurious to the company's permanent enjoyment of prosperity as one that its employes, from the manager down, are banded together against the public. It is sometimes said that the *morale* of an operating force is improved by the knowledge that superior officers will always trust an employe's word against a complaining citizen. This is not true; the effect of such trust upon the average employe is rather to make him insolent to patrons and thus to increase the difficulties complained of.

MOST railway companies are now making special provision for the comfort of their employes during off-hours, in marked contrast to the days of horses, when the only gathering place for the drivers and conductors was around the car house door. Now, nearly every car house which is built has its motormen's and conductors' room, sometimes two, in which the men are encouraged by a variety of means to spend their spare time. In general, some kind of reading matter and amusements in the way of checkers, cards, etc., are provided; often the rooms are furnished with dumb bells, Indian clubs, a punching bag or set of boxing gloves to develop the muscles; and a pool or billiard table is not unheard of. To be sure, this sort of thing costs money from which a direct return may not be seen for some time, but those companies which have gone furthest into the policy of making the car house attractive to the men speak of the results as most favorable. Considering the question in its broad light, it gives to the men more of the feeling that life is worth the living, particularly life in the service of employers who have some regard for the pleasure and interest of those who work for them. Another important benefit following the establishment by the company of such rooms is the opportunity afforded the superintendent or manager of meeting his men upon other than a purely business basis. In winter these rooms can be used in the evenings for occasional lectures in which the superintendent or engineer of the company can explain the construction of the electrical or other apparatus, or the manager can outline the company's policy upon different points, if necessary. At other times regular entertainments by the men themselves can be given, as is now done so successfully by the Metropolitan Street Railway Company, of New York, and to those who have never attended an entertainment of this kind, the amount of genuine talent for music and theatricals in a body of 200 men of this kind will be very surprising. To these entertainments the employes may sometimes bring their families, and these occasions are often looked forward to as among the important events of the winter. While many companies would not wish to go so far as to fit up rooms so completely as to allow this, or give up the necessary space, and while the details in every case would have to depend on the circumstances, the policy of keeping the employes around the car house during their spare hours is undoubtedly correct. In fact, the general trend of practice, especially on the larger roads, is toward a greater effort to cater to the pleasures and wants of the men than formerly.

THE thought has sometimes come to us—cannot profit sharing in some form be made a possibility in street railroading? It is a daring thought certainly, and at first blush it looks as if the complexities would be too great to warrant a trial. We presume, moreover, that street railway managers in many cities would be prone to wax playful at such a suggestion and remark that a profit sharing plan had already been established by their employes, "willy nilly," as it were. Any plan of legitimate profit sharing must surely be so made as to kill illegitimate profit sharing, or at all events to bring about a substantial increase in the net receipts obtained for the company's treasury, if it is to be a success. Suppose, for example, that a street railway company should offer to its motormen and conductors a certain percentage of the gross receipts collected on each trip, half of the percentage going to the motorman and half to the conductor; would not every motorman be on the alert to detect a possible passenger, every conductor graciously welcome that passenger into the car and treat him with such consideration as to make him wish to ride again with so courteous a conductor, and would not both conductor and motorman exercise a constant watch on each other to see that no passengers or fares should be lost? Employes would soon begin to work for records and with a pride in results, the element of competition being potent in matters of this kind where large numbers of men are employed, and shame might bring about many reforms in the practice of "knocking down" fares, which could never be accomplished by a system of inspectorships. It is by no means impossible, we believe, that the best results will follow from the play of forces, checks and counter-checks acting naturally in this manner, and it is certainly true that if the system worked at all it would bring about a great change for the better in the relations between the company's major and minor employes, and between the company itself and its patrons. Not the least important of the good results arising from such a plan would be the possibility of detecting inefficiency or dishonesty, by means of the relative rank of the men in

the matter of receipts taken in; and knowledge of this fact would be one of the most potent influences tending to bring the poor or dishonest ones in the force up to better standards. It is, perhaps, less easy to devise a workable scheme of profit sharing in the department of general expenses and maintenance than in that of transportation, but even here it may be possible to recognize reduction in expenses in such a way as to establish a system of competitive work which will prevent time killing in the shops, and other methods of wasting the company's money. The essential feature of the profit sharing plan which has made it so successful in many industries where introduced, has been found in the way in which employes come to spur each other on to honest work, the object being to increase the distribution of large profits among all. Another feature is found in the reluctance of men to give up their jobs and the difficulty of inciting a "strike" feeling. We should very much like to see this profit sharing experiment tried on some road where the conditions are favorable, and we would be much surprised if, twelve months after its inauguration, the company would not have left in its treasury after payment of the agreed percentages to its men, a sum substantially larger than during the preceding twelve months, and larger too than would have been obtained by any natural increase in traffic.

Municipal versus Private Management of Street Railways.

Elsewhere in this issue will be found an extended discussion on this subject, taken from advance sheets of "Municipal Affairs," and forming part of a controversy in which municipal ownership and operation of street railways is advocated by Hon. John De Witt Warner, of New York, and private ownership by Edward E. Higgins. We very much regret that Mr. Warner's article was not completed in time for presentation in this issue of the Journal, as originally intended, for we believe that it will be exceedingly interesting for our readers to know exactly on what grounds municipal ownership can be theoretically and practically urged.

The argument in favor of private ownership is, on its broadest lines, this: that governments in general, and municipalities in particular, being essentially conservative in trying new things, and unrestricted private capital being, on the contrary, essentially eager to anticipate the future and to pre-empt all possibilities of profit, municipal management, or heavily restrictive control of public service enterprises is not, nor ever will be a success from the standpoint of a people's progress.

This argument dominates all others, and when thoroughly understood in all its bearings makes the economic argument, as ordinarily used—the argument of investment and percentage return on investment in dollars and cents—seem petty indeed. Had our American municipalities been charged with the responsibility of creating and developing their local transportation systems during the past fifty years, we should probably have to-day 5000 miles of track instead of 15,000, and our city fathers would be, in this year of our Lord, 1897, gravely considering the question as to whether or not it would be wise to experiment with some two mile electric line in the suburbs, —with "this new fangled idea." Try as we may to recall to our minds the transportation facilities of fifteen years ago —we can scarcely believe it possible in the light of our present freedom that our cities could be then so cramped for room to expand. Are tremendous sociological changes of this kind of no value to a people? Do they not rather outweigh all *mere* values possible to express in dollars and cents?

Moreover, turn over to our municipalities to-day every mile of street railway track in the United States! Who would dare to believe that fifty years hence we should have as cheap, as efficient and as widely ramified transportation systems as will serve us then if private ownership be continued?

Aside from this controlling argument in favor of private ownership, strong ones on a lower level are not wanting. The economic argument narrowly stated is quite as surely in favor of private ownership as is the case with the broader statement. That which attracts private capital in such quantities to this street railway field is quite as much the desire for *speculative* profits as that for *operating* profits. Operating profits there are in most cases, even with the wonderful extent of our American city systems and the perfection of the service thereon, but these profits cannot, even by the most bigoted opponents of corporations, be regarded as excessive in view of the risks run, not the least of which is the ever-changing "state of the art," which may make heavy losses of investment, through the necessity for improvements, inevitable. Are our municipalities willing to take upon themselves these risks, and to agree to carry out their responsibilities as strictly as they will demand that private capital shall do if left in possession of the field? Will they agree with the public to adopt a new and better form of motive power and throw away their investment in the present form, should the new promise better than the old? All these are questions which the advocate of municipal management usually finds it convenient to overlook, and we shall watch with much interest to see how Mr. Warner will deal with them.

But when all is said and done, it is right that the community should have some continuous interest in, and control of, the transportation facilities which are so intimately connected with its life and development, and it seems to us that a plan of profit sharing is more equitable to all concerned—the municipality, the public and the street railway companies—than the present system of taxation. Taxation of street railway earnings or property is really a form of indirect taxation of the people, since it acts to prevent reduction in fares. Profit sharing, on the contrary, may be so arranged as to benefit the people in two ways, one by reducing the burden of taxation, and another, when profits are sufficient, by bringing about a reduction in fares; while private capital is not burdened beyond its strength, but only in proportion to the profits.

Many are the problems involved in street railway management—many the responsibilities. The skill and training and brain power and executive ability necessary for the handling of great public service enterprises is not to be had for the meagre compensation which tradition permits municipalities to offer its employes, nor do frequent political changes promise well for a municipal management system. In private hands alone can be found the necessary ability in management, permanence in results and definite responsibility to the public which is demanded in so highly developed a social organization as is found in the New World to-day.

CONSTRUCTION

Inclined Railway in Massachusetts.

The work of building an inclined electric railway to the top of Mt. Tom, the highest peak of the Holyoke Mountains, has just been completed by C. F. Parker & Company, contractors. After a careful study of the existing conditions, and of a number of inclined roads already

CARS ON MT. TOM INCLINED RAILWAY.

in operation, the contractors decided to build the road with non-balancing grades, and with the motive power on each car, the two cars counterbalancing each other by means of a cable. The contractors think the economy of construction in adopting the non-balancing grade is evident, as deep cuts and fills are avoided and no trestles are used, thus reducing first cost as well as depreciation and maintenance account very materially, and scarcely, if at all, affecting the amount of power used.

The use of winding engines, which are at all times expensive, both in first cost, operation and maintenance, was unnecessary, as the electric lines of the Holyoke Street Railway Company came to the base of the incline, and it was simply necessary to tap the wires of this company and use motors on the car axles as in ordinary trolley practice.

The following are the principal dimensions of the road: length of incline, 4900 ft., elevation above foot of incline, 700 ft., maximum grade, 21¼ per cent, minimum grade, 7 per cent, average grade, 14 per cent. Near the top of the line there is a curve of 2000 ft. radius.

Two rails of standard type, weighing 56 lbs. to the yard, are used, a third rail being unnecessary, owing to the use of an improved turnout, which is described below. The rails are spiked to 6 in. × 6 in., yellow pine ties, each of which is spiked to two 8 in. × 12 in., yellow pine stringers directly beneath the rails, the gage being 4 ft. 8½ ins. The stringers are spiked to 12 in. chestnut mud sills, spaced 5 ft. 12 ins. center to center, and the whole line is rock ballasted. The ties are spaced 2 ft. centers, and between each pair is a yellow pine separator spiked to the stringers.

A turnout 700 ft. in length and consisting of four tracks is placed at the center of the road. This turnout is a special feature of the road, and, as above stated, requires neither the use of the third rail, spring, nor movable switches, the taking of the proper track being positive and absolute. This is accomplished by the use, on opposite sides of the two cars, of broad tread wheels and deflecting rails. These deflecting rails, which are somewhat higher than the main rails, are about 13 ft. in length and so inclined to the main rail that when the broad tread wheel touches the same the car is gradually deflected to its proper switch point. Near the top and bottom end of the turnout the main rails are omitted for the passage of the cables, the cars being carried over the break on two auxiliary wheels running loose on an axle which runs upon a wing rail laid 15 ins. outside of the main rails.

The idler sheaves for supporting the cable are spaced every 30 ft. and are of the standard cable railway pattern, running in babbitted boxes. The steel cable, which was specially manufactured for this road by the Trenton Iron & Steel Company, is 1¼ ins. in diameter, and is composed of six strands of nineteen wires each, laid over a hemp center. Each end of the cable is leaded into sockets strongly attached to the car frames. At the top of the incline is the deflecting sheave, 6 ft. in diameter, and an 8 ft. return sheave. Upon the A frame carrying this sheave is the specially designed cable grip operated by a fly ball governor so regulated that should the speed of the cars exceed 1400 ft. per minute—1300 ft. being the ordinary

LOOKING UP A GRADE ON MT. TOM INCLINED RAILWAY.

speed—the governor balls will trip a weight, bringing the cable grip into action, and gradually stopping both cars. As an additional safeguard there is placed under each car

an independent safety apparatus, manufactured by the Sprague Electric Elevator Company, which is operated by a governor set to trip at a 1500 ft. per minute speed. This can also be tripped by hand, as, at each end of the car, is located a trip lever, directly under the control of the motorman. The form of the safety apparatus differs radically from those hitherto used on inclines, in that the safety rail is of steel instead of wood which rapidly deteriorates from constant exposure to the weather. The safety T rail which is gripped by the safety proper, is

A TURNOUT—MT. TOM INCLINED RAILWAY.

spiked through a 4 in × 10 in. yellow pine stringer directly to the ties, horizontal bolted spliced plates being used at the joints. The safety proper is hung from and butts directly on the car frame. The stopping of the car when the safety brake is in action results from frictional resistance between the T iron and the safety shoes, the necessary pressure being applied to the shoes by springs. The application of the springs differs from, and is superior to, the standard safety as used on T iron guides, in that the tension of the spring is greater after the shoes have gripped the rail than before the safety was sprung. The tension of the springs is so adjusted that the car fully loaded and at full speed, will come gradually to rest in from 15 ft. to 25 ft., depending on the grade. Communication between the cars can be carried on either by the use of a large gong or by telephone, the connection between the cars being made by two No. 4 hard drawn copper wires. At the side of the track upon these wires ride the proper connecting trolleys. Upon the ends of each car are push buttons operating the signaling bells, which are in series instead of in parallel, as ordinarily used, so that, if the bell upon the car which signals does not ring, the motorman will know that none of the other bells have rung and that there is trouble in the circuit.

The cars are of extra strength, with platforms at each end, the upper platform being large enough to carry such materials and supplies as are required by the pavilion at the top of the mountain.

The electric equipment consists of two G. E. 1000 motors on each car, controlled by controller on either platform. Besides the ordinary shoe brake, each axle has a special electric brake. Two trolley poles are used, one for each direction. Overhead wire consists of two No. 0 wires, one for each car.

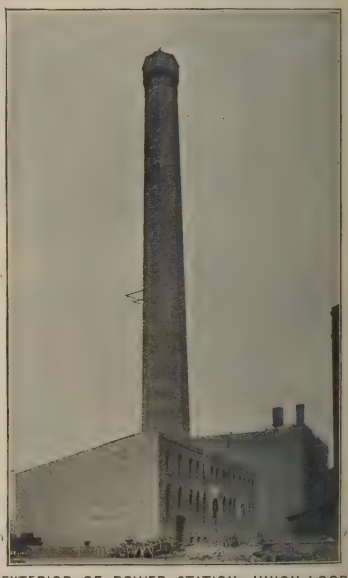
The City Council of Cleveland has appointed a committee to ascertain the cost of carrying street railway passengers and to determine whether or not a proposed three cent fare bill in Cleveland should be passed.

The Union Elevated Railway of Chicago.

Work on the structure of the Union Loop Elevated Railway in Chicago is now practically completed, and within a short time the trains of all the elevated roads will be running over it. The loop was constructed for the purpose of connecting the downtown termini of the elevated roads and enable them to discharge passengers at points more convenient to the business center of the city. Heretofore the elevated lines have been compelled to land their passengers on the edge of the business district, and without the excellent system of loops enjoyed by the surface roads, have been at a considerable disadvantage.

It is expected that the new arrangement will largely increase traffic on all the elevated lines. A pedestrian at any point inside of the section bounded by the river on the north and west and the lake and Harrison Street on the east and south can reach an elevated station in a walk of three blocks. Not only will passengers be brought nearer their places of business, but they may also go from one side of the city to any other without descending to the street.

The loop is in the form of a rectangle about 2 miles in length with its sides in Wabash and Fifth Avenues, Lake and Van Buren Streets. The structure carries two tracks; the inside one will be used by the South Side and Metropolitan Companies whose trains will go around in a direction opposite to the hands of a clock. The outside track will carry the Lake Street and Northwestern trains in the opposite direction.



EXTERIOR OF POWER STATION—UNION LOOP ELEVATED RAILROAD.

With the completion of the loop and the Northwestern road there will radiate from the center of the city a connected system of elevated roads aggregating nearly 86 miles in length, or approximately 43 miles of double track. There is no third track or arrangement for express trains on any of the lines. When it is remembered that every train of the four roads will pass over the loop structure, it is easily seen that it will become a very busy line. The total number of trains now running on the elevated roads is about 1200 per day. To this number will be added some 600 or 800 from the Northwestern as soon as it is completed. It is also expected that it will be necessary to increase the present number of trains on all the lines when connections are made with the loop.

The loop company is a distinct organization. Upon a contract made with each of the other four companies the Union Elevated Company is to receive 10 per cent of the gross passenger receipts and a guaranteed annual payment of $62,500 from each of the four roads.

All lines will be equipped with the third rail electric system; the Alley L is the only one now operated by

steam and the preparations for equipping it with electricity are now in rapid progress.

The stations are so arranged that passengers may enter from either side of the street. Immediately under the waiting platform is a second floor, and passengers coming in on one line or having ascended the wrong stairway may descend to this floor and pass over to the trains on the other track without going down to the street.

The power house is on Market Street at the head of Congress Street on the bank of the Chicago River. It is designed for a present capacity of 7500 h. p. with space for increasing this to 10,000 h. p. The building is irregular in shape; the front length is 141 ft., 63 ft. on the river and 163 ft. 10 ins. deep. To save space it has two stories, the boilers being on the upper floor. The walls are of pressed brick trimmed with Bedford stone. The foundations, like those of the majority of heavy Chicago buildings, are laid on deep driven piles. The brick stack is 250 ft. high with an inside diameter of 13 ft.

Three cross compound condensing engines of 10,000 h. p. aggregate capacity are to be installed, cylinders, 30 ins. × 60 ins × 60 ins., and designed to run at 75 r. p. m. The flywheels will be 25 ft. in diameter and weigh over 100,000 lbs. The George H. Corliss Engine Company is building the engines. The Siemens & Halske Company will furnish the dynamos which are to be direct connected and of 1500 k. w. capacity each. The station will be equipped with Acme stokers, ash and coal conveyors, Wheeler condensers, traveling and post cranes and a coal bin holding 2000 tons.

The floor of the boiler room is 48 ft. $3\frac{5}{16}$ ins. above that of the engine room. It is supported by 52 in. box girders; these rest on girders 51 ins. deep, supported by steel columns. The floor of the boiler room is of sheet steel, $\frac{5}{16}$ in. thick; the engine room floor is also of steel, being $\frac{7}{16}$ in. thick.

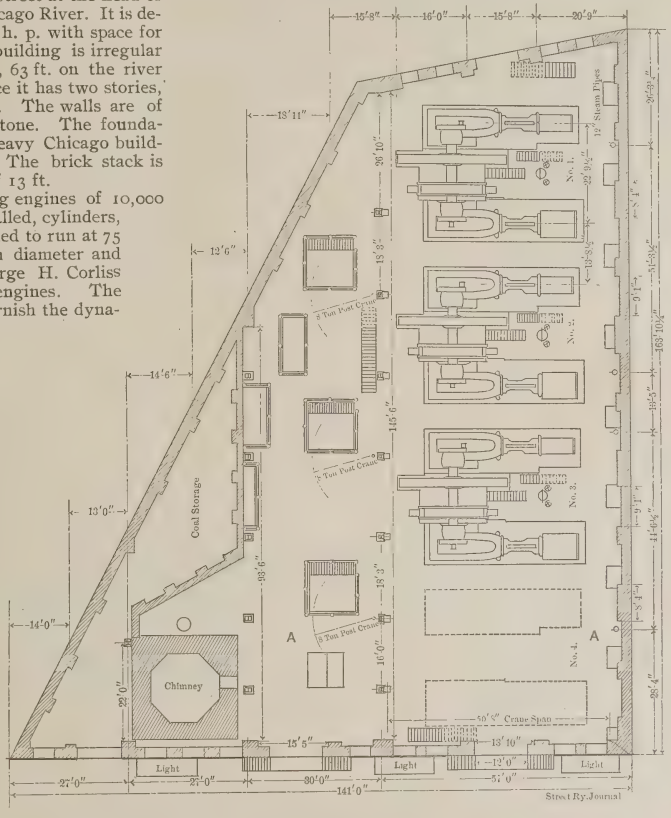
Twelve feet below the boiler room floor is the ceiling of the engine room; the framework is of steel I beams, suspended from the boiler room floor girders. In the intervening space between the floor of the boiler room and ceiling of the engine room will be located the ash conveyors and flues leading from the furnaces to the stack.

The boiler room will contain sixteen Babcock & Wilcox boilers of 400 h. p. each; ten of these will be on the north side and six on the south; the flues leading from the two batteries, as stated, pass underneath the floor and enter the stack from opposite sides; a partition in the stack prevents the draft from one side interfering with that from the other.

The Union Elevated presents a most unique problem in the operation of trains. As stated above, the loop will be operated as a left handed road. The maximum capacity of the loop has been estimated at sixty trains per hour for each track or 120 trains for the two tracks. If but one road were to use the loop no junctions or switches would be necessary and hence no complications, but with the four roads, three junctions and trains passing these junctions at the rate of 120 per hour, the problem is a most complicated one.

The report and plan of H. M. Sperry, signal engineer of the National Switch & Signal Company, after a careful study of the conditions, was adopted by the engineers of all the roads.

The special features of the signaling are torpedo machines placed at each signal. This machine is so devised that when the signal is in the stop or danger position a torpedo is placed where it must be exploded by the first wheel passing over it; when the signal is cleared the torpedo is withdrawn. This device has been in use on the New York elevated roads since 1891. The function of these machines is much the same as that of a derail on a surface road. The arrangement of the levers is such as



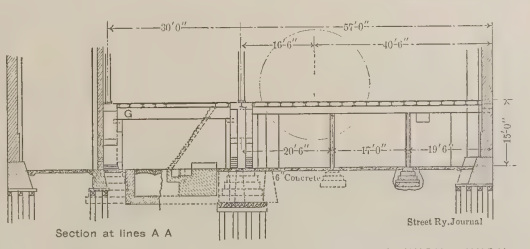


FIG. 1.—PLAN AND PART SECTION OF POWER STATION—UNION LOOP ELEVATED RAILROAD.

to greatly economize the time of the lever man in handling them, the important levers being grouped together. The towers are handsome structures two stories high, of galvanized iron. The sizes and plants are as follows:

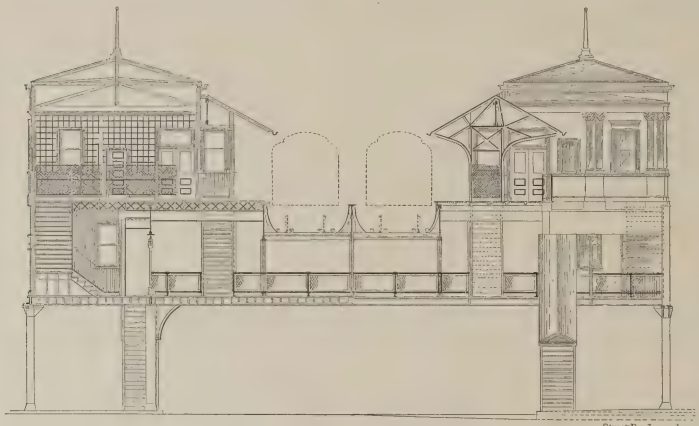
Lake and Market Street Junction operating crossovers for crossing trains from right to left	12 levers.
Lake and Northwestern Junctions for the connections of the Lake Street and Norwestern Elevated (not yet completed)	27 "

Alley L Junction for connection of the Alley L	22 levers.
Metropolitan Junction for the connection of the Metropolitan	29 "
Market Street for the new four track junction of the Metropolitan	19 "
Six diamond crossovers for emergency purposes, eight levers each	48 "
Total working levers	155 "

The Union Elevated Railroad Company was incorporated in the fall of 1894 with a capital stock of $5,000,000. According to the terms of its franchise, the company will pay to the city after deducting $250,000 annually, 5 per cent of its gross receipts during the first four years, 10 per cent during the next five, 15 during the next five and so on to 25 per cent for the last fifteen years of the period of the franchise.

The officers are: president, D. H. Louderback; vice-president, C. D. Hotchkiss; secretary and treasurer, Howard Abel.

The power house was designed by S. Potis, Jr.; and Jas. R. Chapman is the engineer in charge of the electrical construction.



Street Ry. Journal

FIG. 2.—MADISON STREET STATION OF UNION LOOP ELEVATED RAILROAD.

A Bridge Across the Schuylkill River in Fairmount Park.

The illustration given herewith represents a bridge built over the Schuylkill River for the Fairmount Park Transportation Company, of Philadelphia, to connect its railway lines in the east park and west park. The bridge is 1237 ft. long and 79 ft. wide.

A double track railway is constructed on the south side, the entire width of which from center to center of railing is 27 ft. A driveway for carriages, 40 ft. wide, is located on the central portion, and a footwalk 12 ft. wide along the northern railing.

This bridge spans a carriage drive 60 ft. wide in the west park and two drives of the same width in the east park. It consists of one lattice girder span 40 ft. long and two lattice girder spans 70 ft. long, constituting the approach in the west park; four steel arches, each 208 ft. long spanning the river; and two lattice girder spans 70 ft. long and one lattice girder span 85 ft. long, constituting the approach in the east park.

The roadway and the footway are laid in Trinidad asphaltum and have an ascending grade from the west of 2.3 per cent for the western approach, 1.2 per cent on the river spans and 2.5 per cent on the eastern approach.

The ties extend across the entire width of the railroad, and this roadway is planked with 2 in. × 6 in. yellow pine plank between and on the sides of the tracks.

SCHUYLKILL RIVER BRIDGE, FAIRMOUNT PARK—SIDE VIEW.

SCHUYLKILL RIVER BRIDGE—TOP VIEW.

Novel Street Car Advertising.

The accompanying cut shows a method of street car advertising, used by the Canal & Claiborne Railroad Company, of New Orleans, the results from which are said to have been most gratifying. As will be seen from the illustration, narrow banners are stretched before the front dashboard and over the fender. These banners bring before the people of the city, in a very forcible and emphatic manner, the different attractions at the company's park. The banners are changed at frequent intervals.

The roadways for the railroad and the carriage drive are separated by an iron railing of the same pattern as the side railing to prevent accidents to pleasure drivers.

Work on the masonry for piers and abutments was started in July, 1896, and the railway traffic over the bridge was started June 13, 1897. This bridge was constructed by the Phœnix Bridge Company, Phœnixville, Pa., and the masonry was laid by O. M. Viand, Reading, Pa.

The New Underground Conduit Construction in New York.

All legal obstacles that have hitherto prevented the Metropolitan Street Railway Company from commencing work on its underground conduit lines on Fourth Avenue have been removed and under the direction of contractor John D. Crimmins, the streets have been opened through nearly the entire length of the route from City Hall to 129th Street, and work is rapidly progressing. Mr. Crimmins is reported to believe that he can complete the work at an average rate of a mile a day, though it hardly seems possible that this can be accomplished, in spite of his long and valuable experience in work of this kind.

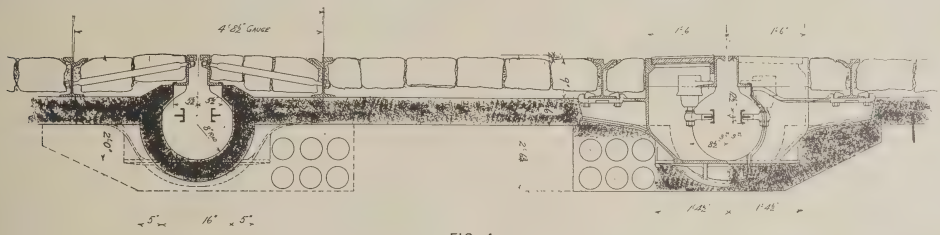


FIG. 1.

The new conduit, in some detail, has been described in previous issues of the STREET RAILWAY JOURNAL. The sections finally determined upon, with dimensions, are shown in the accompanying engravings. The peculiarity of this construction is the comparative shallowness of the excavation and of the conduits, the depth being but 30¾ ins., from street surface to bottom of excavation as against considerably greater depths for ordinary cable conduits as well as for the Lenox Avenue underground construction, although with a certain portion of the latter, experiments have been made with shallow conduits with results sufficiently good to warrant the adoption of this method as a standard for the new work.

The yokes will be spaced 5 ft. apart, the manholes 150 ft. apart, and the handholes where insulators are attached, 15 ft. apart. The conducting rail is a T section with edges lapped in such a way as to give additional stiffness for resistance to the pressure of the plow contacts. These rails are held in position by the insulators, as shown in Fig. 1. The insulation is of porcelain which is screwed and cemented into a cast iron bell, while an iron screw pin holding the yoke is screwed and cemented to the inside of the insulation. The insulator is 7¼ ins. deep, and the conductor rail is 14 ins. below the top of the slot rail.

The manhole construction is shown in Fig. 2. The manholes are 5 ft. in depth and at their lowest point have catch basins connected with the sewer.

The rails are 9 ins. high and weigh 106 lbs. to the yard and the slot rails are 7 ins. in depth and the same in form as those employed on the Broadway cable line.

The Metropolitan Street Railway Company is building a 25,000 h. p. station on the upper East side which will furnish most of the power for the Sixth, Eighth and Fourth Avenue lines, through transmission circuits to different substations in the city where motor transformers will be installed.

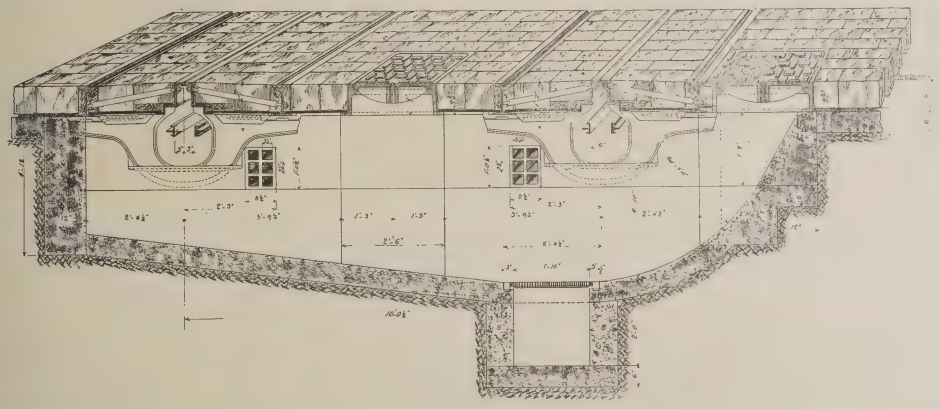


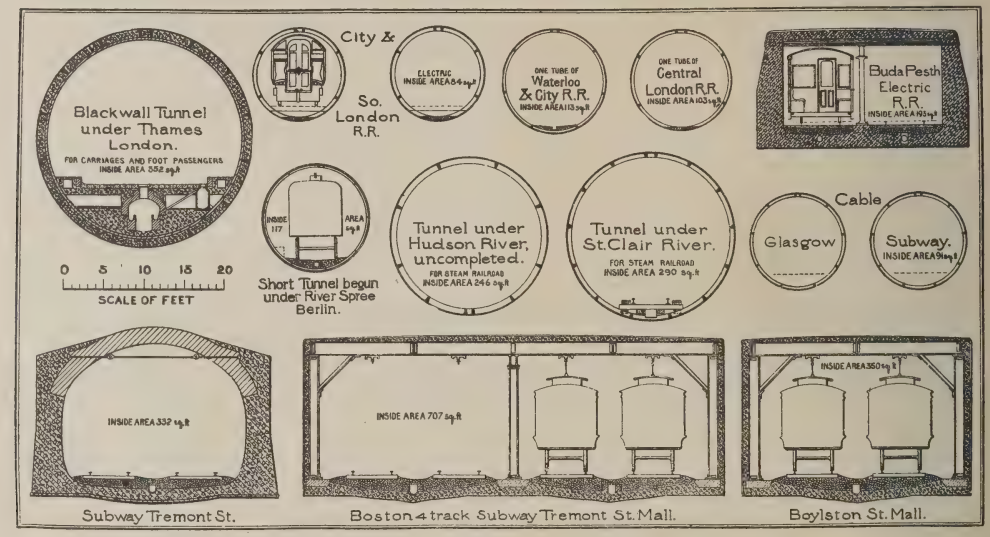
FIG. 2.

SOME interesting details upon the reduction in the cost of steam power from 1870 to 1895 were recently brought out by F. W. Dean, the well known steam expert of Boston, in a recent paper before the Association of Mechanical Engineers. He stated that for years the pumping engine has been considered the most economical in the use of steam, but that within the last few years several engines have been designed and built which compare most favorably with the best of pumping engines; and that compound engines are now being built which produce power from 12¼ to 12¾ lbs. of steam per horse power hour.

Electric Power from the St. Lawrence River.

Work was recently commenced on the plant of the St. Lawrence Power Company, which is to be erected at Massena, N. Y., for the commercial development of electric power from the waters of the St. Lawrence River. The St. Lawrence Power Company is a corporation organized under the laws of the state of New York, with a capital stock of $6,000,000, which is owned jointly by an English syndicate, which is represented in America by Seward, Guthrie & Steele, of 40 Wall Street, New York, and Stewart & Company. The officers are Wm. C. Lane, president; S. H. Gardyne Stewart, vice-president; Carleton H. Reeve, secretary, and Wm. C. Cox, treasurer. All contracts for construction work have been closed, and the engineering and construction work will probably be completed in December, 1898.

The St. Lawrence River carries an enormous volume of water gathered from all the great American lakes, and this water at Long Sault Rapids has a fall of over 50 ft. Southerly from the southern shore of the St. Lawrence River, above these rapids, there extends a comparatively level plateau of about 3 miles, where it meets the valley of the Grass River. The plans of the company include the construction of a canal connecting the St. Lawrence and Grass Rivers, the water of the latter river being about 45 ft. below that of the St. Lawrence River above the rapids. The Grass River has but a small volume of flow, and enters the St. Lawrence below the rapids. The canal carrying the waters of the St. Lawrence from a point above the rapids to the valley of the Grass River will deliver the water upon turbine wheels with an absolute head of over 40 ft. This water, after actuating the turbines, will flow through the valley of the Grass River, and will re-enter the St. Lawrence below the rapids. The headrace of this power will thus be the St. Lawrence River and 3 miles of canal; the tailrace will be the Grass River itself. The canal will be of such size as to carry sufficient water to the valley of the Grass River to develop 150,000 h. p., but the company will install at present turbines and electric generators sufficient to develop but 75,000 h. p. The sides of the canal will have slopes adapted to the material through which the canal passes. The line of the canal is nearly straight from one river to the other. It is entirely in cutting, thus avoiding the dangers incident to embankments. The volume of the material to be excavated is large, but as the excavation is largely in earth, the expense will be very moderate as compared with its great volume. The power house will be founded immediately upon the rock bed of the Grass River, and will receive the water for power from the canal, which terminates in an elevated bank behind the power house. This power house will be between 500 ft. and 600 ft. long and 130 ft. wide. The turbines will be mounted on horizontal shafts. There will be two twin turbines upon each shaft, it requiring four turbines to produce the power and speed required. These turbines will develop upon each shaft 5300 h. p. The turbines will be of the Victory type, made by the Stilwell-Bierce & Smith-Vaile Company. Other contracts that have been let are as follows: excavation of canal, building of power house, intake and outlet construction, etc., the Lehigh Construction Company, Limited; fifteen 5000 h. p. generators, Westinghouse Electric & Manufacturing Company. The engineering work is under the charge of John Bogart, of New York, and Kincaid, Waller & Manville, of London, as consulting engineers.


Blackwall Tunnel under Thames London.
FOR CARRIAGES AND FOOT PASSENGERS
INSIDE AREA 552 sq. ft
City & So. London R.R.
ELECTRIC INSIDE AREA 84 sq. ft
ONE TUBE OF Waterloo & City R.R.
INSIDE AREA 113 sq. ft
ONE TUBE OF Central London R.R.
INSIDE AREA 103 sq. ft
Buda Pesth Electric R.R.
INSIDE AREA 193 sq. ft
0 5 10 15 20
SCALE OF FEET
Short Tunnel begun under River Spree Berlin.
Tunnel under Hudson River, uncompleted.
FOR STEAM RAILROAD
INSIDE AREA 246 sq. ft
Tunnel under St. Clair River.
FOR STEAM RAILROAD
INSIDE AREA 290 sq. ft
Cable
Glasgow
Subway.
INSIDE AREA 91 sq. ft
INSIDE AREA 332 sq. ft
Subway Tremont St.
INSIDE AREA 707 sq. ft
Boston 4 track Subway Tremont St. Mall.
INSIDE AREA 350 sq. ft
Boylston St. Mall.

RELATIVE SIZES OF VARIOUS SUBWAYS.

Relative Sizes of World's Principal Subways.

The accompanyinging engraving, showing the different sizes of tunnels and subways in London, Budapest, Glasgow, Boston and elsewhere, is reproduced from the drawings accompanying an address by the Hon. George G. Crocker, chairman of the Boston Transit Commission, on the subject of the Boston Subway, which appeared in a recent issue of the proceedings of the New England Railroad Club, and is of much interest to students of transportation problems. It will be seen that the smallest tunnel is that of the City & South London Railroad, whose inside sectional area is but 84 sq. ft. Next in size comes the Glasgow Subway, with 91 sq. ft., the Central London Underground Railroad tunnel with 103 sq. ft., the Waterloo & City Railroad tunnel with 113 sq. ft., the tunnel under the river Spree in Berlin, with 117 sq. ft., and the Budapest Electric Railway Subway with 193 sq. ft. The larger tunnels in the series are the Hudson River and St. Clair River tunnels, the Blackwall Tunnel under the Thames River in London, and the Boston Subway, whose four track section under the Tremont Mall is 707 sq. ft.

in sectional area, while other sections are practically of the same areas as the Thames Tunnel.

Eight of the ten subways are circular in section, due probably to the use of the Greathead system of tunneling, the expense of which is comparatively small.

New Cars and Brake Shoes in Chicago.

Under the supervision of J. F. Morrison, superintendent, and A. J. Allen, master car builder, the rolling stock of the "Alley L" is being rapidly overhauled preparatory to the opening of the Union Loop. The coaches are being repainted and varnished both inside and out, and present an appearance fully equal to that of new cars. The effect at night is especially pleasing as all the cars are brilliantly lighted with Pintsch gas.

INTERIOR OF SUMMER CAR.

Some time ago the body of one of the cars was partially destroyed by fire, and in being rebuilt by the Pullman Company it was so constructed that it can be turned practically into an open car. The removal of a hinged cap in the window sill uncovers an opening into which both the upper and lower sash are slid and when the cap is returned to place the car has the appearance of having no windows. The seats are Hale & Kilburn "Walkover" No. 80½; entirely of wood, without cushions and set crosswise. This is a departure in the seating arrangement for elevated trains and increases the seating capacity from forty-six to fifty-four. The car has been exceedingly popular with the public, and every seat will often be taken while other cars of the same train are almost empty.

EXTERIOR OF SUMMER CAR.

In replacing worn out head linings Mr. Allen hit upon a scheme which is not only exceedingly economical, but quite handsome as well. The worn out canvass from the roofs, which is ordinarily thrown into the scrap pile, was reversed, cleaned and with a sufficient amount of padding under it tacked to the ceiling, giving an upholstered head; the cost, of course, being only for the labor.

The company is equipping all of its cars with a new composition brake shoe, the joint invention of Messrs. Morrison and Allen. The composition is of lathe turnings or iron borings mixed with mineral cements; it is heated to a high temperature and placed under heavy pressure in a cast frame of soft gray iron, the walls of which form a dovetail, which prevents the composition falling out in a body.

The chief claims made for the shoe are: being elastic, it gives a smooth, glossy surface to the wheel tread and prevents wear, while as it has a greater co-efficient of friction than iron or steel shoes, it is very hard to skid the wheel; the composition is not affected by heat or cold, will not carbonize and will withstand heat to 700 degs. F., nor will it fall out in small pieces. The shoe is claimed to be 20 per cent more efficient than iron or steel shoes.

The shoe can be made to conform to any style of brake head without the use of springs or other appliances.

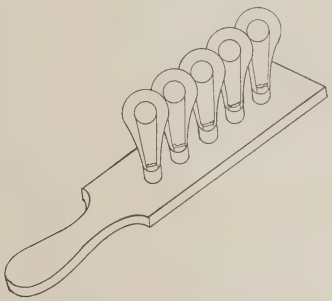
One of the features of this shoe that will appeal to the public is elimination of the disagreeable squeak that always attends braking with metal shoes.

The service on this road requires about 2½ stops per mile from a maximum speed of about 28 to 30 miles per hour.

Recent tests of this shoe showed a uniform wear of $\frac{1}{16}$ in. and a loss in metal ranging (in four shoes) from 9¼ lbs. to 10 lbs., after a service use of 18,000 miles.

A Handy Lamp Bank.

A very handy form of five lamp bank for street railway workis shown by accompanying cut. The base is a piece of well seasoned wood, mahogany being preferable, but almost anything can be used that is dry and stiff. The lamps are mounted in a row as close together as they can well be placed, and wired in series. Binding posts and a switch



A HANDY LAMP BANK.

can be added if desired, but for use in the shop, especially for permanent lighting, the wires had better be run direct to the lamps, and no exposed binding posts left to form fire circuits or man killers. For permanent work also, the handle at the left of the lamps can be omitted, and the bank suspended by taking a turn of the wire around each end of the base board. This way of suspending lamps works very well as long as the city or the insurance inspector does not see it. Then there is sometimes, but not always, an order to suspend the lamps by independent wires.

For testing around cars one of these appliances is very handy, and if the lamps are fitted with wire guards, the rig is a very durable one. In this case, the handle is retained and the wires, passed through rubber tubes, are made fast to the back of the handle. In this manner they both are made to lead off in the same direction, and the machine can be passed in and out, around the machinery of a car, very easily. It is very desirable to fit each of these boards with a snap switch, but when it is to be used for testing there

must be some manner of positively indicating the position of the switch, for it does not improve the feelings of a man to test all around a car and find everything perfect, and then discover that the switch on the lamp board is open.

The Present Status of Electric Heaters.

The subject of electric heaters is always an interesting one to street railway managers, but is especially so at this time of the year when winter rolling stock is being overhauled and put in condition for the winter service. The following will give an idea of the principal changes made since last year in the different electric heaters described.

Figs. 1 and 2 illustrate the electric heaters manufactured by the H. W. Johns Manufacturing Company. The construction of these heaters for the season of 1897-8 is essentially the same as last and consists in covering the resistance wire with asbestos and then weaving the wire so covered into a mat or cloth with an asbestos woof. The heater thus formed is cemented upon an asbestos millboard backing, the heater and backing having first been thoroughly saturated with an insulating compound which effectually prevents the absorption of moisture by the asbestos fibres. The result is a heater which advantageously affords the largest possible radiating surface for the heat generated in the wire, which is thus protected by a hard,

FIG. 1.

dense envelope from contact with the air and otherwise injurious atmospheric influences.

Heaters, as illustrated herewith, for installation on the faces of the panels or risers below the seats in a car, are enclosed in perforated steel casings 50 ins. long, 9 ins. wide and 1½ ins. thick. Six such heaters, known as Class E, consuming from 6 to 9 amps., according to the locality, ordinarily constitute the equipment for cars from 18 to 20 ft. in length; and 8 or more, with a corresponding increase in the number of amperes as required, for cars 22 ft. in length and over.

For situations requiring an upright form of heater, the heater mat is constructed in practically the same manner, with the exception that the wire is placed on both sides of the asbestos millboard support. The whole is enclosed in an ornamental casting, newly designed as illustrated. This heater is adapted for use under the cross seats in cars and for the heating of offices, bathrooms and small apartments, where the flat panel style of heater cannot be conveniently attached to the wall. This heater is known as Class F, and the ordinary car equipment comprises from ten to fourteen heaters, depending upon the size of the car and the available space for their installation.

The regulating switch remains practically unaltered. By this means three degrees of regulation are attainable. In the case of an equipment utilizing 9 amps ,the first point of the switch represents a consumption of about 3 amps., in the second position about 6 amps. and in the third position 9 amps., and the heating capacities correspond to the electrical energy represented. The practical requirements of car heating demand that the heat shall be distributed with reasonable equality throughout the car, so that those passengers seated over or in the immediate vicinity of the heaters shall not suffer from overheating or that the other passengers may not be deprived of their share of the heat. In order to accomplish this the H. W. Johns Manufacturing Company recommends the use of as many heaters as can be conveniently installed in a car. The heating effect is thus equally distributed from one end of the car to the other, with the result that no one heater or part of the car is rendered uncomfortable to the passengers, and the temperature of the car is agreeable throughout.

The electric heaters manufactured by the Globe Electric Heating Company, are fitted with heating coils. In winding these coils one end of the wire is connected to the core and the other end is insulated therefrom. The core also serves as a return conductor so that both connections are made on the holder. This holder is a metallic tube, slotted for the purpose of allowing for expansion and contraction. Each coil is also provided with two metallic reflectors, facing each other. By this arrangement the efficiency of the heating coil is increased 45 per cent over the ordinary spiral resistance coil, which only has direct radiation. The coils wound for car heaters are all 50 volt and ten placed in series, thereby making each heater 500 volts, taking 1 amp.; for other voltages it is only necessary to connect them in series parallel, that is, for 110 volts, two coils in series and each two in parallel; for 220 volts four coils in series and each series in parallel. By this arrangement this heater can be readily changed to use any voltage in a few minutes. Another very essential point is the construction of the case which is so proportioned as to give the best results for a given amount of energy, by admitting cold air at the bottom through a given size opening and circulating it through and around the coils and bringing it in contact with an iron reflector, which is in the top of the heater, then expelling it through the opening in the top, which is larger than the bottom opening. This heater is illustrated in Fig. 3.

FIG. 2.

Fig. 4 illustrates the new No. 5 National section and continuous heater manufactured by the National Electrical Manufacturing Company. The degree of current admitted to this type of heater, and therefore the temperature of the car, is regulated by means of an electrical switch of special construction. There are four graduations on the dial—full, half, low and off. The dial, which is movable, has the brushes attached to its inner face, and these move upon a series of contacts on the fixed plate. In order to reduce the spark on opening or closing the switch, the switch lever is formed separately from the knife, the former being hinged to the latter near its junction with the switchboard. Normally the knife is held against the lever by the tension of a plate spring; but when the lever is pulled open the two are separated, the knife snapping suddenly against the lever as it leaves the

FIG. 3.

contacts and reducing the duration of the spark. As the heat generated is directly proportionate to the amount of current flowing through the wires of each heater, and as this flow of current is governed by the combined resistance of the heaters through which the current must flow, it is but necessary to vary the number of heaters between a point where the current enters and where it leaves again in order to regulate the temperature to any desired degree.

The Consolidated Car Heater Company has made a number of improvements in its heater casings, adapting

them more particularly to different styles of car seats, but the interior construction of this company's heater has remained about the same, as the company thinks that its construction cannot be improved upon.

This type of heater was fully described in the STREET RAILWAY JOURNAL for September, 1896. An interesting test was recently made upon this heater by the South Chicago City Railway Company. This test was made entirely

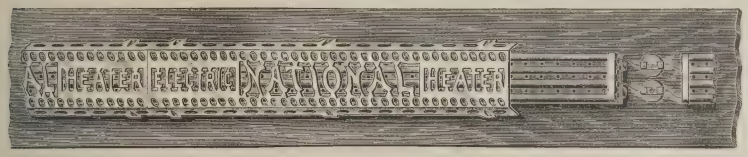


FIG. 4.

without the knowledge of the manufacturers. The tabulated data of the test are as follows:

Test of Consolidated Company's electric heaters on car No. 18 of the South Chicago City Railway Company, Nov. 30, 1896.

Six heaters to each car, controlled by five point regulating switch.

Thomson portable wattmeter used. Voltage, 525 volts.

1st	point	. . . . .	1,100	watts per hour.
2d	"	. . . . .	1,500	" " "
3d	"	. . . . .	3,800	" " "
4th	"	. . . . .	4,900	" " "
5th	"	. . . . .	6,500	" " "

Cost of fuel for generating one kilowatt hour, $0.0024.

Cost of generating one kilowatt hour, including fuel, oil, waste and wages of operating force in engine department, $0.0065.

Cost of screenings burned at the power house during this test, ninety cents per ton.

Cost of running heaters, eighteen hours per day, on the basis of fuel cost only.

1st	point	. . . . .	$0.048
2d	"	. . . . .	0.064
3d	"	. . . . .	0.163
4th	"	. . . . .	0.211
5th	"	. . . . .	0.28

Cost of running heaters eighteen hours per day, on the basis of fuel, oil, waste and wages of employes in engine department:

1st	point	. . . . .	$0.13
2d	"	. . . . .	0.175
3d	"	. . . . .	0.442
4th	"	. . . . .	0.572
5th	"	. . . . .	0.76

The Gold Street Car Heating Company has made a number of improvements in its line of electric heaters. This company's aim in the construction of its heaters has been to utilize all the electrical energy consumed to the very best advantage, that is, securing the most heat delivered into the car body for the least amount of current possible. In this heater, which is shown in Figs. 5 and 6, the resistance coils are placed in such a position that all of the cold air entering the heater at the bottom is thoroughly cut up and divided into the smallest particles by the hot resistance wires. This produces a steady flow

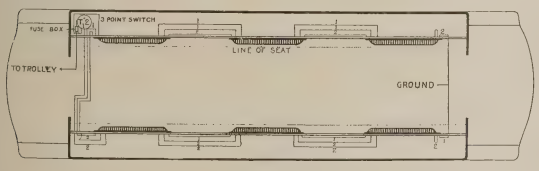


FIG. 5.

of evenly warmed air. In order to most thoroughly heat cold air the air must be first separated into small portions and brought in contact with the heated surfaces simultaneously, and this company has aimed to carry out this principle to its fullest extent in its heater design. The resistance coils of this type of heater are usually about 1¼ ins. in diameter and generally three coils high, one placed directly above the other in a horizontal position. These coils are held securely in position by slight grooves in the solid and specially prepared enamel plates, so that should a wire break it could not leave its original position, thereby avoiding any short circuit or burning of wires or fuses. The company has given special attention to the composition of its resistance wires and in that which it is now using for its heaters it has endeavored to combine high resistance and absolutely non corrosive qualifications. With the Gold electric heaters three graduations of temperature of heat are obtainable. They are fitted with an especially constructed switch with which the first or lowest degree, the second or medium degree, and the third or hottest degree may be had by turning the handle to points 1, 2 or 3, noted on the dial, for such degree of heat as may be desired. This company manufactures and carries in stock several different styles of heaters, the majority of which, however, are constructed on the same principle as outlined above. Fig. 5 shows the usual method of placing the heater in a car with side seats.

The American Electric Heating Corporation offers for this season its car heaters in a variety of forms comprising seven distinct sizes and shapes, which enables it to arrange the distribution of heat most advantageously, regardless of the form of car or arrangement of seats. Three sizes are made for cross seat cars and four for side seat arrangement. Where panels are placed under seats the "F" type, which is let in flush with the riser, is the most popular. A new design for cross seat cars is type "G." The heating coils are of the spiral spring form, on porcelain supports, protected from vibration and firmly held in place by a strong asbestos cord running through each coil as a core. The coils are made of wire of liberal section, giving good mechanical strength and large surface area and are non-oxidizable. It is claimed that the wire used in the heaters is preferable to ordinary galvanized steel or iron wire.

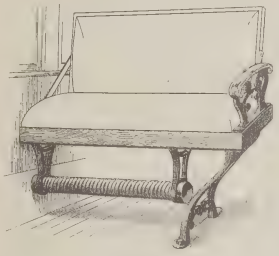


FIG. 6.

In the American heaters the resistance of the coils is practically constant at all temperatures; hence, no undue flow of current is possible at any time. The proportioning of the coils is such that when installed the heaters are wired in series with two circuits only from switch to heaters when arranged for three divisions of heat. When any heaters are in service all are, each supplying its proportion of whatever division of heat is on, and discharging it throughout the entire length of the heater, thereby giving under all conditions the maximum distribution.

The American Electric Heating Corporation offers two types of switches with its heaters, one (No. 1) designed for operating a single circuit, having a wide break. This switch is fireproof, with all working parts free from screws or other details to be affected by vibration. The No. 2 switch also has these features and has double break. It is made to operate two or more circuits with a single lever. Last season this switch operated 45,000 times on a trial test without developing a defect. The heaters of this company are equipped with the "D. & W." non-arcing fusible cut-outs.

Change in Organization of the Union Traction Company, of Philadelphia.

Important changes in the operating staff of the Union Traction Company, of Philadelphia, took place in August. The resignations of E. H. Shaufler, the company's assistant general manager, Wm. M. Wampler, its superintendent of rolling stock and equipment, and other department heads have been accepted by the board of directors. It is stated that an entirely new system of operating the road is to be put into effect, the "General Division" system organized by former General Manager Beetem being done away with. Instead of this, it is stated, the superintendents of minor divisions are to have entire charge of the department and lines under their control, and all the general division officials are to be retired. It is also said that a large number of engineers and draughtsmen under Chief Engineer Twining are to be discharged as well as employes—all in the interest of reducing expenses; and a change in the engineer shifts in the power stations from eight hours a day to twelve hours, by means of which one crew will be dispensed with, is mentioned as a probability.

The Three Wire and other Systems of Distribution for Electric Railway Work.

The following extracts from the discussion of the paper on "Some Recent Developments in Electric Traction Appliances," recently read by A. K. Baylor before the (London) Institution of Electrical Engineers bears upon highly interesting and most important features of American and English electrical engineering practice.

Mr. E. W. Rice, Jr.: I was much interested in Mr. Baylor's remark in reference to the application of the three wire system to electric traction. The extent of the application of electric motors for traction purposes in the United States is undoubtedly familiar to you all, and does not need any description from me; and in this increased application we have come to a point where long distances are to be covered. Starting from Boston, it is possible to ride in an electric car for at least 50 miles in almost any direction, except out to sea. This is true of almost all our large centers—New York, Philadelphia, Cleveland, Buffalo, and so on. In covering such large distances—20 to 50 miles—there are two methods which have grown up. One, due to the gradual extension of such lines, is using a number of separate power stations. This has been the natural evolution in consequence of the fact that the railways frequently connect the large centers with outlying suburban districts, or, it may be, several cities with a large number of inhabitants. In such cases, each of these cities, having its large central station, supplies the current to the cars within a radius of from 5 to 8 miles. However, the cost of the feeders and copper required in such large distances as are now under consideration has brought forward other systems, and among the systems tried has been the one mentioned by Mr. Baylor—that of the three wire system. In several instances, to my knowledge, this system has been proposed and actually employed—in Portland, Ore., in Bangor, Me., in Milwaukee, Wis., and other places—and after a careful trial was abandoned, chiefly on account of the difficulty of balancing the current on the two sides of the system. This is reasonable when one considers the variation in the amount of energy required by the different parts of an electric traction system. Therefore, in searching for a practicable method, the generation of electricity by means of multiphase generators in a large central station, its transmission to substations, at which substations alternating current motors of multiphase type were used to drive direct current generators, which generators were attached to the local 500 volt circuit, have been employed. Such a system, however, has been found to be somewhat inefficient as compared with the more modern method, and one now frequently employed, and which will undoubtedly be extended in future. This system is a modification of that I have just mentioned, and consists, briefly, in the generation of the electricity by means of two phase or three phase—generally three phase—currents in a large central power station, and its transmission over aerial or underground lines at high pressure—2000 to 5000 volts—to substations located at different points along the line. At these substations the high pressure alternating current is reduced in pressure and converted into 500 volt continuous current by being passed through so-called step-down transformers and rotary converters. The static transformer is of the usual construction, and artificially cooled in large substations. The rotary converter is, as you are probably aware, essentially a direct current dynamo electric machine, provided with collector rings, three or four in number, according to the system employed; these collector rings have suitable connections to the proper points in the same armature winding to which the commutator is connected. Such a machine becomes, therefore, a commutating device for the alternating current. It differs from and is superior to a motor generator, in that the alternating and direct currents combine in the same winding so as to materially reduce the armature reaction. In practice the rotary converter behaves as if it possessed no armature reaction; the point of commutation remaining fixed over the entire range of output, without any sparking; in fact, the commutating properties of the rotary are not equaled by the ordinary generator or motor. At the same time the losses due to hysteresis and eddies, as well as the $C^2 R$ in the armature conductor, are materially lessened by combining the two functions in the same armature. As an obvious result the output per pound of material is large, and the efficiency extremely high.

In comparison with the alternating current motor direct current generator system, there is a net gain of from 5 per cent to 7 per cent in efficiency, in addition to the other advantages mentioned.

The efficiency of the static transformers used in such a system is extremely high, ranging from 96 per cent to 98.5 per cent, including waste in ventilating apparatus.

Mr. C. E. Grove: I wish to confine my remarks to one point of the paper, and it is that which deals with the advisability of employing the three wire system for cases which are beyond the range of applicability of the ordinary two wire. The author's contention, as I understand the question, is that if you wish to employ a three wire system you are practically prevented from doing so by the difficulty of balancing the current in the two sides; and the best thing to do in those circumstances is to employ an alternate current system of generation, transmit the power by alternating currents to feeding or distributing points on the line, and there convert it through statical transformers and rotatory transformers into continuous currents for working the railway. I think that was the proposition, and I think that Mr. Rice spoke on that point. Now I wish to combat that proposition as a *general* proposition, because I think it would be very dangerous to lay that down as a canon in electric traction work. The subject is of particular importance just now, for this reason—that there are before the public schemes for the construction and working of quite a large number of electric underground railways in London. It has been my duty for the last year or fifteen months to have worked on designs in connection with that subject, so that I happen to have in my possession a number of facts and figures which have led me to an entirely opposite conclusion to that of the author of the paper: and as the consideration of a particular case will often carry conviction where general arguments may fail, I ask leave to deal with that general proposition from this particular point of view. There have just been submitted designs for the working of the Central London Railway by electricity, the Central London being the largest railway of the kind that has yet been proposed; and it is significant that the two systems in question—i.e., three wire v. alternating—have been in competition for the carrying out of the work. The engineers to that railway did not themselves choose a system, but simply laid down the conditions that the trains, which weighed so much, were to be pulled along the railway at so many miles an hour, and a 2½ minute service was to be maintained. For the rest the contractor was free to propose what he liked. The Thames Ironworks Company, and at least one other large English company, went in on the three wire system; the Americans went in, I believe, on the alternating system. Now, what are the conditions? The railway consists of two lines of tunnel, one up and one down, each about 7 miles long. The generating station is at one end. It seems to be exactly a case in which the three wire system is the thing to use. The up line can be used as a positive side, the down line as a negative side; the electricity can be generated at double the ordinary Board of Trade voltage, while at the same time one never has more than the Board of Trade voltage of 500 volts or so in one tunnel. The line is fed by currents which at that potential can be safely transmitted on bare copper feeders, and the feeding points can be kept at approximately the same potential. We have here all the elements of a secure, stable, well understood and economical system. The potential is nowhere dangerous to life, and there is little likelihood of leakage, because the rails are simply the neutral conductor, earthed all the way, and carrying not the maximum current, but only the balancing current between one side and the other—and that not for the whole length, but only for short sections, as between trains in one tunnel and trains in the other tunnel. With regard to the carrying of the balancing current, it is rather difficult at first sight to understand why there should be any considerable difficulty in maintaining a balance. The dynamos are, almost obviously, arranged to work in pairs at 500 or 600 volts apiece, because for the large generators such as would have to be used—dealing with thousands of kilowatts in total—500 or 600 volts is a very convenient voltage for a multipolar bar armature, having regard to safety. In that case, a very simple arrangement of switches at the central station enables you to throw any number of machines on one side, to deal with, what may perhaps be called, fairly constant inequalities of load between the two sides, such as might be occasioned, for example, by a block or breakdown stopping the service in one direction; but as regards momentary and lesser fluctuations, those can be dealt with conveniently by means of balancing transformers placed across the feeders at certain feeding points. We chose half a dozen, which brought us to each alternate station; but we might, if we liked—and there is no reason why we should not, if we found six insufficient—choose a dozen, and put one at every station. Now, by providing a capacity in those balancing transformers of about one-fifth or one-sixth part of the whole output of the station, it seems to me that we provide a very large margin for the shifting of the current from one side to the other, due to irregularities in train weights or speeds, or to supply extra currents in starting the trains—an arrangement facilitated by the use of flywheels and other obvious things. There is here all that is necessary for maintaining a very fair balance on the system. And be it remembered that if this system be not adopted and the railway be supplied by continuous currents which have been first generated as alternate currents, you have in the apparatus which transforms them, to deal not merely with a certain fractional part of the station output, but with the whole output. Further, the whole output of the station has to pass through statical transformers to reduce the pressure to the equivalent of the line pressure; because the alternate currents would be generated, I take it, at a couple of thousand volts or more, and the alternate currents

at low pressure have then to pass through rotatory transformers or motor transformers. Mr. Rice said the ordinary motor transformers are no good—that you must have rotatory ones; that is to say, you must put the alternating currents in one end of an armature, and take out the continuous currents at the other end. It is rather interesting, by the way, to mark that Professor Mengarini, who has been doing that at Rome, thinks that it is quite impracticable for machines of large size, owing to the sparking which takes place at the continuous current side, due to the periodic alternations between dynamo and motor working in each alternation of the current.

Now as to the commercial side of the question. In this case we have to deal with a total capacity of 5500 k. w., or something like that, and the question of substituting alternators for continuous current machines means putting more expensive machines in the central station—perhaps £1 or 30s a kilowatt more, or, taking a mean figure, an increased expenditure of some £7000. Then we must have statical transformers capable of dealing with the same output. Of course, there is a certain amount of reserve plant in the station, and it might be urged that we have only to deal with the transformers and apparatus at t e feeding points with an output equal to that portion of the station plant which is actually running. But I think if that be examined it will be found delusive. There must be a margin of power there, and it cannot be in the form of some machines idle and some working. To provide against breakdowns and fluctuations, transformers must be employed of larger capacity than are really capable of dealing with the load, and they will be worked on the average at, say, three-quarters of their full load, and therefore below their full efficiency. For traction work also a low periodicity would preferably be employed, again losing a little bit in efficiency. Then there are 5500 k. w. in rotatory transformers to be provided, and adding the cost of this transforming machinery to the extra cost of the dynamos there is, at the ordinary market rates, which can be got from anybody's price list—I am not speaking of contract prices, or anything of that sort—about £45,000 of machinery employed over and above what is necessary for the continuous current work.

Now as to efficiencies. As I have said, in these transformers—which have got to work at something like three-quarters load, and a fluctuating load, and low periodicity—you cannot reckon on getting more than 95 or 96 per cent as an average efficiency. In the rotating machines you may get 96 per cent or a little more; but in the two together you have to reckon on a loss of 7½ per cent or 8 per cent of the output of your station, in getting the energy into the continuous current form on the rails. This is really a very serious amount, because it can be easily calculated that the coal bill alone for working that railway, according to what they propose to do, will be something like £25,000 or £30,000 a year; and the total works cost of generating the energy, apart from the question of rents, directors' fees, and establishment charges, will be something like £60,000 a year, more or less. Eight per cent of that is, say, £5000; and £5000, even assuming that the money to the promoters of the company is worth 4 per cent, means the interest on £125,000—a very considerable sum of money. When you add that to the additional outlay on machinery, it appears that there is a very big balance of disadvantage against the alternating system for work of that kind. It does not matter, for the sake of my argument, whether the one scheme on the whole, as submitted, was cheaper or dearer than any other scheme on the whole, as submitted to this particular company. I am dealing simply with general market figures. No matter from whose pockets the money comes, if you spend £160,000 or £170,000 more on one set of plant than on another that would do the work quite as well, that money is wasted, lost to the world, and its expenditure cannot be justified.

The question of cables may be left out of account. The copper for the continuous current system would be large, but bare; for the alternating system it would be smaller, but insulated; and the cost of insulation would pretty certainly run away with any gain that would be effected by reduction of section. I think, therefore, that the general contention of the author on the point raised is untenable, and that the arguments drawn from American tramway practice do not apply to such a case as that I have sketched.

MR. H. F. PARSHALL: Inasmuch as the discussion has now proceeded broadly outside of the limits of Mr. Baylor's paper, and the last speaker has made a specific example of the Central London Railway in advocating the advantages of a three wire system for electric traction, I may be justified in showing that the three-wire system, according to experience, is inapplicable to such a traction system, and that the three wire system has certain inherent defects that have not been taken into consideration by its advocates.

The three wire system as applicable to a large system for electric traction to-day exists in theory only. It has been given repeated trials, and it has repeatedly failed, and it has been replaced by a multiphase system of distribution with substations in which there are large rotary converters. I am speaking of the traction system at Portland, Ore.

During my connection with the Edison General Electric Company I had an opportunity of studying the conditions and advantages of three wire systems for lighting work. It was found, even in lighting work, that the great advantages that have been predicted for the three wire system could not be realized, and that the loss in the neutral wire was considerable, and that to get the best advantage the neutral wire must nec ssarily be much larger than was originally contemplated. There are broad differences between a three wire lighting system and a three wire traction system. If in the three wire lighting system the voltage on one side falls below the normal, it is to some extent compensated for, since the resistance of the lamps on that side increases, and the current consumption is cut down automatically. In a traction system the opposite is true. When the voltage falls on one side of the system through overloading, the motorman turns his controller handle to a farther position, so as to maintain a given speed schedule; that is, to maintain a constant work at the car, means consuming an excessive current. In other words, the effect of unbalancing in a lighting circuit is differential, in that it is compensated for by the nature of the load; whereas in a traction system it is cumulative, since the work is maintained constant at the expense of current consumption.

At St. Louis a three wire traction system was tried in a network—conditions much more favorable to balancing than any other rectilinear system such as that mentioned by the preceding speaker. After a thorough trial it was abandoned, since it was found that the extra cost and trouble in compensating from hour to hour was of vastly more consequence than the extra cost of the copper. This occurred in a system where there were several hundred cars, each of which consumed, as a maximum, but a small fraction of the total output of the station—conditions comparable to some extent to a lighting system; the difference being, as pointed out above, that unbalancing in the traction system is necessarily cumulative. Consider such a case as the Central London Railway, instanced by the preceding speaker. There are to be operated between twenty and thirty trains. Each of these trains weighs some 130 tons, and to make an average running schedule of 15 miles an hour the trains at times must attain a speed of some 30 miles an hour and must be accelerated at least one foot per second. Under the most favorable conditions of control—that is, with the series parallel controller—these trains will absorb from the system at times 1000 amps. I am basing this figure on actual tests made, since I have before me the results obtained in actual practice, comparable with that of the Central London Railway. The average output per line on a three wire system such as the Central London for the above service would not exceed 3000 amps. You have, then, a three wire system in which one unit or train will absorb one-third of the normal current per line—a condition impracticable to compensate for in a lighting system, and a condition which, in practice, introduces the use of compensating machines of such size and character as immediately determines that the three wire system cannot, in such a service, compete, either economically or practically, with the three phase and rotary converter system.

Assuming that the rails are to be used as the neutral conductor, the number of substations may be determined from the Board of Trade regulations. The resistance of four rails bonded together amounts to about .13 ohm per mile. Consequently, 500 amps. unbalanced in the neutral would give 6½ volts drop per mile. The Board of Trade regulations specify that the maximum drop in the rails, when used as any part of the earth return, cannot exceed 10 volts. From the above it follows that these substations or compensating stations, should not be more than 2½ miles apart, assuming that there may be one train unbalanced on such a section, this train working at its full capacity. From my own experience in electric traction work, I should not be satisfied with any such meagre allowance in compensating arrangements, since under the most favorable conditions, with four trains opposite on one side of the system, it is reasonable to expect that two of these trains may be absorbing maximum power, while the other two trains are running light, in which case the amount of unbalancing would be double that which I am assuming for the sake of making a fair comparison. Making allowance for the reversibility of the machines—that is, that each machine is to act from time to time as a motor or generator to compensate for the capacity of one train—these compensating machines would have to have a capacity of at least 300 k. w. Taking three substations as the least number consistent with the Board of Trade regulations, and compensating for the section near the generating station through the neutral conductor, the loss in these sub-stations becomes considerable. The loss in the neutral conductor seems to have been lost sight of by the three wire advocates.

Taking the case of the system at Portland, Ore.—where the three wire system has been replaced by the three phase—and also the case at St Louis, it was found that the neutral conductor had to be quite as large in the cross section as the outside conductors, and that in this condition the loss in the neutral conductor and the compensators (about which I shall have more to say presently) is, under favorable conditions, about equal to the loss in transformation in a well designed multiphase converting station. Where, then, can be the economy in the three wire system, since in the three phase system the energy may be transmitted at 5000 volts, where in the three wire system it is transmitted at 1000 volts, or for the same transmission efficiency one-twenty-fifth of the weight of copper will do for the three phase system as for the three wire system? The duty of the compensating machines in a three wire system does not seem to have been considered.

If two trains are unbalanced on the opposite side of one of these stations, it has to be relied upon to compensate for this unbalancing by itself. A station 1½ or 2 miles away with a track resistance does not lessen the load liable to come from time to time upon one of these substations; that is, each substation must have a capacity sufficient to compensate for all the unbalancing that may occur locally. When half-way between the stations the unbalancing may be compensated for equally by the two substations. This increases the size of the machines in the substations, and likewise greatly increases the deterioration of the commutator.

Another feature of these substations in a three wire system is that, when the load suddenly drops, the voltage at these substations suddenly increases; so that they must, in order to accelerate them-

selves, to correspond to the increased voltage, absorb from the system a portion of the load that had been on the system—a condition most unfavorable for the operation of commutating machines. All of these difficulties and losses seem never to have been taken into consideration by the advocates of the three wire system, and I have never yet met an expert of broad experience in traction work who has confidence in such three wire systems as have been proposed; and I have never yet met an expert in traction work who has had experience in using a three wire system in practice, who considers that such a system is either economical or practicable to operate. The preceding speaker said that Professor Mengarini had shown that rotary converters beyond 50 k. w. capacity would give trouble from sparking. I believe I am familiar with the paper in which this was stated. This statement was entirely confined to the single phase rotary converters. Multiphase rotary converters have entirely different properties. If Professor Mengarini has stated that three phase rotary converters will not run well beyond 50 k. w. capacity, then I should ask for an explanation why the 600 k. w. machines at Niagara, that are generating constantly 3750 amps. for 365 days in the year, have developed that beautiful blue, glossy commutator which has so recently been the object of admiration before this Institution. A broad difference between a multiphase rotary converter and the single phase rotary converter is that in the single phase rotary converter the machine has to deliver from its commutator a constant flow of energy in the consuming circuit, whereas from the alternating current circuit it receives an intermittent flow of energy—a conditon most unfavorable to good commutation. In the three phase rotary converter there is a constant flow of energy into the machine from the alternating current side at constant load, so that the machine is working under conditions favorable to good commutation. As I have already pointed out, in the three phase machines the reaction between the three phase and continuous current functions of the machine is such that current losses, and the effect of the current in the armature upon the field poles to produce distortion, are largely ameliorated—so largely that a 500 k. w. rotary converter will carry 1000 or 1500 k. w. without the slightest sparking at the brushes.

In a recent experiment it was found that a rotary converter of 600 k. w. would maintain itself at synchronous speed and commutate perfectly up to 900 k. w. without excitation—an experiment that sufficiently demonstrates the efficiency and practicability of a properly designed rotary converter. The efficiency of a well designed rotary converter of 600 k. w. capacity may be taken to be, from the tests made at Niagara, 96 per cent at full load, and 94 per cent at half load; of a 200 k. w. static transformer, 98 per cent at full load and 96.5 per cent at half load. It becomes obvious, therefore, that with wide ranges of load the losses in transformation in a multiphase system are small, and are not greater than those in compensating stations and neutral conductors in a three wire system of distribution.

There is one point more that I should like to present with respect to three wire systems, or in fact, in any system for electric traction where the voltage in the consuming circuit is allowed to vary between wide limits—that is, in a system where the average transmission efficiency is taken as 90. If the loss is entirely in the consuming circuit, or in the consuming circuits as supplemented by feeders, the motors on the locomotive are working at one end of the line at 500 volts, and at the other end at 600 volts. To maintain a constant speed schedule, which is the usual condition in electric traction, and with the other conditions remaining the same, the average loss in the resistance becomes excessive. In a case like that under consideration, I have worked out what the loss would be with most efficient motors and with a series parallel controller. At the least estimate, the efficiency of the locomotives working on such a widely fluctuating voltage will be some 10 per cent lower than that of the locomotive working on a system in which there is a constant voltage maintained in the consuming circuit. By 10 per cent I mean taking the locomotive at the highest efficiency—that is, the locomotive, working under favorable conditions, as 100. This locomotive working on a variable e. m. f. would not have an efficiency exceeding 90. In the operation of the Dublin Southern Traction work it has been found that the motors showed an increased efficiency owing to the constancy of the voltage in the line; so that the net result in watts output per car mile has been satisfactory, efficiency considered. There are other features, however, that require enlarging upon, and I am now engaged in writing a paper broadly discussing the advantages of this system.

I would point out that the three wire system for traction work is purely in an experimental condition; that it has been tried in practice and proved a failure; that it necessitates the use of commutating machines and substations, the loss in which, and in the neutral conductor, is comparable in magnitude with that in the substations in the multiphase system; that the advantages of high voltage transmission are lost; that it introduces additional losses in the locomotive, owing to the fluctuation of voltage in the consuming circuit. (I am aware that this variation of voltage may be compensated for by feeders and boosters. Such an arrangement, however, is at the expense of efficiency, and I will not complicate my discussion by taking it into consideration.)

In conclusion, I would state that, in considering the efficiency of an electric traction system, the loss in transmission may not be in itself considered as final; that the efficiency of the system in its entirety as affecting the efficiency of the locomotive must be considered; and that those who are advocating the use of a three wire system for electric traction are ignoring many of the factors that are of first importance in determining the ultimate economy of a complete traction system.

MR. W. H. PREECE: May I ask Mr. Parshall one question? With reference to the three wire system, I have read somewhere—I forget where—that on one of the lines in the United States they have applied the three wire system in such a way that each coach becomes its own equaliser. There are two trolleys, one picking up the positive and the other the negative current, the wheels being neutral or to earth. Can you give us any information about that modification?

MR. PARSHALL: That system has been rather carefully considered; and although in the United States the circuit breaker has been brought to a high state of perfection, we are quite unable to provide for the number of short circuits which are liable to occur on such a system.

MR. A. K. BAYLOR: This question of subdivision, and my remarks on the three phase and three wire systems, seem to have brought about a locking of horns between the advocates of both systems, particularly as applied to one particular line which is rather prominent just now. In their various arguments Mr. Grove and Mr. Parshall have pretty well covered the ground *pro* and *con*. As to the technical difference between three phase and three wire systems, I can add nothing to Mr. Parshall's remarks as supporting the statements embodied in my paper; but I think Mr. Grove is in error on certain points not specifically taken up in the discussion. He claims that for the particular line used as illustration the expenditure for machinery would be some £45,000 greater with three phase than with three wire distribution. The relative expense for cables is left out of account, as he has taken it as approximately the same in both systems. I cannot understand how Mr. Grove arrives at his values for electrical machinery and feeders. From the best information at my command, based on innumerable sales of machinery of the sort under discussion, the excess of cost is in favor of the three phase system by some three or four times the amount—£45,000—given by Mr. Grove. This is assuming the same general conditions in both cases, with equally constant potential on the consuming circuit.

Mr. Grove shows a formidable array of figures representing the loss in coal due to the lower efficiency of the three phase system; but experience has shown that the relative efficiencies that he has estimated for the two systems are not correct, and that the difference, taking the locomotives into consideration, is in favor of the three phase system.

The questions raised in Mr. Snell's communication have been already well covered in the discussion. The chief difficulty certainly lies, as Mr. Snell has assumed, in the matter of balancing, and it is this that must always stand in the way of free use of the three wire system for traction purposes; and wherever this question arises, it must be settled upon the exact conditions to be met with for the given service.

I would say, for Mr. Snell's information, that the practice followed in America in trials of the three wire system has been to connect the ordinary 500 to 550 volt generators in pairs of two in series, so that the neutral wire was connected between the two generators. One reason for following this plan was that it allowed the use of the existing plant practically without change, excepting in the switchboard, although such an arrangement is to be preferred in any event.

Certainly in theory there would appear to be much to recommend the use of the three wire system on lines exceeding the limits of 500 volts transmission; but in practice, wherever it has been applied to traction work, it has been found inapplicable, and has been discarded after actual trial. That is certainly strong ground to stand on in condemning the system for traction work generally.

Municipal and Private Ownership and Operation of Street Railways—a Study of Results and Possibilities.*

BY EDWARD E. HIGGINS.

The principal powers which the state may rightly confer by charter upon its municipalities may be grouped in three classes, as follows:

Class I. Primary investment powers.

1. Power to lay out and construct streets and other thoroughfares.
2. Power to construct a sewer system.
3. Power to construct public buildings.

These powers are primary and essential. In their exercise the city creates a "plant," so to speak, and incurs a bonded debt which may be less in amount than the actual investment if property owners whose holdings are directly benefited by the city's action be assessed for a part of the cost.

Class II. Powers involving public service without profit earning possibilities.

4. Power to maintain, light and clean thoroughfares.
5. Power to maintain the sewer system.
6. Power to maintain public buildings.
7. Power to establish and maintain a health department and to remove ashes and garbage.
8. Power to establish and maintain a police department.

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9. Power to establish and maintain courts of justice and correctional institutions.
10. Power to establish and maintain a fire department.
11. Power to establish and maintain a system of public education.
12. Power to establish and maintain public charities.
13. Power to acquire and maintain public parks.

The distinguishing feature of all but the last three functions of Class II are, first, the necessity for constant expenditure with little if any income and no possibility of self support, and second, the service of all citizens, directly or indirectly, and to approximately the same extent. A free public school system requires constant expenditure, but does not serve *all* the people, except in the indirect way of bringing about better citizenship, but the injustice of taxing all for the benefit of nearly, but not quite, all may safely be disregarded in this case. Public charities are a necessity of civilization and a true burden upon the community. The acquisition and maintenance of parks may be justified not only by the health and pleasure giving benefits, open to all, but by the certain appreciation in value of park lands as a part of city's property.

The cost of performing these non-profit earning functions must, therefore, be assessed upon the entire community, unless some revenue earning capacity can be developed by the municipality, which will act as a credit to reduce these costs. Such revenue earning capacity is found in

Class III. Powers involving public service with profit earning possibilities.

14. Power to provide for a water supply.
15. Power to provide for a system of public lighting.
16. Power to provide for steam and electric supply service for power and heating.
17. Power to provide for transportation facilities by surface, elevated, or underground railways.
18. Power to provide for transportation facilities by ferries.
19. Power to provide for the transmission of intelligence by telephone, telegraph, compressed air or messenger.
20. Power to provide for a cab service.
21. Power to provide for the transportation of goods by vehicles of all kinds.
22. Power to impose taxes upon private vehicles.
23. Power to provide for market places.
24. Power to provide for the development of water fronts by means of wharves, docks, etc.

The common feature of all these powers of Class III, which brings them clearly within the domain of municipal administration or regulation, is the necessity which is upon each of using some part of the city's plant purchased at the common expense. Water, gas and steam supply systems require pipes laid in the streets; electric lighting, power, telephone, telegraph, and messenger call systems, require street space for their wires; a railway transportation system calls for tracks, terminals and overhead structures burdening the streets; and vehicular traffic of all kinds, including that by cabs, wagons and private carriages, wears out the people's pavements.

The right of a city to establish market places or to construct and own wharves and docks is hardly an inherent one, but when possessed and exercised, rests frequently upon "ancient custom" or royal grants of land or water front. The right to provide for ferriage is on a par with that for railway transportation in the streets, since the water thoroughfares of all cities possessing them are usually maintained only at considerable public expense.

Now, by no school of political theorists would it be denied that the whole community which has built the city's plant and which is taxed to pay for its maintenance should derive compensation in some form for all burdens placed upon this plant in the performance of services rendered to a portion only of the community or to certain classes more than to others. The real question is, therefore—In what way can this compensation best be obtained?

In the first place, consistency does not require that all these powers be exercised by the city in the same way. There may be special reasons why a municipality may wisely decide to perform certain functions on its own account and allow others to be done for the people by private capital. A good and sufficient water supply, for example, serves the entire community and is essential to its health and to the city's prosperity. It would sometimes be difficult, and perhaps unwise to give into private hands the powers necessary to properly protect such a water supply at its sources, and the argument may occasionally be urged, with some plausibility, that it would be dangerous to leave in private hands such a tremendous power for good or evil to a city. Moreover, most cities are, themselves, by far the largest single consumers of water, and questions of municipal economy in expenditure naturally have an important influence in shaping policy.

The question of how best to handle public lighting in its various forms stands, too, on a basis different from all the functions of Class III, except the first, inasmuch as here again the city is itself a large purchaser of light. The problem of how best to do its own work—whether directly or by the contract system—is one which confronts a city at every turn, and is to be decided, in general, on the basis of comparative economies. Theoretically, there ought to be no possibility of saving the public money by municipal ownership and operation of a lighting plant strictly limited in capacity to the city's needs, for, apart from all other considerations, the natural economy in production on the larger scale required for commercial and municipal necessities together ought always to be sufficient to insure prices lower than the bare cost of production in the smaller plant required for municipal purposes alone. Where this theoretical condition does not obtain in practice, the problem of dealing with public lighting may be solved by the establishment of separate plants for municipal lighting alone—an economic absurdity as far as gas supply at least is concerned—or it may be argued on the broader question of public and private ownership of the entire city lighting system, commercial and municipal.

But when we come to such public service functions as railway and ferry transportation, telegraph and telephone service and vehicular traffic, we find that these are essentially different from water supply and lighting, in that no municipal corporation is a user of these services to an extent which would justify it in performing them itself as a measure of economy in expenditure, and in that a portion only and not the whole of the community is reached by these services.

In short, it does not follow by any means, as some would-be leaders of opinion would have us believe, that the growing agitation for municipal control of all public service industries is merely a logical development of the success which may have been found in the control of one or two of them. It is true, however, that those who advocate the municipal control of transportation agencies, telephone and telegraph systems, etc., on the ground, either that the use of the city's plant is necessary, or that they are natural monopolies which should not be given into private hands, are logically bound to go still further and demand that the city shall own and operate all cabs, wagons and carts, a steam and electric power supply system for factories, a district messenger service, and every similar agency of living which may, directly or remotely, use the facilities which the city has provided for the transaction of business and the comfort of the people. Moreover, these advocates must go even farther and demand that such railroads, telegraphs and steamships as use facilities of any character the cost of which has been paid by the public, should be owned and operated by the national or state governments—and the step from this to common land ownership and to pure socialism is a short one.

He who advocates the municipalization of one public service industry while opposing others, may do so consistently, however, if his argument be that the city should own and operate all profitable, or excessively profitable industries of this kind, while leaving to private capital all unprofitable or but slightly profitable ones. In other words, the economic argument as applied to any particular industry is a good one—it is, as a matter of fact, almost the only one used in practice—and it is entitled to respectful consideration, though I do not by any means admit that it should be, by itself alone, a controlling factor in determining municipal policy—certainly if "economy" be defined narrowly as a direct money saving in dollars and cents. As a matter of fact I presume that all, or nearly all honest advocates of municipal ownership and operation will admit that excessive, and not merely moderate, profits must be clearly shown in any particular case under consideration, if the economic argument alone ought to prove effective in bringing about a change of policy from private to municipal responsibility, in matters involving such complexity and technique as are found in the management of public service industries.

I now leave this general discussion of municipal functions for a special one on the relations between street railways and municipalities, and first of all, in deference to those who wish to measure all values by the standard of dollars and cents, I will take up the economic questions involved.

* * * * *

The public in general has a greatly exaggerated idea of the profits of street railway operation. It has seen the capitalization of American street railways suddenly expand, during the last ten years, from $400,000,000 to $1,400,000,000; it has seen individuals and syndicates derive large fortunes from street railway manipulation in our principal cities; it has seen that these fortunes are made possible by the possession of franchises given to these individuals and syndicates by the people's chosen representatives; and it forgets entirely that speculative, market or par values are not necessarily real ones, as measured by earning power, and that in a period of railroad building and inflation, confidence and hope in coming profits always exceed realization.

In its belief in excessive street railway profits the public has been confirmed by pronouncements on the subject by "Citizens' Committees" and other public spirited bodies, formed for the most part with excellent intentions and entire honesty of purpose, but composed chiefly of men who refuse to spare from their own affairs time sufficient to thoroughly investigate the questions upon which they vote so confidently in "Committees of One Hundred" The circular letters of such committees are often almost amusing, or would be, were not the results sought to be obtained of such tremendous consequence. Take, for example, the two opening paragraphs of a circular issued by the recently formed "Association for the Public Control of Franchises," of New York City, under date of July 17, 1897.

"According to the most conservative authorities, half the city's revenues could be derived from its street car, gas, and other franchises. In this event, taxes upon private and personal property would be cut in two.

"What is even more important to the mass of our citizens, public control of the means of transportation and illumination will lead to a similar reduction in car fares and gas bills."

Are we to believe it possible that the esteemed president of the association issuing this circular is *personally* aware that the amount of money now raised by taxation in the city of New York is nearly or quite $45,000,000 per annum, while the entire net earn-

ings (exclusive of interest or dividends) of the street railway, gas and electric lighting properties do not exceed $18,000,000 per annum, of which by far the greater part would be consumed in paying interest—even with New York City's credit—on the lowest price at which the city could possibly secure the tangible assets of the different companies if purchased on appraisal by unbiased judges of values? Or can we believe that the association's vice-presidents, would be willing to *individually* engage to so handle the city's finances and operating properties as to cut *both* city taxation and street railway, gas and electric light charges in two, under these conditions? Or must we not charitably conclude that for none of these busy gentlemen has it been possible to personally investigate and revise the statements appearing over their names as committee members?

Another example of the way in which public sentiment is sought to be manufactured by certain kinds of reformers: The city of Chicago furnishes an asylum for a "Three Cent Fare Association," one of whose assets is an "Educational Committee." This committee was also moved not long ago to circularize the public on the subject of street railway fares, and an extract from its circular reads as follows:

"Taking the accounts as furnished by the 'combine' officers (of Chicago) it shows the net earnings are 30 per cent of the gross receipts, or, otherwise stated, 30 per cent of every nickel collected is profit. Thus, their books show it costs 3½ cents to carry each passenger, the profit on which is 1½ cents, or 43 per cent added to the cost. Conceding the 'combine' should be allowed its alleged 3½ cents of cost, with 7 per cent added for profit, the cost to the people would then be 3¾ cents each ride, or an equivalent of seven rides for 25 cents. Should not a general ordinance be passed regulating the rate of street car fares?"

It is almost inconceivable that such utter ignorance of the simplest business principles should be found among men behind public movements of any kind, and the conclusion is forced upon us that office boys or clerks are allowed to do the "public work" of many of our business men.

A bit of street railway history, and an explanation of the true practical meaning to investors and would-be investors (including municipalities) of street railway capitalization, earnings, operating expenses and profits applicable to return on investment, will perhaps help the layman in street railway affairs to better understand the technicalities of a somewhat difficult subject and to form a clear idea of the relative merits of different proposed solutions of the problem under consideration.

The street railway industry was a small one indeed prior to 1870 and was limited to horse railway lines in a few of the larger cities. From 1870 to 1880 came the first efforts to bring about improvements in motive powers, several of the hill lines in San Francisco being equipped with the cable system in that decade. A few years later the cable system was adopted in other cities and the early experiments in electric traction began. In 1888-97 has come the electric era.

The old horse railway properties were not, as a rule, overcapitalized. Many of them were really undercapitalized on account of the fact that earnings were frequently put into extensions of mileage instead of into dividends on stock. In the larger cities of the country, these horse railway systems were quite profitable, one reason being that the lines were operated only on the main streets and the companies took no chances of possibly unprofitable extensions. In cities of moderate size also the horse railways, by dint of close management and condensed mileage, managed to make fair profits gaged by percentage dividends on investment, but operation was on so small a scale that the total amount of profits involved was small and was likely to disappear at times. In the smaller cities and country towns street railway properties were practically valueless from a profit earning point of view. Averaging street railway operation in cities of all sizes in New York State and Massachusetts, it is found that in 1885, the New York properties showed apparent net earnings of 8.8 per cent. on the total investment, and the Massachusetts properties 6.6 per cent. For reasons which will presently appear, these apparent rates of return were, in reality, considerably too high.

Electricity took the street railway world in America by storm. Extravagant estimates of the possibilities of operating profits served as a basis for extravagant ideas of capitalization. Syndicates were formed to purchase horse railway properties and equip them with electricity, and these syndicates were forced to pay high prices for assets whose value largely disappeared with the adoption of electricity. The electric manufacturing companies, two or three only in number, were taxed to the utmost to furnish apparatus rapidly enough to supply their would-be customers, and as a result of this urgent demand and of the heavy cost of experimental work and manufacturing processes necessary in a new industry, the prices charged by them for apparatus were very large—five to eight times present prices—while the apparatus itself was extremely poor and inefficient as compared with the types common to-day. Similar pressure was brought to bear upon car builders, rail rolling mills and other manufacturers of street railway material, and with similar results both as to prices charged and imperfection of product. Taken almost by surprise, the mill owners and manufacturers found that they must devise new types to meet a host of varying conditions, and must do it under pressure. Millions upon millions of dollars have been honestly but vainly spent in the endeavor to provide a roadbed suitable for electric traction, the early belief that 50 to 60 lb. girder rails mounted on chairs would be stiff enough for all requirements, having given way to the reluctant admission that our present 80 to 90 lb. standards are necessary. Millions upon millions more have been spent by the street railway companies in teaching the manufacturers that their motors were too weak and their dynamos too small for economical operation. The money wasted in this field, and wasted entirely legitimately—since managers bought the best they could get and none had experience—is almost beyond belief. Joined to this has undoubtedly been real and attempted overcapitalization of costs, which has not always been successful, owing to the necessities for money brought about by the waste investment already described.

Out of this chaos of changing conditions our street railways have come forth burdened with capital liabilities averaging for the United States $95,000 per mile of track, of which about $41,000 is in funded debt and $54,000 in capital stock. The amount of real overcapitalization of costs is, of course, impossible to obtain with any approach to accuracy, but from a somewhat intimate knowledge of the way in which these capital liabilities have in general been created and from the fact that many, if not most of our street railways have been obliged to incur more or less large floating debts in addition to their stock and bond issues in order to provide for the necessary changes in roadbed and equipment brought about by "improvements in the art," I am inclined to believe that the total amount of "water" in American street railway securities hardly exceeds one-third their total par value.

We frequently hear it said of some local street railway system that "it is heavily overcapitalized. An engineer thoroughly familiar with the facts states that the cost of duplicating its tangible assets would be but half its stock and bond issues." Such an argument, used for this purpose, and in the light of the above statements of fact regarding the destroyed horse railway investment and high prices for apparatus and material in the old days of electric railroading, is obviously unfair and demagogic. So long as managers are fallible and their judgments imperfect, so long will all industries be burdened with waste investment, which is none the less, however, true investment and rightly to be capitalized. The public may properly seek to prevent genuine overcapitalization of costs in order to make sure that excessive operating profits be not concealed by such overcapitalization, but it has no right whatever to attempt to scale down the capitalization to the basis of cost of duplication, or to found arguments for imposition of additional burdens of taxation on such a flimsy sub-structure.

I now come to street railway earning power. Here I am prepared to make a broad statement of fact, which cannot I believe, be successfully controverted.

The true earning power of nine-tenths of our street railway properties is far less than their apparent earning power.

The net earning power of any operating property for a series of years is that part of its gross receipts which remains after all operating expenses (including taxes) have been paid, together with all contingent losses of any kind not properly chargeable to operating expenses. In other words, the net earnings in order to be truly such, must be properly applicable to return upon the investment.

The operating expenses of a street railway enterprise are usually sub-divided into four main classes: "General Expenses," "Transportation Expenses," "Maintenance of Way and Buildings," and "Maintenance of Equipment." The first two classes ordinarily include direct annual expenditures only, which are easy to ascertain when once incurred and not difficult to estimate for future years, except that they include contingent losses by fire and for "damages for accidents to persons and property," which losses are decidedly variable in amount. The two maintenance classes are of an entirely different order, since to them should be charged not only the direct expenditures for repairs from year to year, but also a certain amount for renewals or for a measure of that depreciation of plant and equipment which will, in course of time, make renewals inevitable. In other words, the actual operating value of the tangible assets plus any sums held in the treasury to balance depreciation must be at all times equal to the original investment before returns can be properly made upon that investment. The necessity for such a balance to depreciation in the form of a "reserve fund," "depreciation fund" or an account with "deferred operating expenses" is evident, and such a fund should, theoretically at least, form an integral part of any correct financial system.

With long established enterprises, however, such as are found in the steam railroad field, the amount of money per annum which it is necessary to put into the property in the form of renewals in order to keep it up to its original condition, becomes reasonably constant after many years of operation, so that cash depreciation funds of the kind described are not always needed. Nevertheless, their necessity has been proven in innumerable instances in the history of steam railroading, as may be inferred from the fact that but few American railroads can now be found which have not at some period of their career passed into bankruptcy and been forced to provide for urgently needed "improvements" upon their property by the raising of new supplies of capital—"earnings" having been paid out too liberally to stockholders in the early days of the undertaking. In Europe, depreciation is always taken care of by an annual charge upon earnings, and the management of any industrial enterprise would be considered "wildcat" indeed did it not establish amortization funds for this purpose.

In any new enterprise, particularly in the electric railway field, where the total experience with a new form of motive power has extended over a period of less than ten years, it is necessary to form some estimates in advance of what the depreciation is likely to be throughout a term of years, and to set aside out of earnings the sums necessary to balance this depreciation, charging them, of course, to "operating expenses" and thereby raising the apparent percentage of operating expenses to receipts found in the earlier

years of the operating period, to somewhere near their true *average* figure.

Net earnings applicable to return on investment are not always equal to the earnings from operation, i. e., to the difference between the gross receipts and the true operating expenses. A limited time franchise, for example, may easily involve a contingent loss at the end of the franchise period in the disposal of the property, or its transfer to new owners, in case a renewal of franchise to the original owners is refused. This loss must be estimated as closely as possible at the beginning of the operating period and amortized by an annual charge on earnings, if capital is to remain intact. This annual charge may easily be a very large one if, as is the case with many of our electric railways, the original investment was made in the purchase of an old horse railway system for equipment by electricity, since these old systems were usually bought, as before stated, at a large price placed on their then earning power, whereas their assets available for electric traction were but a small percentage of this price.

This statement of the principles underlying a correct system of street railway finance may properly be supplemented by an "illustration drawn from real life" in order that the relative importance of these profit determining factors may be grasped.

A certain American street railway company has been operating about six years under franchises which have thirty years yet to run. The original cash cost of its roadbed, real estate, buildings and equipment, was about $5,000,000, to which must be added an investment of about $2,500,000 in previously existing horse railway properties which formed the backbone of the present much larger system. This investment of $2,500,000 is properly chargeable to "franchises" under the new conditions, though representing "plant and equipment" under the old.

To-day the roadbed and rolling stock are in comparatively poor condition. The company's engineers estimate that not less than $1,750,000 of new money will be required to put the property in good condition according to modern standards, and that a "perfect plant" to do the same work as that which cost $5,000,000 originally would cost, at present prices, but $3,500,000. Here, then, is an absolute destruction of capital investment amounting to $3,250,000—considerably more than the total apparent earnings from operation of the six year period. "How can this lost investment be regained?" is the legitimate inquiry of the investors.

Let us assume, what is actually the case, that capital has received in interest (no dividends) during this six year period a moderate return only for its use, averaging as a matter of fact, hardly 4 per cent per annum. Let us assume that the investors decide to follow their engineer's advice and put their hands deep in their pockets for the additional $1,750,000 required to modernise their plant and equipment so as to give it greatest earning power. May they not be pardoned if, in this particular case, they capitalize this new money, by adding it, on their books, to their original investment, and demand of the management of the rejuvenated property that it so handle its trust as to pay back to the investors at the end of the thirty year franchise period $9,250,000 of unimpaired capital together with whatever annual return can be made on this investment? This may not be ultra conservative bookkeeping, but it is "common sense."

What will be this annual return?

The gross earnings of the property in its present imperfect physical condition are about $1,250,000. With a perfect roadbed and equipment we may strain a point and assume gross earnings of $1,500,000 for the first complete year under the new conditions.

The company's "General Expenses" for the past two years averaged about $150,000 per annum. Under the new conditions they will be about $175,000 per annum, the principal increases coming in taxes, accident insurance and miscellaneous general expenses.

The company's "Transportation Expenses" at present average about $525,000, but under the new conditions will be reduced to about $500,000, the principal decrease being found in operation of power station where the modern apparatus will prove more economical than the old.

The average cost of "Maintenance of Way and Structures" during the last two years was about $50,000, and of "Maintenance of Equipment" about $100,000, these sums nominally covering both "repairs and renewals," but in reality very little of the latter element of maintenance. They are entirely too low, as will readily be understood from the following table and discussion. In this table the cost of each class of apparatus making up the entire plant and equipment is carefully estimated on the basis of present prices and standards and on the assumption that the expenditure of the $1,750,000 of new money has brought up the total value of the tangible assets to that of a "perfect plant," estimated, as above, at $3,500,000.

The first step in the process of obtaining a true measure of the depreciation is to determine the probable life of each kind of apparatus; the second step is to determine the average annual ordinary *repairs* during that life; and the third step is to determine the sums which should be passed to a reserve or depreciation fund each year, in order to provide for the *replacement* of each class of apparatus at the end of its estimated life.

Without going too much into detail in explaining the figures of this table, the idea will be clearly seen by taking the single item of "roadbed." In the first column is given an estimate of the present cost ($1,875,000) of building for this system a "perfect" roadbed according to modern standards. It is assumed that this roadbed will have a life of ten years, though the exceptionally severe and frequent service always given with electric traction in city work has so far proved more destructive to track than this life would indicate, and so long a life is possible in this particular city only with heavy girder rails and the best construction throughout.

During this ten year life assumed, the average annual cost of repairs necessary for keeping the track in fair operating condition can hardly be less than $31,250, a figure based, in the estimates, on track mileage, but less than 2 per cent of cost.

At the end of its life, when the track must be taken up and the rails and ties replaced with new, a salvage of 10 per cent may possibly be realized from the sale of rails as "scrap." The net cost of replacement to be amortized becomes, therefore, $1,687,500.

	First Cost. 1897.	Life in years.	Salvage.	Net Cost of Replacement.	Average Annual Cost of Repairs.	Renewal Fund. Total.	Renewal Fund. % First Cost.
Roadbed	$1,875,000	10	$187,500	$1,687,500	$31,250	$134,142	7.2
Overhead and underground construction	450,000	15	52,500	397,500	31,250	18,419	4.1
Car bodies	244,000	15	None.	244,000	27,500	11,366	4.6
Motor trucks	263,500	10	13,175	250,325	71,790	19,898	7.6
Steam plant	225,000	15	22,500	202,500	9,000	9,383	4.2
Electric station plant	60,000	25	6,000	54,000	2,400	1,131	1.9
Buildings	350,000	Repairs and renewals ½ per cent.			875	875	.....
Miscellaneous equipment	32,500	10	None.	32,500	2,500	2,583	7.9
Totals	$3,500,000	.....	.....	.....	$176,565	$197,737	.....

It is to provide this replacement money that the reserve fund is to be established out of earnings, and by a simple calculation on actuarial principles it is found that $134,142 set aside each year and allowed to accumulate at 5 per cent compound interest will amount in ten years to the $1,687,500 required. This sum added to the average annual cost of repairs, amounts to a total maintenance and depreciation account of but 8.9 per cent of the original cost of roadbed, which is considerably less than the percentage usually estimated by engineers upon roadbed.

The other items in the table being treated in a similar way, we have a grand total of $374,302 as a reasonable estimate of that highly uncertain element of "repairs and renewals," and one constructed in a somewhat more scientific and convincing way than can be done by the ordinary "guesswork" percentages where the favoring influence of compound interest is not taken into account.

Note this—that an item practically lost sight of in American street railway finance, the item of depreciation, is practically equal, under the best conditions of modern roadbed and equipment assumed, to the entire average direct expenditures for ordinary repairs covering a series of years, and is therefore considerably greater than the direct expenditures during the first few years of operation when everything is comparatively new and in good condition. Note also that the combined maintenance charges—the "repairs and renewals"—amount for this particular plant to a little over 10 per cent of the valuation at present prices of its tangible assets and to nearly 25 per cent of the assumed gross receipts.

The true operating expenses of this plant are thus $1,049,302 or about 70 per cent of the gross receipts, and the true earnings from operation are $450,698. These are not yet, however, the net earnings applicable to return upon investment, for a pro rata proportion of the loss to be realized at the end of the thirty year franchise life must first be provided for.

This lost investment may be assumed to be $9,250,000, less $3,500,000, or $5,750,000, if we can safely estimate that the plant and equipment can be sold to new owners thirty years hence for a sum which, together with the funds held in reserve to balance depreciation, will amount to the present valuation of a "perfect plant." This is hardly certain, by any means, but is a convenient assumption for present purposes.

Now to amortize in thirty years this investment loss of $5,750,000, it will be necessary to set aside at 5 per cent compound interest, the sum of $86,500 per annum, and this is a true "fixed charge" against the earnings from operation. The net earnings applicable to return on investment become, therefore, $364,198, or slightly under 4 per cent upon the investment—*provided*, that, within the whole thirty year period, fire or accidents do not cause large uninsured losses impossible to foresee; that the municipality do not again raise tax rates or impose other and heavier burdens upon the enterprise; that the engineers have properly estimated the depreciation; and—most harrowing proviso of all to the worried and anxious street railway manager—that the ever active and utterly inconsiderate inventor do not effect improvements in the art of street railroading, which will play havoc with all these estimates, and render new expenditures of money a necessity. Contingencies of this nature may be confidently relied upon to more than neutralize any probable increase in earning power, caused by growth of cities, and are among the influences which make it impossible to get well informed investment capital for street railway enterprises at low or even moderate rates of interest—and which will operate just as effectually to wipe out the profits of street railway plants owned and operated by municipalities as of those owned by private parties.

It may be said that this illustration must represent an extreme case, not possible to duplicate elsewhere. On the contrary, it is by no means unusual. Here is a table, made up with great care and without prejudice or selection, showing certain operating features of twenty American street railway systems of the first class in magnitude of operation. No particular order of arrangement is followed, as identification is not necessary or desirable for present purposes:

Here are twenty properties, none earning less than $1,000,000 gross per annum. Their aggregate capitalization in bonds and stock outstanding is nearly $500,000,000; their aggregate gross receipts are about $67,000,000; their apparent operating expenses (including taxes) about $42,000,000, or 63 per cent of the gross receipts; and the percentage of apparent earnings from operation to the total capitalization is, in the aggregate, almost exactly 5 per cent.

Case No.	% Operating Expenses to Gross Receipts.	% Earnings from Operation to Capital Liabilities.	% Maintenance Charges to Capital Liabilities.	% Maintenance Charges to Gross Receipts
1	60.4	5.0	2.0	15.7
2	58.5	6.0	1.9	13.0
3	51.1	3.7	.7	9.0
4	61.9	3.9	1.1	11.0
5	80.0	6.8	10.6	31.1
6	65.5	5.2	1.1	7.2
7	59.6	5.5	1.1	8.4
8	65.7	9.9	. .	. .
9	61.3	4.9	. .	. .
10	60.2	5.0	. .	. .
11	47.8	11.0	. .	. .
12	58.0	4.6	. .	. .
13	61.3	4.0	. .	. .
14	66.1	3.6	. .	. .
15	63.9	6.2	. .	. .
16	65.9	2.9	. .	. .
17	58.3	4.3	. .	. .
18	50.9	5.3	. .	. .
19	63.4	3.2	. .	. .
20	61.8	3.3	. .	. .

"But these properties are overcapitalized," it will be said.

Admitted.

Suppose I admit, too, *for the purpose of this argument only*, that the overcapitalization is 100 per cent—that the real accumulated cash investment in all these properties is not $500,000,000, but $250,000,000! This certainly would seem to be an admission sufficiently sweeping to suit any critics.

The result is only this, that the apparent net earnings would be equivalent to a return upon investment of 10 per cent, instead of 5 per cent. Is this larger figure "extortionate," "excessive" or "outrageous" for risks so great as those which have to be taken by investors in street railway properties?

This is not all. These twenty properties are not now in reality earning 5 per cent on their $500,000,000 of capital liabilities, or 10 per cent on half this amount. Look at the percentages of maintenance charges to gross receipts and to capital liabilities of the seven properties for which they can be obtained, and at the percentages of operating expenses to gross receipts in all! Case No. 5 is an exception among these properties, in that it is not overcapitalized, its maintenance accounts are sufficient and its percentage of earnings from operation to total capital liabilities can probably be maintained in the future. But it is safe to say that hardly one of these properties except case No. 5 can be permanently operated at the percentages to gross receipts given in this table.

* * * * *

If these things be true, how are three cent fares possible in Toronto and Detroit?

"Three cent fares" in Toronto do not mean a general three cent fare rate, by any means. The contract between the city and the company reads as follows regarding fares:

"Single (cash) fares are to be five cents each.

"Fares on night cars (12 midnight to 5.30 A.M.) are to be double the ordinary maximum single fare rates.

"A class of tickets must be sold at the rate of eight for twenty-five cents to be used only by passengers entering the cars between the time the day cars commence running and 8 A.M. and between 5 and 6.30 P.M.

"A class of tickets must be sold at the rate of twenty-five for $1, and another class at the rate of six for twenty-five cents (good at all times.)

"Children under nine years of age are to be carried at half fare rates and infants in arms are to be carried free; school children are to have school tickets at the rate of ten for twenty-five cents, only to be used between 8 A.M. and 5 P.M. and not on Saturdays.

"Police constables in uniform, detective police officers in the employ of the city, and (while a fire is in progress) members of the city fire department in uniform, shall be carried free."

The actual average rate of fare paid by Toronto citizens under this schedule was, in 1896, 4.24 cents per passenger—a very different thing from three cents.

The Toronto Railway Company pays to the city under its contract 8 per cent of its gross receipts up to $1,000,000 per annum ($997,273 in 1896) and $800 per mile of track per annum (84 miles at present). Its total payments in 1896 were, therefore, approximately $150,000.

It is possible for the company to make these payments, to establish the schedules of fares described above, and to make fair profits for its stockholders, for the following reasons among others:

1. Because Toronto is small in area (10.5 sq. miles) and the population density large (15,000 per square mile) as compared with American cities of about the same population.

2. Because it is theoretically possible to serve a city of this area with less mileage and fewer cars than a city whose population is more "spread out."

3. Because, as a matter of fact, the Toronto system is much smaller in size and operates fewer cars than American systems serving the same population.

4. Because the Toronto Railway Company is granted exclusive rights for street railway operation within the city limits and can therefore lay out its lines to the best advantage from a street railway point of view without fear of competition.

5. Because in a system so laid out, in a territory of this kind, the average length of ride per passenger is comparatively small.

6. Because, in consideration of the franchise payments described, the company is relieved of all other burdens of taxation (except school tax), including original cost of pavements, even between the tracks, and their annual maintenance—all of which is undertaken by the city.

7. Because at the end of the thirty year franchise period, the company has rights of property which the city and any new lessee are bound to respect.

8. Finally, because the Toronto installation was made at a time when electrical apparatus and equipment material were fairly good, so that the waste investment has been less than usual.

In substantiation of certain of the above statements the following table is submitted.

City.	Population.	Area Square Miles.	Population per Square Mile.	Track Mileage.	Cars Owned.
Omaha	140,452	24.0	6,000	110	291
Toronto	166,141	10.5	15,000	84	300
Louisville	161,129	13.9	11,500	150	500
Minneapolis	164,738	54.0	3,000	122	553

"Three cent fares" in Detroit served their real purpose in converting a Mayor of Detroit into a Governor of Michigan. They might have been, also, a financial success had the element of competition been absent. The "Detroit experiment" is well worth explaining on account of the possibility that similar ones may be tried in other cities with equally unsatisfactory results.

For several years prior to 1894, one of the street railway companies of Detroit, operating in its principal streets, had been engaged in a bitter contest with the city about its franchise rights and obligations. The company had been uniformly successful in the courts, but its victories were hollow ones, since public opinion, always so ready to pronounce against corporations, had found a verdict of "guilty" and cared not for law nor vested rights.

The city Government, headed by Mayor Pingree, attempted to force this company to reduce rates of fare to three cents and claimed in support of this demand that street railway profits were excessive at a five cent rate. The company proved that it was financially impossible to do what was asked of it, in view of its large accumulated investment for horse and electric operation, and its legal right to charge a five cent fare being upheld by the courts, the city was again defeated.

In December, 1894, a syndicate of capitalists, including several interested in the Toronto Railway Company, was granted by the city the right to build a 60 mile electric railway system in direct competition with the old company. The contract with the city specified

1. That the company was to charge a five cent cash fare; was to issue tickets good between 5:45 A. M. and 8 P. M. at the rate of eight tickets for twenty-five cents; was to issue tickets good between 8 P. M. and 5.45 A. M. at the rate of six for twenty-five cents; and was to issue tickets for police and fire department use at the rate of fifty cents per 100 (in books).
2. That no taxes on earnings were to be paid by the company, but that taxes on the company's real estate and personal property should be levied as on a private individual.
3. That the city should do all paving, repaving and repairing of pavement over the entire street.
4. That the city should have the right to purchase the company's plant and equipment at the end of thirty years at a valuation to be reached by appraisal.

Now this was not, to all appearance, a particularly difficult contract to fulfill, and Mayor Pingree can hardly be accused of driving a sharp bargain with the new company. The latter came into the market for equipment at a time when it was able to purchase modern apparatus and material at almost the lowest prices ever known; it was not obliged to lay a foot of pavement nor to pay taxes on earnings; it had no burden of waste investment to labor under; and, more important than all perhaps, its lines were so laid out as to make its regular, everyday patronage a short distance one, while it might reasonably expect to obtain an average fare of at least 3½ cents.

The fatal defect in the plan lay in the assured competition of the old company. The latter held a superior strategic position in the struggle for traffic not easy to overestimate. A glance at the accompanying map will show clearly how the system of the old company radiates from the business district in nearly straight lines, while that of the new turns and twists indirectly to reach practically the same termini. Add to this the fact that the streets of the old company were, naturally, the best in the city from a street railway point of view, and it will be seen how completely at its mercy would be the new company, were the rates on the old temporarily

reduced to the lower level. Lost traffic would be almost immediately regained under such circumstances, for, no matter how strongly the public sympathizes with a new company in its fight against a "grinding monopoly," a majority of its individual units will not long express their sympathy at considerable personal inconvenience in daily life.

The inevitable result of such a condition is:

1. Consolidation, or common ownership of the rival systems.
2. A street railway system "overbuilt" for the city's needs.
3. Necessary reduction, or abandonment of service on the least profitable routes.
4. Rigid economy in expenditures, possibly leading to deterioration in service and surely to caution in making suburban extensions.

In Detroit these results have come about, and the companies have been financially fortunate in having settled their difficulties and formed a practical consolidation without a "rate war"—a thing which permanently benefits no one in the long run. The two companies are still operated independently (after a reorganization of the new company), but the latter is understood to be controlled by the old company.

It is worthy of note in passing that with general popular sympathy in its favor, the new company earned in 1896 $6800 per mile of track as compared with $10,400 per mile earned by the old company. In the first three months of operation, the new company received on an average 3.46 cents per passenger carried, its tickets receipts being about 78 per cent of the total. Its cars earned barely 12 cents per car mile, a very low figure, with which compare the Minneapolis system which earns from 18½ cents to 21 cents per car mile, the Boston system which earns over 31 cents per mile, the Chicago system earning 23 cents per car mile, and many others large and small. For its first year of operation, the company's percentage of operating expenses to gross receipts was 67.7, this figure covering practically no charges to maintenance, everything being new and in good condition for operation.

* * * * *

We look this country over in vain to find a single example of municipal ownership and operation of street railways. In Canada there is one example, found in Port Arthur, a town of 2700 inhabitants, which owns an 8 mile line on which four cars are operated. In Germany, the world's center of advanced socialistic thought, there are but four cases and these among the smaller towns, such cities as Berlin, Hanover, and Hamburg, being served by private companies. In Switzerland there are three cases of operation by cantons. In France, Austria, Hungary, Belgium, Italy, Russia, Spain and Holland cities have apparently no intention of assuming operating responsibilities in this direction. It must not be forgotten, however, that the great expense of running European city governments which makes it necessary to tax everything on which a tax can possibly be laid, will doubtless lead to the manufacture of municipal theory to fit fiscal necessities, and the street railway industry can hardly hope to escape the desire to impose indirect taxes upon the people.

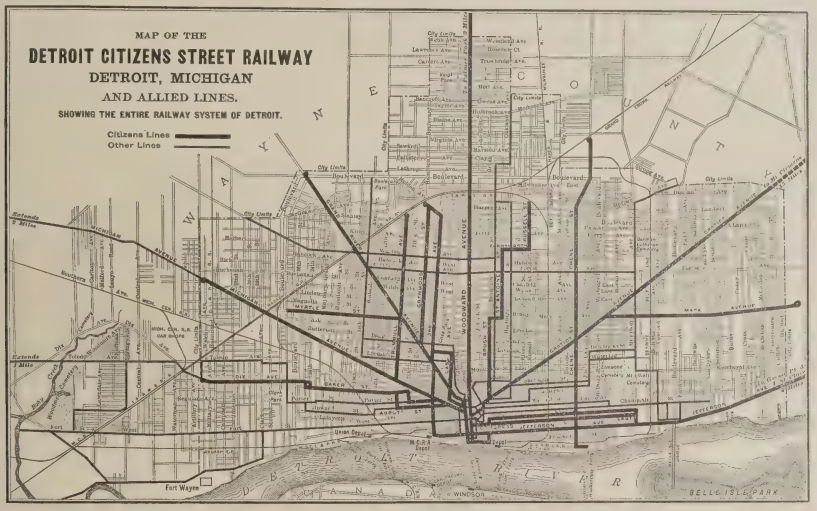
In Great Britain there are six cases of municipal ownership and operation of "tramways," as against about 125 privately controlled. One of these six cases, that in the city of Glasgow, is worthy of special study, while the others are not; in three instances because municipal operation has but just commenced and no valuable results have yet been obtained, and in two because operation is on an extremely small scale. The following table may be of interest, however, as showing what is being done in these five cities.

The city of Glasgow, Scotland, is the one example of municipal ownership and operation of street railways to which advocates of this municipal policy are accustomed of late to point as a practical and apparently successful demonstration of their theories. In 1894, the Corporation of Glasgow obtained from Parliament the powers necessary to "take over" the lines of a private tramway company, whose twenty-one year rights were then expiring, and to operate these lines on its own account. The experience so far gained (up to May 31, 1897) has covered a period of two years and eleven months, and is for horse operation only.

Town.	Population.	Miles Road.	Total Capital Investment.	Gross Receipts.	Operating Expenses.	Earnings from Operation.	Per Cent. Return on Investment.
Blackpool.....	6,100	4	$276,865	$ 49,345	$ 34,425	$14,920	5.4
Huddersfield	95,422	20	681,390	137,055	105,560	31,495	4.6
Leeds.....	367,506	17	622,730	289,240	230,070	59,170	9.5
Plymouth	84,179	4	No information obtainable.				
Sheffield.....	324,243	9	606,325	111,840	75,235	36,605	6.0

NOTE.—Conversions from pounds sterling to dollars are on the assumption that £1 = $5.00.

The accompanying table of statistics of the Glasgow tramways for the year ending May 31, 1897, is taken from the report of the Lord Provost's Committee on Tramways, and is the latest official information obtainable. The system comprises 46 miles of track, and the total capital invested to May 31, 1897, was £1,240,000, or $6,200,000. The gross receipts for the year were £1,200,000, or $6,000,000, and the net profit £200,000, or $1,000,000. The number of passengers carried was 140,000,000, and the number of car miles run was 12,000,000. The average fare per passenger was 1.71 cents, and the average receipts per car mile were 50 cents. The net profit per car mile was 8.33 cents, and the net profit per passenger was 1.43 cents. The net profit was 16.67 per cent on the capital invested.



The accompanying diagrams, which are drawn to the same scale (1 inch = 5 miles), represent the tramway lines of Glasgow in their entirety, and the lines on the principal avenues in Brooklyn and Boston on which uniform five cent fares are charged (it being impossible to represent on so small a scale all the network of lines in the business centers of the two American cities.) The relative sizes of the three systems are shown not only by these diagrams, but also by the following statement of track and line mileages in the three cities.

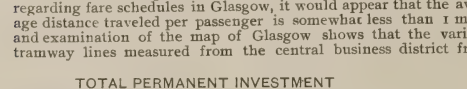
Glasgow, Scotland, is the one example of municipal ownership and operation of street railways to which advocates of this municipal policy are accustomed of late to point as a practical and apparently successful demonstration of their theories. In 1894, the Corporation of Glasgow obtained from Parliament the powers necessary to "take over" the lines of a private tramway company, whose twenty-one year rights were then expiring, and to operate these lines on its own account. The experience so far gained (up to May 31, 1897) has covered a period of two years and eleven months, and is for horse operation only.

The Glasgow tramway system is an example—all too rare—of a municipal enterprise managed with honesty, skill and intelligence, and strictly in the interests of the public, so far as those interests are understood by the public itself. Its general manager, John Young, is a broadminded and progressive man, who would gladly develop the municipal tramway system on broader lines than the conservativism of the public at present allows. The schedule of fares in Glasgow is on a basis of distance traveled, the highest fare being 3*d.* (six cents) for a maximum ride of about 6 miles. Until the purchase by the city of the old tramway system, the minimum fares were two cents for a distance of about 1 mile, but the municipality has reduced this minimum fare to one cent per one-half mile. This action has been quite generally misunderstood in this country, being taken by many to be an actual reduction of fares to one-half former rates.

Let us look a little more closely into this matter of fares. The city of Glasgow, with its suburbs, covers an area of nearly 23 sq. miles, and its population contained therein is about 800,000, the population density being, therefore, about 35,000 per square mile. The two American cities corresponding most closely to Glasgow in population are Brooklyn, N. Y., and Boston, Mass. The former (within its present limits) contained about 840,000 inhabitants by the census of 1890, distributed over an area of 37 sq. miles, and having, therefore, a population density of 22,700 per square mile; and the latter, with its immediate suburbs, contains about 700,000 inhabitants, distributed over an area of 122 sq. miles, and having, therefore, a population density of 5700 per square mile.

	Miles of line.	Miles of track.
Brooklyn	243	504
Glasgow	37	77
Boston (five cent lines) approx.	168	325

Now the average fare paid by passengers on the Glasgow tramway system was, in its last financial year ending May 31, 1897, 1.85 cents. From this figure and in the light of the previous statement regarding fare schedules in Glasgow, it would appear that the average distance traveled per passenger is somewhat less than 1 mile, and examination of the map of Glasgow shows that the various tramway lines measured from the central business district from



which they radiate are from 2 to 3 miles only in length. It is evident that the Glasgow citizen is a "short distance" rider by necessity.

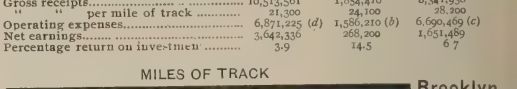
Citizens of Brooklyn may leave the East River water front at the extreme western side of the city and travel eastward 7¾ miles to Flushing, or 10¾ miles to Jamaica; and southward 7¾ miles to Fort Hamilton and 10¾ miles to Coney Island; or they may take an 18 mile ride by trolley in various directions; all for the sum of five cents.

A citizen of Boston may leave Scollay Square near the business center of the city and travel southward 7½ miles to Neponset, or 5 miles to Forest Hills, Dorchester or Jamaica Plain; on the west 7 miles to Newton or Watertown; on the north 9 miles to Arlington Heights, 5 miles to Medford or Malden or 6 miles to the beaches of the North Shore; a single five cent fare paying for his transportation on any one of these routes.

There is no possible way of ascertaining the average ride of Brooklyn or Boston street railway passengers, but the immense areas covered by these cities and the location of their residence

31, 1897, of the eight Brooklyn surface and elevated railway systems for the year ending June 30, 1896, and of the West End Street Railway Company of Boston, for the year ending Sept. 30, 1896.

	Brooklyn system.	Glasgow system (*a*)	Boston (West End) system.
Cost of plant and equipment	$93,782,048 (*e*)	$3,158,430	$24,796,811
" " per mile of track	190,000	41,000	83,990
Gross receipts	10,513,561	1,854,410	8,341,958
" " per mile of track	21,300	24,100	28,200
Operating expenses	6,871,225 (*d*)	1,586,210 (*b*)	6,690,469 (*c*)
Net earnings	3,642,336	268,200	1,651,489
Percentage return on investment	3.9	14.5	6.7

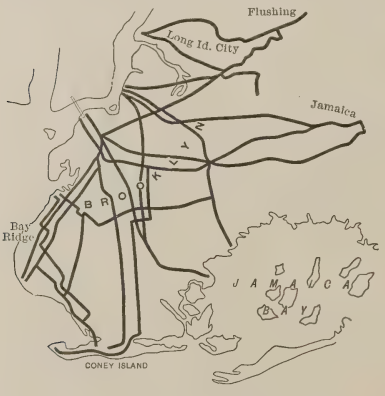


(*a*) Assuming £1. = $5.00
(*b*) Including $142,550 depreciation and renewal fund, and $12,230 rentals.
(*c*) Including taxes $343,898 and rentals $11,952.
(*d*) Including taxes, $598,285.
(*e*) Not including investment of Brooklyn Rapid Transit Company, or Kings County Traction Company.

Note these things:

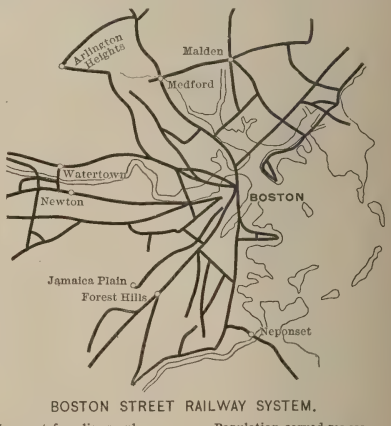
1. Boston, one of the most carefully and wisely governed cities in the world and one which has from the earliest times adopted a liberal and far sighted policy with regard to quasi public corporations, has invited and brought about an investment of private capital in a single local transportation system of over $40 per capita served as against an investment of less than $4 per capita in Glasgow. There is believed to be no overcapitalization of any nature in the street railway system of Boston. In Brooklyn, which has also been wisely generous to its street railway corporations, the actual cash investment in its transportation system, apart from all overcapitalization, is probably not less than $60 per capita.

2. Private capital is serving both American cities far more lib-



BROOKLYN STREET RAILWAY SYSTEM.

Five cent fare lines only. Population served 850,000.



BOSTON STREET RAILWAY SYSTEM.

Five cent fare lines only. Population served 700,000.

districts at considerable distance from the business centers—together with the fact that the congestion of cars in these business districts largely prevents short distance riding as a time saver—make it certain that *street railway transportation rates per mile traveled are, in both American cities, much lower than in Glasgow.*

A word about the service rendered in the three cities. In its last financial year the city of Glasgow so operated its cars as to require each to carry 12.2 passengers per car mile run. The West End Street Railway Company of Boston so ran its cars as to require each to carry but 6.5 passengers per car mile run—and this too in spite of the fact that the average Boston car has considerably greater carrying capacity than the average Glasgow car—while in Brooklyn the car service is so frequent as to give each car a carrying capacity of but 4.8 passengers per car mile.

The service given to the people of Brooklyn and Boston by the private corporations owning their street railway systems is vastly superior in frequency to that given to the people of Glasgow by the municipality.

Now as to comparative financial results. The following table will be of interest as showing the capitalization and operating figures of the Glasgow municipal tramways for the year ending May

erally and, in a sense, unselfishly than Glasgow has been served during the last ten years by private capital jealously restricted by the municipality, and municipal capital itself.

3. The public has responded to the better service given in Brooklyn and Boston by patronizing their street railway systems to the extent of over $12 per capita, as against but $2.30 per capita in Glasgow. It should be noted, however, that the gross earnings of the two American systems are not nearly as large in proportion to the cash investment as is the case in Glasgow.

4. The private capital invested in the West End Street Railway system was forced last year to be content with net earnings equivalent to a return of but 6.7 per cent, while the return paid upon the aggregate book investment of the Brooklyn properties was but 3.9 per cent.

5. *During its last financial year the West End Street Railway Company of Boston paid into the public treasury in the form of taxes a sum greater by 28 per cent than the entire operating profits of the Glasgow municipal system during its last financial year; and the street railway properties of Brooklyn paid as taxes over twice as much as the Glasgow operating profits.*

Those who cite European experience in street railway transpor-

tation matters, do not seem to at all realize the tremendous economic importance of population density, frequency of service, and maximum and average lengths of ride as affecting investment and returns upon investment. All the great European cities are essentially different from American cities of corresponding size, in that their people are hived together in tenement house districts as close as possible to the business centers, and there has been no such centrifugal force from centers to suburbs, as is found in the wonderful municipal transportation facilities of America. Europeans in general do not know what street railroading is, according to our standards, and to attempt to apply Old World theories and restrictions to American practice in this field would be like adopting for New York City the municipal polity of Oshkosh—would be a passage backwards into a far earlier stage of social development.

* * * *

The purely economic argument against municipal ownership and operation of street railways, data concerning which has been given in the preceding pages, may be summed up as follows:

Excessive returns on the necessary accumulated cash investment can never be earned in America by either municipal or private capital engaged in the operation of street railways.

In nearly every city in America, moderate returns on capital invested in street railways are possible only by the exercise of great skill and economy in management.

The history of the conduct of municipal enterprises does not lead to the belief that this exceptional skill and economy can be obtained under municipal management.

* * * *

I have said that I do not admit that the purely economic argument should be the controlling one in the question of private, versus municipal ownership and operation of street railways.

Who believes that had our municipalities been in control of transportation facilities from the earliest days of street railroading, we should see to-day this immense expansion and development of American cities which has made our social problems so easy to solve, as compared with those of the Old World cities? Who can estimate in dollars and cents the value to Americans and to the world in general of such a magnificent sociological experiment? Are we now to grope around with eyes intent to earth seeking the paltry sixpence which we fear has been lost, when all the grand world of light, and beauty and freedom—created by a policy whose essential wisdom we can hardly realize, it is so simple—is around us?

These results have not come about by accident. There are underlying principles and laws of governmental and human nature, which have been and are, as inevitable in their action as any in the domain of scientific sociology.

Governments in general, and municipalities in particular, are essentially conservative in trying new things. Private capital, on the contrary, is essentially eager to anticipate the future and preempt all possibilities of profit. Herein lies the real and fundamental reason why municipal ownership and operation of public service enterprises is not, nor ever will be a success from the broader points of view—from the standpoint of a people's progress.

With 100,000 fellow citizens intently watching and ready to call him to account for the slightest extravagance or appearance of extravagance, the municipal official dare not be broad minded and progressive. He moves deeply, in channels of routine and mazes of precedent. Red tape binds him to earth and produces in him narrowness of vision and suspicion of new things.

Private capital sees in public service enterprises immense opportunities for *speculative* profits. Earning power may be large or small or may fluctuate within wide limits from year to year without destroying this chance for speculative profits. Street railway extensions may be built without possibility of adequate returns for years to come—sometimes to shut out competition, sometimes to obtain construction profits, sometimes in a really wise determination to build for the future. New and beautiful cars may be bought, and parks and amusement resorts established to attract the public. Those controlling street railway properties realize more deeply than the public often gives them credit for, how essential to their financial prosperity it is to please that public and avoid antagonisms. All these influences are genuine public values, obtained solely from private management, and what thoughtful person will not admit that they enormously outweigh a slight reduction in taxation, even if such reduction could be obtained through municipal ownership?

* * * * *

A word about the socialistic tendencies found in this idea of municipal ownership and operation of public service industries. Its advocates hardly seek to deny these tendencies, but usually resort to generalities or sophisms, as, for example, "Such charges will have little weight with thoughtful persons," or, "If municipal ownership be socialistic as to which, while not conceding the charge, we may well care nothing, providing it be also desirable and profitable, then New York is already committed to socialism, for the new charter declares," etc.

I do not believe in socialism nor am I willing to treat these socialistic tendencies lightly as of little account. I do not believe in operation by national or state governments or by municipalities of any public service industries which can be possibly placed in private hands. I readily concede that many arguments, some strong and some merely plausible, may be brought forward in support both of pure socialism and of that more limited branch of it where the goverment controls every enterprise which uses the facilities which it has created. I shall not attempt to recapitulate the many arguments against the socialistic idea, but shall content myself with saying that the development of individual and self-poised character is, to my mind, a higher end of social organization than the performance of every social function in the cheapest possible manner. I would willingly pay a price, were it necessary to do so (which I believe, however, to be not the case), for the privilege of living a life free from the iron hand of the governmental bureaucracy which would be created by the application of these socialistic and semi-socialistic principles, and of the tremendously powerful political organization which will surely go hand in hand with this bureaucracy. Go to Germany—a country curiously combining absolutism with advanced socialism—and learn how this "iron hand" is felt by the humblest even more than by the most powerful; ascertain how impossible it is for the individual outside the machine to place responsibility or to obtain redress for wrongs and incivilities; feel how inflexible is the paternalism which confines that country's children into narrow courses of conduct; and take note of the breath of relief heaved by our German-American friends as they step again upon our shores after a brief—an always brief—return to their native country.

Tell the restless, energetic American that he must confine his attention to agriculture or trade—that he shall not enter the vast field of effort found in the service of the public, except as the minute cog-wheel of an enormously complicated and truly monopolistic—though governmental—machine, and you speak to him not of progress, not of development, not even of justice as between man and man, but of contracting minds and inevitable degeneration.

* * * * *

I reject municipal ownership and operation as the best solution of the street railway problem, not only for the reasons already stated, but also because there are better, more truly scientific and more broadly profitable ways of gaining for the people the maximum money return possible to be derived from street railway operation. The present system (?) of dealing with street railway corporations by limited term franchises and by the imposition of constantly heavier burdens of taxation is far from being among these better ways, and is, in the highest degree, chaotic, unprofitable to the city and unsatisfactory to private capital. Adequate compensation for franchises cannot possibly be obtained by the city nor be offered by private capital under such a system, for everything is so tentative and uncertain that ordinary business prudence requires the utmost caution in undertaking obligations by trustees for invested capital. Burdens of taxation imposed upon street railway companies are, in reality, a form of indirect tax upon the people, since they act to prevent reductions of charges for services rendered. Capital cannot be secured on advantageous terms where franchises are short, and this, too, keeps charges above a minimum, not only because a higher price has to be paid capital in the form of interest, but also because a larger sum has to be set aside each year out of earnings to provide for contingent losses on investment at the end of the franchise period.

The best solution of the problem, and one which is capable of the widest application, is found, I believe, in *complete monopoly, private ownership and operation, perpetual franchises and a system of perpetual profit sharing with the municipality, joined to a remission of charges to the public if and whenever profits come to be sufficient for that purpose.*

By a policy of this kind it is possible:

1. To avoid pledging the city's credit for making the necessary original investment.

2. To place upon private capital the burden of all losses realized or contingent.

3. To obtain for the city an equitable share of all profits realized.

4. To avoid the creation by the city of a complex bureaucratic organization with its attendant political dangers.

5. To secure for the benefit of the municipality, its people and the private capital invested the undeniable benefits of private management as affecting profits, perfection of service and direct responsibility.

6. To secure for the municipality, the people and the private capital invested the true pro rata shares of each in the additional profits coming with municipal development in the future.

7. To borrow capital at interest rates hardly greater than those quoted to the municipality itself.

This plan possesses, moreover, a great advantage in that it can be put immediately into practice on many of our existing systems as well as on new ones. A street railway company is operating in a city under a franchise which has thirty years yet to run. Let the city and company officials meet together, and, in the full light of public scrutiny, prepare a profit sharing plan of this nature. Both have something to give and something to receive. The city offers a perpetual and exclusive franchise, freedom from taxation, and the right to a moderate return upon the investment before declaring "profits." The company offers to the city the right of inspection and audit of its books (with an agreement about the system by which they are to be kept), and a predetermined share of all profits now and in future realized over and above the agreed return upon the investment. Both agree with the public that when the profits, over and above the agreed return on investment, reach a certain percentage of the gross receipts there shall be a reduction in fares.

When all the safeguards possible to devise shall be thrown around a municipal contract of this character, it will be found that the street railway problem in that particular city is solved for all time, and in a fair and equitable manner. Thenceforward the municipal government and the street railway corporations will work *together* to build up and develop on its broadest lines the municipality of whose interests they are at once guardians and servants.

SCIENCE · ENGINEERING · INVENTION ·

THE Berlin (Germany) central station is distributing electric power to 1700 electric motors with an aggregate of 6110 h. p.

IT is reported that Henry M. Whitney, of Boston, with Canadian capitalists, has formed a syndicate for establishing a system of electric railroads in Kingston, Jamaica.

SOME tests were made last December of the Serpollet motor cars on the Wurtemberg railways. The cars operated so successfully that they have been in regular service ever since, averaging about 120 miles a day at an average speed of 24 miles per hour. The cost for fuel, oil and waste for this period has averaged 2.8 cents per car mile.

THE Maryland Steel Company has recently sold 7500 tons of rails in India at a considerable reduction over the price quoted by English mills. The Bengal & Nangpur Railroad has also recently placed an order for 2000 tons with an American firm at $23. The Johnson Company, it is also reported, has received orders for 20,000 tons of rails for street railway work in Ireland.

THE importance of electric railroading as a means of interurban travel in metropolitan areas is brought out very clearly by a sixteen page supplement now published regularly in Bullinger's Monitor Guide, devoted entirely to trolley routes and time tables within 50 miles of New York. This matter is handled in much the same way as is done with steam railroad time tables and is a very valuable addition to the guide.

AN experiment in third rail propulsion for steam railroads was made in the yards of the American Ordnance Company, at Bridgeport, Conn., Aug. 23, in the presence of Daniel S. Lamont, N. H. Heft and others. The system experimented with is the invention of Edwin C. Crocker, and it is aimed to sectionalize the third rail in such a way as to make the latter perfectly safe and free from current except in the immediate neighborhood of a train taking current therefrom. This is accomplished by means of magnetic cut-outs operated from the train.

THE Street and Water Commissioners of Jersey City, N. J., have prepared a set of rules to regulate traffic on asphalted streets, the principal provisions of which are to exclude vehicles with a total weight of more than 2000 lbs. on tires less than 3 ins. wide. The rules provide that where the weights shall exceed 4000 lbs. the tires shall be at least 5 ins. wide; where it exceeds 5000 lbs. the tires shall be 6 ins. wide; where it exceeds 6000 lbs. the tires shall be 7 ins. wide; where it exceeds 7000 lbs. 8 ins.; 8000 lbs., 9 ins.; 9000 lbs., 10 ins.; 10,000 lbs., 11 ins.

LORD KELVIN stated in an interview, after a recent visit to the power station of the Cataract Construction Company, at Niagara Falls, that in his opinion, a great industrial district would soon arise within 10 or 20 miles of the Falls, and that he hoped that the third generation would not see the Niagara cataract. While power from the Falls could be transmitted to New York City for lighting and power purposes, he believes that more than half the power would be lost in transmission, and that it would be better for the factories wishing to use the power to go to the power than for the power to go to the factories.

THE Chicago City Railway Company, which has the reputation of paying its employes the highest wages of any street railway company in the country, is making an effort to effect a reduction in these wages among the employes who are to be transferred from cable to electric cars. It has just issued a general circular letter to its employes reading as follows: "It is contemplated that all cable lines be electrically equipped. As an expression of preference you will state on this card whether you would prefer to operate an electric car at twenty-one cents per hour or a cable train at approximately twenty-three cents per hour for trains."

THE recent contract given by the Central London Railway to American manufacturers for the electrical equipment of its line has aroused considerable dissatisfaction in England upon the ground that the apparatus could have been built at home. The reason why the apparatus could be purchased in America at a lower price than in England, in spite of the higher cost of labor in this country, is given by the secretary of the Central London Railway, who stated that the more extensive use of electrical apparatus in this country had brought the manufacture of apparatus to a higher pitch and that consequently it could be produced with greater economy than in England.

An interesting feature of the competitive struggle in the iron and steel business is seen in the opening of the Pittsburgh, Bessemer & Lake Erie Railroad, which is practically owned and operated by the Carnegie Company, and which will haul iron ore from Conneaut Harbor, O., to the Carnegie furnaces on new steel cars of 50 tons capacity. On the return trip it will take coal from the Pittsburgh district to the Lake Erie terminal to be used in the Lake Superior iron mines of the Rockefeller syndicate. It is said that this new line will commence business with Carnegie-Rockefeller contracts to the extent of 4,000,000 tons per annum, and that the cost of transportation to the Carnegie Company will be fifty-three cents per ton for the entire haul, which is much below the best price possible to obtain by other Pennsylvania furnaces.

THE question of nationalization or purchase of the whole system of railways in Switzerland by the state has been under serious discussion for some time past. A law was enacted empowering the Government to examine the books of the different companies, so as to arrive at a true estimate of the value of the lines. The result shows that over $200,000,000 would be required to purchase the lines, a sum representing in some cases not more than half the estimate given by the companies of the value of their property. Many of the shares are held in Germany, and much of the loss to private individuals, arising from the transfer of property, would fall on foreigners. It is probable that the measure will eventually be passed by the Chambers, but its final adoption will depend on the verdict of the nation, if an appeal be made by means of a "referendum" within three months.

THE students, alumni, and friends of Lehigh University will be glad to know that the reports which have appeared in the daily press about the University closing its doors are without foundation. It is true that the partial failure of the ordinary revenues of the University for the past four years has given the trustees much anxious thought, but there was no authorization for the statement that the college exercises would be suspended unless state aid were granted to the institution. Fortunately, however, the present emergency has been provided for by a liberal grant from the state. The public announcement that the Governor had approved the bill for the relief of the university so far as it related to "maintenance" and "general expenses" was made on Monday, July 26, and met with general approval throughout the state. The amount appropriated for these items was $150,000.

A New Governor.

The accompanying illustration shows a new governor, manufactured by the Ball Engine Company.

Recent developments in connection with electric lighting in office buildings, insist on such exacting service as to allow only the minutest variation of speed under widely varying loads and changing pressures. Not only must the speed be uniform, but it must

IMPROVED BALL GOVERNOR.

remain so during the period of the change. To meet these new and rigid requirements, the Ball Engine Company has, after months of experiment, placed upon the market a governor for which it is claimed that it in every way fulfills the demands referred to, with the additional beauty of extreme simplicity. This governor is an adaptation of the Rites governor system.

This governor regulates with an extraordinarily rapid adjustment and with no instability or surging. The centrifugal element upon which the degree of the refinement of regulation of all governors depends, is combined with an inertia element, relatively so great that instant and extreme changes of load are immediately provided for without waiting for the otherwise necessary manifestation of centrifugal force. The entire governor consists of but a single moving piece suspended upon one pivotal point, thereby reducing the friction to a minimum, and with no joints to interfere with the best action of the governor. The suspension pin or pivotal point is made of hardened crucible steel. The suspension pin eye is lined with phosphor bronze, and the little lubrication that is required is accomplished by forcing grease by means of a compression grease cup into a number of recesses arranged around the bore of the bushings. The extreme simplicity and good regulation of this governor will recommend it to users of engines.

An Electrically Operated Drawbridge.

An interesting application of electricity to the propulsion of a drawbridge is embodied the case of the Burlington Bay channel swing bridge of Toronto. It is interesting, partly because the case is somewhat unique and partly because it shows how small a power will replace an extensive steam equipment usually employed for such purposes.

The pier of the bridge is not in the middle, being 159 ft. 9⅝ ins. from one end and 100 ft. 1⅜ ins. from the other. Balance is secured partly by the installation of the motor and the moving machinery on the shorter end and partly by counterweights. The bridge revolves on a nest of rolling wheels between two circular girders in the usual way.

ELECTRICALLY OPERATED DRAWBRIDGE.

One of the peculiar features about the bridge is that it is driven from the end instead of by gearing on the pier. Fig. 1, which shows a side elevation and plan of the bridge, will enable the reader to see how this is accomplished. The short end of the bridge describes a quadrant over a chain path and the chain takes a turn around a suitable pulley on the bridge, which is driven by a 12½ h. p. Walker bridge motor manufactured by the Walker Company. It is easy to see that when the pulley is revolved the bridge may be either opened or closed according to the direction in which the pulley winds up the chain. The difficulty of maintaining the chain on a curved path is obviated by the use of ten guiding wheels. This makes the chain a portion of a polygonal perimeter instead of the arc of a circle. The connections of the motor to the driving pulley are shown in Fig. 2. The motor makes three reductions by spur gearing and a fourth by a bevel gear, and on the shaft of this last combination is the chain wheel. This arrangement is shown in both plan and elevation in Fig. 1. The bridge is provided with a latch to line it up when closed and a brake to check its momentum just before closing. As there is no further apparatus other than the brake and the latch levers, the controlling apparatus is very simple.

The 12½ h. p. motor has proved itself ample to do the work. It receives its current from the local railway system which passes over the bridge. The bridge is swung a comparatively small number of times a day, and it will easily be seen that a great saving is effected, for the reason that if steam were used the pressure would

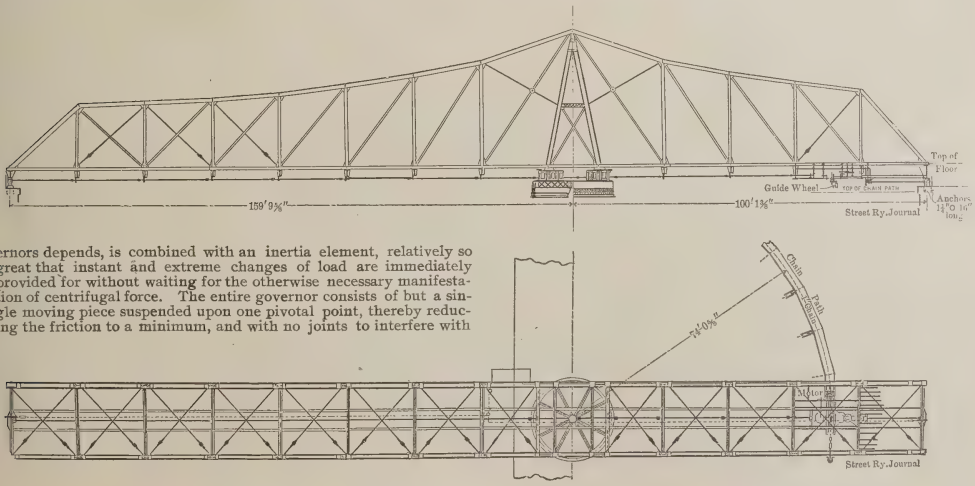


FIG. 1.—ELEVATION AND PLAN OF DRAW, SHOWING METHOD OF ELECTRIC OPERATION.

have to be kept up by a 20 h.p. boiler all day, no matter whether the work was small or great, and the apparatus for moving the bridge would require continuous care. With the electric system the maintainence of power is no part of the bridge watchman's duties. The power is always there, and beyond the application of a little oil and cleaning no further attention is necessary. Moreover, and not least important, the outfit is very much less expensive.

The use of electric power for such purposes is such an obviously superior method that the field has appeared of sufficient magnitude for the Walker Company to enter it with a line of motors specially

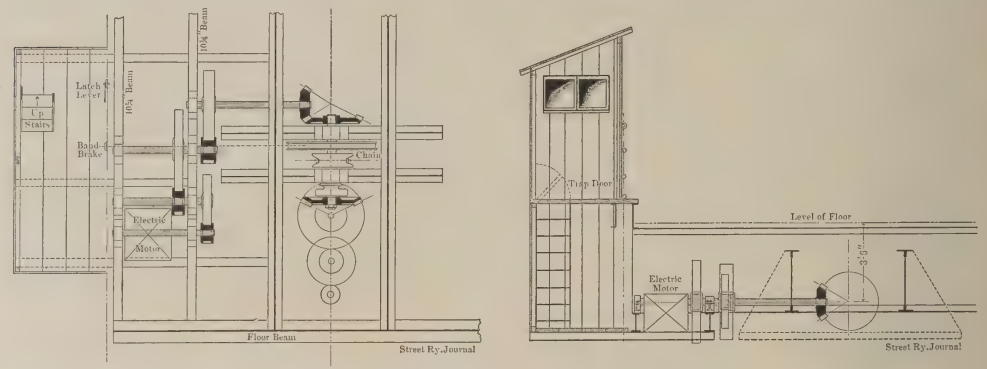


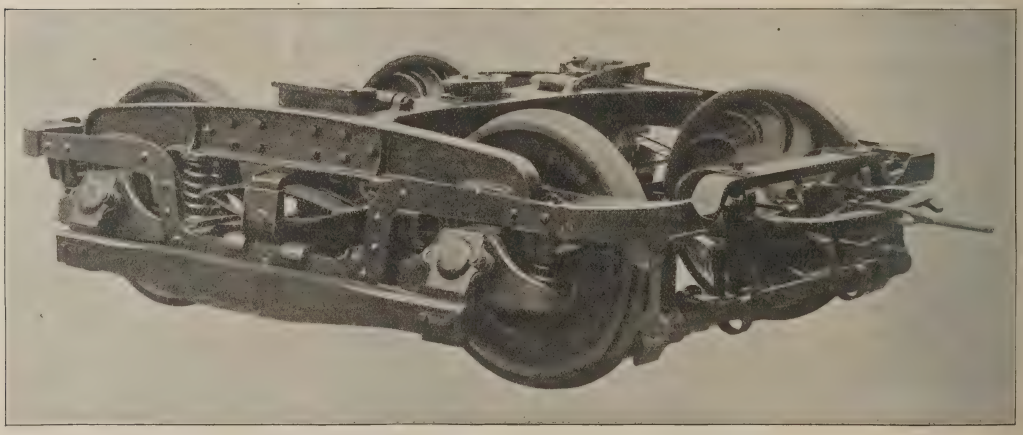
FIG. 2.—PLAN AND ELEVATION OF MOTOR AND CONNECTIONS.

built for this purpose. They are arranged to carry a very heavy load for a short time only, and hence are very small in dimensions, and inexpensive. They are amply able to perform the service for which they are designed. There is an enormous saving in first cost on such an equipment as compared with engine and boiler, and by thus taking advantage of the fact that the work is intermittent, and designing the motor accordingly, the Walker Company has reduced the cost to figures that are insignificant by comparison.

More about the Schenectady Tests of the Sprague System.

From July 15 to the present time, there have been in progress on the private tracks of the General Electric Company, at Schenectady, a series of tests and experiments with the Sprague system of multiple unit control for electric trains, which are of great interest to all railway men, and especially to those connected with elevated railways. A train of six standard elevated railway cars from the South Side Elevated Railway Company, of Chicago, were taken to Schenectady, each car being equipped with one McGuire standard No. 28 truck, of 5 ft. 6 in. wheel base, with 33 in. M. C. B. standard wheels and 5 in. axles. On each of these trucks were mounted two G. E. No. 57 motors, having a rated capacity of 55 h. p., but an actual capacity of over 100 h. p. each. The ordinary standard elevated railway coach truck was retained at one end, and one of the above described motor trucks was placed at the opposite end of each car. At some convenient point on each car was located a Sprague automatic controller, and on each platform was mounted a small switch, about equivalent to three push buttons, by which the operator, or motorman, regulated the action of the main controller. One of the main features of the Sprague system, is that the rate of acceleration is determined, and the controller is then set for that rate, and the car or train cannot be accelerated more rapidly than this predetermined rate, therefore, a careless or reckless motorman cannot waste current or injure the motors. During the tests an acceleration to a rate of 32 miles an hour was obtained in thirty seconds. This enabled the operators to make a schedule time of 18 miles an hour, including stops of ten seconds every 2150 ft. The General Electric track is a little over 1½ miles long, and includes a 100 ft. radius curve on a 4 per cent grade, and at about the center of the run is a 600 ft. radius curve. The track was laid last winter and has neither gravel nor stone ballast, so that it is not nearly as smooth and true as the ordinary elevated railway track, but this train of six cars, and sections of it, ran around this 600 ft. radius curve day after day at speeds ranging from 10 miles to 38 miles per hour in a manner to arouse the admiration of every one.

One of the remarkable facts brought out by these tests, was that the motor trucks rode much steadier than the standard elevated railway coach truck, especially on curves. This was explained as being due to the elastically controlled side motion of the motor truck bolster frame, and the elimination of half the draft friction, by making only one set of vertically moving friction surfaces between the axle journal boxes and the car body. It was also noticed that although motor trucks generally ride rougher than trail trucks, owing to the communication of vibration from the motors and gearing to the car body, these cars rode more softly at the motor truck



STANDARD TRUCK FOR SOUTH SIDE ELEVATED RAILWAY—CHICAGO.

end than at the opposite end where the standard elevated railway coach truck was supporting the car body. This result was caused by the motors being hung from the lower truck frame, which was spring supported on the axle journal boxes, so that the motors were supported below and independent of the main car springs on which the bolster frame was mounted.

Another feature that the writer observed that will be of interest to railway men as showing the perfection of the pivotal action of these trucks, was that on leaving a curve, the center of the motor truck seemed to follow from the curve into the center line of the tangent or straight track, all four wheel flanges being clear from the rails and the space between the flanges of either pair of wheels on either rail being alike, showing that the center line of the truck was parallel with the center line of the track.

The above are points of interest to railway men, developed during this very interesting series of tests and experiments, that seem to have been overlooked in previous articles describing them.

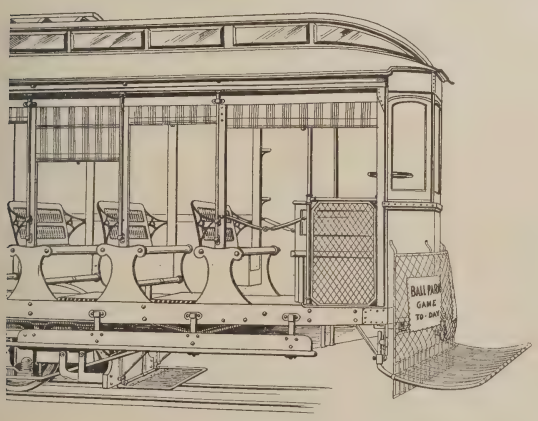
The accompanying cut shows the motor truck used, some of the points of which are described above.

Power Station Economy in Paterson, N. J.

Wm. M. Brock, manager of the Edison Electric Illuminating Company, of Paterson, N. J., whose plant is considered one of the finest in the country, has written to the Ball & Wood Company, who furnished its engines as follows: "We are reaching pretty close to 300 watts (actual conditions) per pound of buckwheat anthracite coal. Show me a Corliss plant in the United States operating at within 20 per cent of this economy under actual working conditions, month in and month out, and I will show you something that the committee of nineteen members of the National Association has failed to discover. Of the eighty-one stations embraced in their report, the five highest in the list show respectively 237, 213, 212, 180 and 178 watts per pound of coal; 85 per cent are below 150 watts and 60 per cent are below 100 watts. I cannot, of course, ascribe our higher efficiency alone to the type of engine employed by us, but I do say, without hesitancy, that to our engines belongs a good portion of the glory obtained."

An Electric Car Fender.

The accompanying engraving shows an electric car fender for which a number of valuable features are claimed. As will be seen, this fender consists of a resilient buffer frame and a scoop which is normaly suspended just in front of the wheels. The scoop is made complete, of two pieces of gas pipe. When a body is collided with it is first struck by the resilient buffer frame. When this frame is moved rearwardly one inch it closes an electric circuit—before the real impact of the collision has been delivered to the body struck. Simultaneously with the primary contact with the buffer a magnet is vitalized and the scoop released, it reaching the ground before the body becomes prostrate. Two circuit breakers are used upon



NEW TYPE OF FENDER.

each car. They are placed in two boxes which are secured one upon each side to the bottom of the platform floor, being placed back some 6 or 8 ins. from the front edge of the platform which serves as a perfect protection in case of collision with vehicles and also prevents any possibility of trouble from rain, snow or other like causes. The boxes are cast complete in one piece of ordinary cast iron and require no finishing.

There is also placed upon the front platform a tripping device whereby the motorman can by a blow with his foot release the scoop independent of the electric current and can reset it without leaving the platform. This fender is supplied with or without a projecting cradle as desired. It is manufactured by Paul Jones, of Cincinnati.

Axle Compressor for Air Brakes.

The accompanying engravings illustrate the axle compressor and governor and the engineer's valve for the system of air brakes manufactured by the Christensen Engineering Company. These brakes have been introduced on a number of street railway systems and are said to be giving excellent satisfaction.

Among the strong points claimed for air brakes in general, and for this system in particular, is the brake cylinder. Where brakes

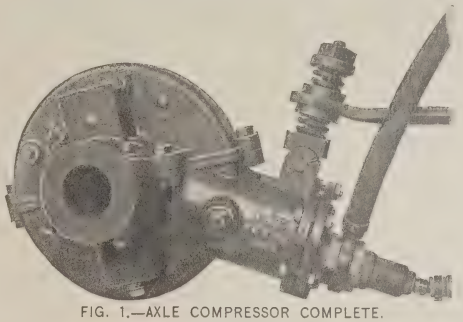


FIG. 1.—AXLE COMPRESSOR COMPLETE.

are set and locked rigidly, there may occur circumstances which will materially add to the amount of pressure brought upon the brake shoes, such as the expansion of wheels and the shoes from heat, caused by friction, or through the swinging of a truck in passing around a curve, which, without an elastic cushion to relieve the undue pressure caused thereby, will create sufficient friction to skid the wheels, or in the latter case possibly to derail the car. With the air brake, the air in the brake cylinder will exert only a certain maximum amount of pressure. If an unexpected strain is then brought against the shoes from any cause, the air in the brake cylinder acts as a cushion, and will yield, thus insuring that no greater pressure than is intended can be brought against the wheels.

Fig. 1 illustrates the Christensen axle compressor and governor, showing the method of elastic suspension. All moving parts are completely enclosed, insuring their entire protection from dust and grit. The casing is partially filled with oil, thus securing good lubrication. The springs in the elastic suspension protect the com-

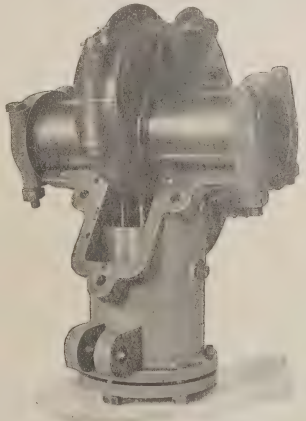


FIG. 2.—AXLE COMPRESSOR WITH TOP HALF OF CASING REMOVED.

pressor from shocks occasioned by sudden jars. Besides the vertical motion, this suspension admits of universal motion of the cylinder, sufficient to allow the compressor to follow all motions of the axle occasioned by the necessary play of the same in the journal bearings and the spring of the truck frame. This feature is very important as it insures that the entire line of the cylinder is always at right angles to the center line of the axle.

Fig. 2 shows the axle compressor with the top half of the casing

removed. It will be seen from this cut that the features of simplicity, durability and efficiency have been carefully studied.

The eccentric strap is of steel, with phosphor bronze bushing for pin bearing. The pin is case hardened and ground. The eccentric strap bolts are provided with crown nuts and split pins. The piston is provided with a cast iron packing ring.

The governor in this system of air brakes is of very simple construction, and is so arranged as to be removed and replaced with a new one in a few moments, should it become inoperative from any cause; but as it contains only three moving parts, one being the suction valve, one the discharge valve and one the governor proper, and all being large and durable, this contingency is not likely to occur until the parts have been destroyed by legitimate wear. The office of the governor is to trip the suction valve when the maximum pressure in the reservoir is attained. Thereafter, until a reduction is made, the air passes back and forth through the suction hose without compression.

The air reservoir is one seamless, cold drawn steel shell, and all are tested by the manufacturers to 600 lbs. hydraulic and 150 lbs. air pressure. A diagram of the engineer's valve is shown in Fig. 3. This controlling valve is so arranged as to permit of perfect lubrication of bearing faces, and also to drain off all moisture which may accumulate therein. This is important, especially in freezing

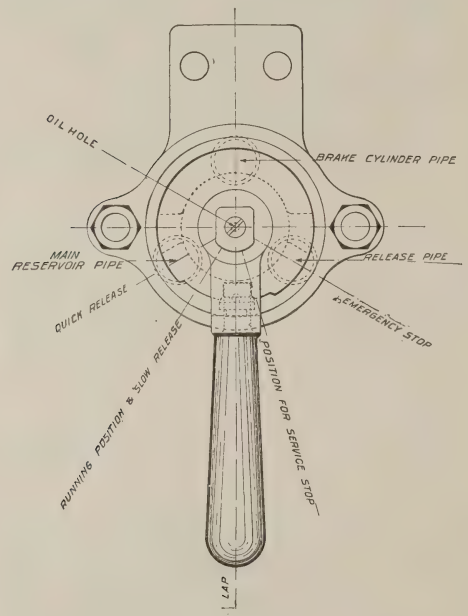


FIG. 3.—TOP VIEW OF CONTROLLING VALVE.

weather. This diagram shows the position of the handle for all of the different services which the valve is intended to control. The motorman, having impressed these different positions on his mind, which can be done with a few minutes' consideration, should have all the information necessary to enable him to completely control his car. By practice, manual dexterity will be attained, which will enable him to operate the brakes with less waste of air than at first.

The construction of the brake cylinder is such as in no way to interfere with the operation of the brakes by the hand lever, the connecting rod being loose in the pipe and not connected with the brake cylinder piston.

Trial of a Compressed Air Locomotive on the Manhattan Elevated Railroad.

The Hardie compressed air motor, which was built by the American Air Power Company to demonstrate the possibility of drawing trains on the Manhattan Elevated Railroad, was put into service Aug. 23, and a public test of it was made by taking a train loaded with 192 persons over the Sixth Avenue road from Rector Street to Fifty-eighth Street and back to Cortlandt Street.

Robert Hardie drove the locomotive and H. Paige, a regular engineer, was his pilot. Among those on the train were W. J. Fransioli, general manager of the elevated roads; E. J. Elias, president of the Third Avenue Railroad Company; H. H. Vreeland, president of the Metropolitan Street Railway Company; F. S. Pearson, chief engineer of the Metropolitan Street Railway Company; David Young, general manager of the Consolidated Traction Company, of New Jersey, and a number of steam railroad men.

The run to Fifty-eighth Street was made without a stop, in nineteen minutes. There had been no attempt to make special speed on the run because there was a regular train ahead, but it was made in three minutes less than the regular schedule time. The trip back was begun at 10:01 o'clock and completed at 10:27.

A number of the passengers then visited the plant at 100 Greenwich Street, where the air is compressed for the use of the locomotive. A big steam engine operates two compressors, each of which consists of two water jacketed pumps. The first pump receives the air and squeezes it down to about 65 lbs. pressure to the inch, the next one reduces it to about 165 lbs., the third to about 750 lbs., and the last to nearly 3000 lbs. Water circulates about each cylinder to carry off the heat and the passage of the air is from one cylinder to another through a coil of submerged pipe for the same purpose.

The air is finally forced into a stack of steel tubes, which are arranged in four sets. From these it passes in a pipe to the water station on the elevated road near Rector Street. When the engine is to be charged a connection is made with this pipe and the air passes into another stack of steel tubes concealed in the boiler like jacket, which receive it at a pressure of 2500 lbs. to the inch. A charge which will run a train to Fifty-eighth Street and back can be taken on in the same time it usually takes to receive the water for a trip.

When the air is being used it passes out through cylinders exactly like those for steam, except that special valves are used to control it. Between the tubes which hold the charge and these cylinders are the peculiar features of the Hardie system. A reducing valve delivers the highly compressed air into a receiving tank in the cab at a much lower pressure, and then it passes through a tank of hot water, which returns to the air some of the heat which it lost in being compressed, and also gives back to it the water vapor which it also lost in that operation. It is this feature which, Mr. Hardie claims, makes his motor commercially economical in working.

It is intended that the motor shall be placed in regular service upon the road to test the actual economy of its operation, but no announcement has been made as to when this will be done.

Deoxidized Babbitt Metal.

Bridgeport Deoxidized Bronze & Metal Company.
New York City, Aug. 15, 1897.

Editors Street Railway Journal:

The following information concerning babbitt metal may be of interest to your readers.

"You cannot tell by the looks of a toad how far he can hop," and the same may be made to apply in a measure to babbitt metal, for it is almost impossible to judge accurately by the looks of a metal of its wearing quality in a bearing. However, the best genuine babbitt metal is always clean and smooth both to the eye and touch, and this is mostly due to the presence of tin and absence of lead in its make-up.

It is certainly a strange coincidence that the two requisites for a perfect bearing—babbitt and oil—are so hard to obtain because of the great amount of adulteration and also misuse of trade names for standard articles, but such is the case, and one must therefore possess some practical knowledge of these things in order to buy and use them intelligently.

As before mentioned, tin is the base of genuine babbitt, the original babbitt's formula being ninety-six parts tin, four parts copper and eight parts antimony, and many large consumers prefer this mixture to-day. There is no doubt about the superior anti-friction qualities of these three metals when properly combined, but slightly different proportions than the above will sometimes give better results for certain classes of work. Lead and antimony is upon the market in various proportions, and sold very extensively under many fancy names, and has been found in some instances plenty good enough. An electric motor, however, requires better metal, for in the first place, lead in any quantity will surely squeeze out of the bearing, and, moreover, lead is rapidly attacked and corroded by oleic acid, which is found in most oils and greases, and a bearing so roughened is liable to heat, and in some cases actually melt and run out. Tin, on the other hand, effectually withstands the action of oleic acid, and this fact alone should be sufficient to make it preferable to lead for all anti-friction purposes. Another thing overlooked by many buyers is the difference in specific gravity, lead being about one-third heavier than tin, and, therefore, deoxidized genuine babbitt is often cheaper per bearing though dearer per pound than the various lead and antimony mixtures.

D. C. Sanford, Secretary.

Not a little of the expense in brazing is due to the cost of removing the brass which has stuck to the metal where it is not wanted. The removal of this brass is usually attained only by patience and diligent filing. The Joseph Dixon Crucible Company is now introducing for the aid of the brazier that unique mineral, graphite, which is not affected by acids, alkalies, heat or cold. Braziers who have made use of Dixon's pure flour of graphite pronounce it extremely valuable. A sample will be sent without charge by the Joseph Dixon Crucible Company, Jersey City, N. J., which is the only manufacturer.

STREET · RAILWAY · NEWS

The Coming Street Railway Conventions.

AMERICAN STREET RAILWAY ASSOCIATION.

Secretary Penington of the American Street Railway Association, has been busily at work at Niagara Falls during the past two weeks, and at Atlantic City, laying out the space in the exhibit hall, and in other respects looking after the details of the October convention. It is expected that the plan showing the arrangements of the exhibits, etc., will be mailed early in September to those who have reserved space.

The convention hall is at the corner of Walnut and Sixth Streets, about a mile from the International Hotel, but reached very readily by the Niagara Falls & Suspension Bridge Railway, the time taken being but about four minutes, while a very frequent service is promised during the convention.

A rough plan of the convention hall is given herewith. It consists of two adjacent buildings, one having a ground space in the clear of 75 ft. × 105 ft., and the other a ground space as at present arranged of 52 ft. × 126 ft. This last building, which is being erected, can be very easily and quickly extended in the direction shown marked "Annex," and the local committee wishes it understood that this will be done during September should the demands for floor space exceed the present capacity, and it wishes every manufacturer to be absolutely sure that he will have all the room which he requires. Another important point which will be generally appreciated, in view of the experience of the last two or three years, is that the entire building will be thoroughly lighted and heated. The heating will be partly by steam and partly by electric power.

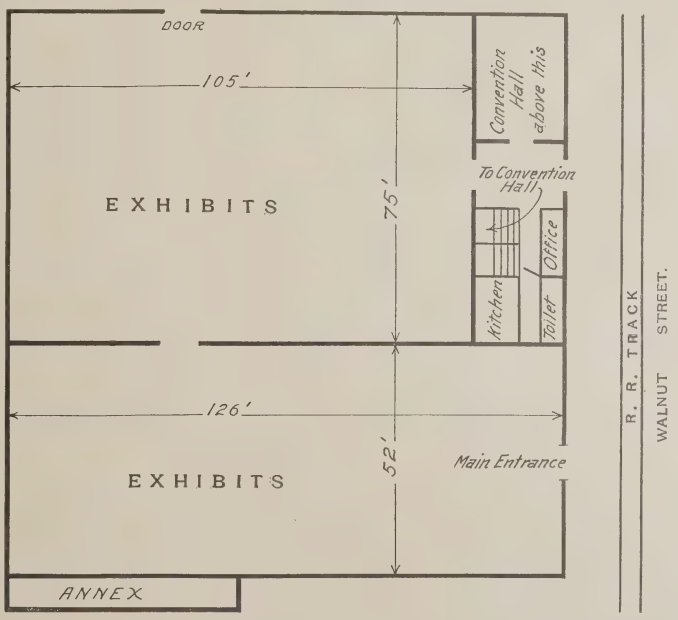
The building has three doors, two on Walnut Street and one on Sixth Street. Those on Walnut Street are opposite a spur from the Erie Railroad tracks to be laid during the coming month, so that two freight cars can be unloaded at one time. During the progress of the convention, however, all the doors, except at the point marked "main entrance," will be kept closed. By this means the only entrance to the meeting hall will be through the exhibition space and this will insure attention to exhibits.

W. C. Cloud, local agent at Niagara Falls for Wells-Fargo express, desires it announced that, as many of the manufacturers who will have goods on exhibition at the New York State Convention, Sept. 14, may desire to store these goods until the American Street Railway Association Convention, one month later, Wells-Fargo & Company will be pleased to store and care for all goods shipped via their line for the four weeks, without charge.

It is earnestly requested that all exhibits shall be in place and all work finished by Monday evening, Oct. 18, which is the evening prior to the opening of the convention. Possession of the hall can be had on Monday, Oct. 11, thus giving a full week for preparation of exhibits. Watchmen will be in charge of the premises to insure safety.

Too much credit cannot be given to the local street railway managers, Messrs. Ely, Hill and Brooks, for their efforts to make the meeting in October a success and to give the visitors at the convention a pleasant and enjoyable time. They have been ably seconded in their work by H. W. Beardsley, local secretary. The local committee, of which Mr. Ely is chairman, is arranging a programme whose attractiveness can be easily imagined from the beauty of the country surrounding Niagara. Ladies in attendance at the convention will receive special attention, and a ladies' entertainment committee, selected from well known residents of Niagara Falls, has been appointed to make this feature of the convention an especially successful one.

The usual arrangements have been made with the different traffic associations of the country for the sale of tickets at reduced rates—a fare and one-third for the round trip. All proposing to attend the convention must purchase, not more than three days before the date of meeting, a first class ticket (either limited or unlimited) to Niagara Falls, for which he must pay the regular tariff fare, and upon request the ticket agent will issue a certificate of such purchase properly filled out and signed. Tickets for the return journey will be sold by the Niagara Falls agents at one-third the highest limited fare to those only who hold certificates signed by the ticket agent at the points where through tickets at Niagara Falls were purchased, countersigned by the clerk of the convention, and vised by the agent of the Passenger Association, certifying that the holder has been attending the convention. Under the rules of the Passenger Association it will be necessary for all persons holding certificates to deposit them with the clerk, Frank J. Duffy, when they arrive at the hall on Tuesday, Oct. 19. They will then be signed and vised and ready to return to the owners on Thursday at 1 P.M.



PLAN OF CONVENTION HALL—NIAGARA FALLS.

All parties who have not yet made arrangements for space should write at once to H. W. Beardsley, chairman committee on exhibits, Niagara Falls, N. Y., and payment for space should be made to T. C. Penington, secretary and treasurer of the American Street Railway Association, at 2020 State Street, Chicago, Ill.

There will be hotel accommodations for everyone. The headquarters of the association will be at the International Hotel, and the rates at this and other hotels will be as follows:

Hotel.	Rooms.	Rate per Day.
International Hotel	350 to 450 people,	$3.50 to $4.50
Cataract House	" " "	" "
Imperial	140 rooms,	2.50 to 4.00
Tower Hotel	35 "	2.00 to 3.00
Columbia	50 "	2.00 to 2.50
Niagara Falls House	25 "	2.00
Salt's New Hotel	30 "	2.00
Temperance House	50 "	1.50 to 2.00
Atlantique	22 "	2.00
Kallenbod	30 "	3.00
Prospect House	40 "	3.00 to 4.50

The annual dinner will be held at the International Hotel, Thursday, Oct. 21. Tickets will be sold at $7, the actual cost to the association.

The following interesting letter has been received by the STREET RAILWAY JOURNAL:

CINCINNATI, O., Aug. 20, 1897.

EDITORS STREET RAILWAY JOURNAL:

A very enthusiastic meeting of the street railway people and supply men interested, was held to-day, called by the Cincinnati Convention League, and it was unanimously decided to not only invite, but to do all in their power to get the 1898 convention of the American Street Railway Association for Cincinnati.

An invitation to the association will be extended by the different street railway companies and also by the commercial bodies, the city, etc., at the meeting at Niagara Falls and every effort made to secure this convention.

Cincinnati being centrally located, having perfect railway facilities, has also one of the finest buildings in this country for convention purposes, the music hall, to which is attached an enormous power building used for exposition purposes.

At the meeting to-day committees were appointed and another meeting will be held on Aug. 31, at which time these committees will report and a definite form of action be decided upon.

We want this convention and trust that you will prominently mention the fact in your coming issue.

Yours very truly,
G. R. SERNGHAM.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA.

The following is a summary of the papers which will probably be read at the next meeting of the Street Railway Accountants' Association at Niagara Falls, in October, 1897:

"The Handling and Checking of Transfers, from Printer to Furnace."

"The Care and Handling of Fares, from Receipt to Bank."

"Materials and Supplies Accounts, from Purchase to Use."

"Power House Accounts."

"Pay Rolls Timekeeping and Method of Paying."

"Car Mileage: How Arrived at and its Use." (Street Railway.)

"Car Mileage: How Arrived at and its Use." (Interurban.)

"Statistics: Their Use and Abuse."

The report of the Standardization Committee, also of the secretary and treasurer and of the Executive Committee, will be received, and it is announced that President McCullough of the American Street Railway Association has signified his intention of recommending the formal endorsement and approval of the Accountants' Association by the other. He will also invite the members of the Accountant's Association in a body, to attend the meetings of the other association.

Arrangements have also been made to provide the members of the Accountants' Association with the same badges worn by the American Street Railway Association with the addition of a designating ribbon for the former.

The following applications have been received for membership in the Accountants' Association:

St. Louis & Suburban, St. Louis, Mo.
The People's Railway, St. Louis, Mo.
Lowell, Lawrence and Haverhill Railway, Lawrence, Mass.
New Orleans Traction Company, New Orleans, La.
Richmond Traction Company, Richmond, Va.
Campañía de Tranvías de Merida, Merida, Mex.
Lindell Railway Company, St. Louis, Mo.
Missouri Railroad Company, St. Louis, Mo.

President McCullough has accepted an invitation to appear at a meeting of the Accountants' Association.

THE NEW YORK STATE ASSOCIATION.

The New York State Street Railway Association does not propose to be overshadowed by its rival, the American Street Railway Association, but is laying plans for a convention on Sept. 14 and 15, which will attract not only its own members but street railway managers from Massachusetts and Connecticut who have already written asking permission to attend. This result has been brought about partly by the knowledge that a programme of special interest to managers will be laid out for the convention and partly because it is now well understood that the New York State Street Railway Association is second to none in the country in virility, strength of purpose and executive force in obtaining results. Its methods are well worth studying, certainly by every state association, for under the administration of President Rogers the street railways have been welded together into a coherent whole which is able to do, and is doing, much to bring about important improvements in existing conditions.

Among these results has been the establishment of very pleasant relationships between the steam and street railways of the state, and this will be evidenced at the Niagara Falls convention by the presence of a number of prominent steam railroad officials. It is also expected that the members of the Railroad Commission will be present as well as some of the principal members of the Assembly, who have been invited by President Rogers in order that they may get an inside view of street railroading in practice, with the idea that some erroneous legislative beliefs will be thereby corrected.

The feature of ten minute papers, which has during President Rogers' administration made the meetings of the New York State Street Railway Association so bright, attractive and profitable, will be found this year as usual, and a list of titles of these papers with names of some who will speak briefly on these subjects follows:

Points on Financial Organization. (Allotted.)
Street Car Wheels: Should they be Made Heavier? (Allotted.)
Construction and Maintenance of Trucks and Car Bodies. (Allotted.)
Liability Insurance: The Best Form. Can we Insure Ourselves? (Allotted.)
Points on Care of Dynamos.
The Use and Abuse of Transfers.
How Can we Increase our Receipts?
Storage Battery. Herbert Lloyd, Philadelphia.
The Power Station from an Economic Standpoint.
The Office: Suggestions for Records, Reports, etc.
Municipal Ownership. H. H. Vreeland, New York.
Street Railroads vs. State: The Relation to Each Other.
Facts and Fancies of Railways. W. W. Cole, of Elmira.
General Track Construction: The Most Approved Method.
The Advantage of a Single System for Single Track Roads.
Low Joints: How to Prevent Them? C. L. Allen, Syracuse.
Long Distance Power Transmission: The Most Approved Plan.
Freight and Express Service on Suburban and Interurban Lines.
Air and Power Brakes for Electric Cars: Are they Practicable?
The Repair Shop. How to Obtain the Best Results. Robert Dunning.
A Decade of Electric Railway Development. W. J. Clark, New York.
Pleasure Resorts as a Means of Stimulating Travel. Are they Profitable?
Track Bonding: How Can we Obtain the Best Results? H. S. Newton, Syracuse.
How Can we Increase the Efficiency of Employes? W. W. Wheatly, Brooklyn.
Interurban Electric Roads: Possibilities and Advantages from a Financial Standpoint.
The Effect upon Street Railroads of the Application of Electricity to Steam Railroads.
The Prevention of Accidents: The Best Method to Accomplish this End. H. S. Cooper, Schenectady.
The Influence of Accurate Measurements upon Economical Operation. Caryl D. Haskins, of Boston.
Daily Inspection of Car Equipment. How Can we Accomplish the Best Results with the Least Expense?
"Receipts from Other Sources." How to Obtain Best Results from Sale of Advertising Privileges, Power, etc.
Rails: Their Construction from a Scientific Standpoint. Results of Chemical Analysis. A. J. Moxham, of Johnstown.
Advantages of "Up-to-Date" Street Car Service; Why the Rate of Fare should not Be Reduced. C. L. Rossiter, Brooklyn.

The programme of the convention as at present laid out (subject to change, however, according to circumstances) is as follows:

First day.—Tuesday, Sept. 14.
9:30 A. M.—Meeting of the executive committee.
10:30 A. M.—Meeting of the association. Usual routine of business.
12:30 P. M.—Adjournment.
2 P. M.—Reassembly and papers.
4:30 P. M.—Adjournment.
5:50 P. M.—Executive session.
7 P. M.—Banquet.

Second day.—Wednesday, Sept. 15.
9:30 A. M.—Meeting of the association for the reading of papers and other business.
Adjournment taken when completed and remainder of day given up to the entertainment provided by the local committee.

Some of the features of this entertainment as at present planned (but also subject to change) will be as follows:

A three hour trip across the Suspension Bridge and via the Niagara Falls Park & River Railway to Clifton and Queenstown; thence by the Niagara Falls Navigation Company's steam ferry to Lewiston and return to Niagara Falls by the Great Gorge road.

A visit to the great electric power plant of the Niagara Falls Hydraulic Power & Manufacturing Company, in which the electrical apparatus is 300 ft. below the top of the high bank of the river.

A two hour trip by the cars of the Niagara Falls & Suspension Bridge Railway Company to the great plants of the Niagara Falls Paper Company and the Niagara Falls Power Company, where 15,000 h. p. is being generated and 35,000 additional h. p. is now

being installed for use by various electric railway and manufacturing plants and where the initial work of the great transmission line to Buffalo may be seen.

A 1½ hour trip to the state reservation and islands and on steamer "Maid of the Mist."

For the first day, arrangements have been made for a delightful excursion for the ladies to Toronto and return at reduced rates.

For the evening of Sept. 15 a grand ball has been arranged by the management of the hotel.

On the morning of the 16th the entire party will be conveyed to Buffalo in special cars of the Niagara Falls & Buffalo Railway, through the courtesy of that company and its connections, the Niagara Falls & Suspension Bridge Railway Company and the Buffalo Railway Company.

It is expected that several literary lions will be present at the association banquet and that in general a good time as well as a most profitable one will be had by all in attendance.

THE PENNSYLVANIA STATE ASSOCIATION.

The sixth annual meeting of the Pennsylvania Street Railway Association will be held at the Hotel Allen, in the City of Allentown, on Wednesday and Thursday, Sept. 1 and 2, next. The association will convene in the parlors of the hotel on Wednesday, at 11 A. M. An interesting programme has been arranged, including the reading of papers on scientific subjects of special interest to the members of the association; a detailed report will also be made by the Committee on Legislation, of the work done by it at the recent session of the Legislature. When it is considered that some fifteen bills were introduced into the Legislature affecting electric railways, many of them of a character most dangerous and damaging to the welfare and success of these roads, the necessity of organized effort to control such legislation will be realized. It is only by a full and representative attendance at Allentown that such organization can be effected. To this end all electric railway companies in the state of Pennsylvania, whether members of the association or not, are not only invited, but urged to send as many representatives as possible to the Allentown convention.

Meeting of the American Institute of Electrical Engineers.

The fourteenth general meeting of the American Institute of Electrical Engineers was held at Greenacre on the Piscataqua, near Eliot, Me., July 26, 27, and 28, under unusually interesting circumstances, the society having accepted the invitation of Miss Sarah J. Farmer to visit Greenacre and assist at the jubilee of the electrical work of her distinguished father. A number of very interesting and valuable papers were read and thoroughly discussed. An interesting feature of the convention was an exhibit of some 400 or 500 photographs, framed and unframed, relative to electric railway work and loaned for the occasion by the General Electric Company, S. H. Short, of the Walker Company, the Westinghouse Electric & Manufacturing Company, the STREET RAILWAY JOURNAL, the *Electrical Engineer*, Prof. Elihu Thomson, W. J. Hammer, T. C. Martin, and others. These were displayed on long tables and on the walls, and were carefully labeled with explanatory references so as to be readily understood. They showed the whole range of the art during the last ten years of rapid commercial development and were representative of roads and apparatus in all parts of the world. Portraits were also shown of men active in street railway work. This photographic exhibit was supplemented by a beautiful collection of electrical portraits loaned by W. J. Hammer and including also some of his data and relics relative to Professor Farmer. The exhibit and that of Professor Farmer's papers and apparatus were in charge of Messrs. Key, Keefe, Martin and Hammer.

Among those present were W. C. Andrews, Dr. Louis Bell, C. T. Bancroft, Prof. C. F. Brackett, Princeton University; Putnam A. Bates, Adam Bosch, D. Burnett, R. G. Brown, Prof. G. F. Barker, University of Pennsylvania; J. H. Craig, C. T. Childs, A. E. Childs, Prof. F. B. Crocker, Columbia University, N. Y.; G. A. Damon, G. S. Dunn, Prof. A. E. Dolbear, Tufts' College; Prof. W. Estey, Urbana; C. L. Edgar, Prof. W. E. Goldsborough, Lafayette University, Ind.; F. W. Hadley, Caryl D. Haskins, G. A. Hamilton, W. J. Johnston, W. S. Key, Francis Keefe, T. C. Martin, L. B. Marks, Prof. R. B. Owens, University of Nebraska; N. W. Perry, Clayton W. Pike, Prof. F. A. C. Perrine, Leland Stanford, Jr., University, California; R. W. Ryan, Almon Robinson, C. T. Rittenhouse, W. H. Ripley, C. P. Steinmetz, C. K. Stearns, H. C. Spaulding, Prof. Elihu Thomson, H. Wray Weller, W. D. Weaver. Some of those present were accompanied by members of their family, and there were, of course, a large number in attendance at the Institute meetings and the conferences from the resident population of Eliot, Me., and from those sojourning at Greenacre for the studies and recreations of the season.

Consolidation of Brooklyn Roads.

A consolidation of the Coney Island & Brooklyn Railroad Company and the Brooklyn City & Newtown Railroad Company was effected last month. The capital stock of the Brooklyn City & Newtown Railroad Company, which is at present $1,000,000 issued, and $2,000,000 authorized, is to be increased to the full authorized limit, and $1,000,000 of the new issue is to be exchanged for the $1,000,000 of capital stock of the Coney Island & Brooklyn Railroad Company. The funded debt of the Brooklyn City & Newtown Railroad Company is $2,000,000, and it is understood that it assumes the debt of the Coney Island & Brooklyn Rallroad Company amounting to $7,000,000.

The Coney Island & Brooklyn road is the pioneer line to Coney Island, having been opened for business May 2, 1862. It purchased the Prospect Park & Flatbush Railroad in 1891, and adopted electricity as a motive power in 1893. The Brooklyn City & Newtown road (commonly known as the DeKalb Avenue line) was chartered in 1860 and commenced operations in 1862.

It is believed that important benefits will be gained by the consolidated companies in providing a new through route to Coney Island. The gross and net receipts of both companies have fallen off materially of late, with improvements in service given by the competitive Brooklyn lines, but it is expected that a great deal of new business will be developed when both companies are operated together.

Col. John N. Partridge will remain as president of the consolidated companies, and President Sullivan, of the Coney Island road, will, it is understood, be put in charge of the Coney Island division.

Certain minority stockholders of the Coney Island & Brooklyn Railroad, headed by P. H. Flynn, have obtained a temporary injunction preventing the exchange of stock, but it is not expected that this injunction will be made permanent.

Metropolitan Traction Company, of New York, to Be Wound up.

H. H. Vreeland, president of the Metropolitan Street Railway Company, of New York City, has sent out circulars calling a special meeting of the stockholders of the Metropolitan Traction Company to be held at the company's office on Sept. 14, for the purpose of voting upon a proposition that the Traction Company be dissolved according to statute. In another circular to stockholders this action is further explained in the following language:

"The Metropolitan Traction Company has substantially accomplished the object of its organization by uniting in one system most of the surface railroads in the City of New York. The great advantage to the public from the union of such roads has led to the enactment of statutes in this state under which street railroad companies themselves may now accomplish directly the same results by consolidation, purchase of stock and leasing. We have availed ourselves of this authority to concentrate in the Metropolitan Street Railway Company all the various properties brought together by the Traction Company and making up its system.

"The combined property is directly represented by the capital stock of the Street Railway Company now in the hands of the Traction Company. The stockholders of the Traction Company are the real owners. There seems to be no reason why these owners should not now receive the stock which directly represents their property, and at the same time be relieved from the now unnecessary burden of double administration and very heavy double taxation.

"The directors of the Traction Company have accordingly resolved to wind it up. They have passed the necessary resolution for its dissolution and have called a meeting of stockholders to be held on Sept. 14, 1897, pursuant to statute, to act on their resolution.

"The entire assets of the Traction Company to be distributed will consist of $30,000,000 of stock of the Metropolitan Street Railway Company, being the entire capital stock of that company, and other property and securities valued at about $6,000,000, which can readily be exchanged or converted into securities capable of distribution.

"Each Traction stockholder will receive in exchange for his Traction stock an equal amount of Metropolitan Street Railway stock, share for share, and in addition thereto further securities to the amount of 20 per cent of the par value of his stock."

It will be seen that by the proposed plan the holders of each share of Metropolitan Traction stock, will receive in exchange one share in the stock of the Metropolitan Street Railway Company, together with what is practically a stock dividend of 20 per cent, this dividend to be distributed probably in the form of collateral trust certificates, covering the large holdings in the stocks of several of the New York City companies now leased to the Metropolitan Street Railway Company, which are held in the treasury of the Metropolitan Traction Company.

Opening of a New Electric Railway in Australia.

The new tramway of the Brisbane Tramways Company, at Brisbane, Australia, was opened to the public recently. This road is built in a very thorough manner and the greater part of the supplies came from America.

Some Recent History in Liverpool.

The city of Liverpool (Eng.) is about to experiment with the overhead electric system as a preliminary to the substitution of the trolley car for its present horse tramways. This street railway system is one of the most important in the United Kingdom.

The tramway system of Liverpool has been operated on a basis peculiar to that town. The track belongs to the municipality, which leased it to the Tramways Company for a certain term of years. The Tramways Company owned the entire motive power and rolling stock, and having absorbed all independent lines of omnibuses controlled the entire street railway system of the city. By the terms of its charter the Municipality of Liverpool reserved to itself the right of purchase of the holdings of the stockholders of the Liverpool United Tramways & Omnibus Company, and this right it has exercised, entering into possession Aug. 31 of this year. The market value of the shares was £11.10.0, or $57.50 each, and as the lease had eighteen years still to run, the shares were purchased at £12.15.0 or $63 each. The total purchase price amounted to £575,000, or $2,875,000. The affairs of the company and the control of the tramway and omnibus system are now vested in a Committee of the City Council, which has been credited with the intention of expending some $2,000,000 to $3,000,000 in order to bring the system up to date in every way.

The first steps in this direction have been made, and experimental lines equipped with the overhead system, will shortly be laid down from St. James Street in the heart of the business district as far as the Dingle on the south side of the city. Before taking this step the committee called for reports on the question. These were submitted by Le Graham Harris, an English engineer; F. S. Pearson, of New York, and G. C. Cuningham of Montreal. From indications received, that of Mr. Pearson seems to have had most weight with the committee. In his report he compared the cost of operation per car mile for different systems as follows:

Overhead trolley	3.68*d*
Slotted conduit	4.00*d*
Compressed air	5.02*d*

and the total annual cost of operation, based on 120,000 car miles, per mile of track

Overhead trolley	£138,000
Slotted conduit	150,000
Compressed air	188,250

Compared with these figures the committee reports that the cost of horse traction in Liverpool ran as high as 7.19*d* per car mile and the annual cost of operation £269,625. In recommending the use of electricity special stress was laid upon the comparative cheapness of the overhead system, and on Mr. Pearson's statement that a conduit system would cost some $25,000 per mile more than the overhead system. Before embarking, however, on any extended change, the committee decided upon carrying out the experimental line above referred to. The cost of equipping this line for electricity and the relaying of the track is estimated at £50,000 or $250,000. Work is to be begun at once, and Liverpool will shortly be abreast of the times.

The question of employing a consulting engineer became international. Knowing that the municipality intended to appoint an engineer to supervise the construction of the line, several engineers sent in applications for the position, that of F. S. Pearson being among the number. Mr. Pearson's qualifications evidently proved highly attractive, so much so indeed, that his appointment was urgently pressed by the chairman, Sir Arthur B. Forwood, who urged that he was the "engineer who possessed by far the largest scientific and practical experience in tramway construction and operation in America, and *à fortiori* was far more suitable than any English engineer in that special particular." This view was not entirely shared by the members of the committee, and as the majority vote was against Sir A. B. Forwood, he immediately resigned the chairmanship. It is probable, however, that Mr. Pearson will ultimately be appointed.

The feeling in Liverpool on the question of nationality can be gaged from the following clipping from a letter published in the *Daily Post* of that city:

"Shall we refuse to accept a good thing because it comes from America? What does science care if Edison is of one nationality or another? Are we to cease using labor saving appliances found in every home, because they had their origin out of England? Who cares where the telephone or the sewing machine came from? Let this matter be decided simply by asking who is the best man? Who ever imports into the discussion questions of race or color or language, and would have us adopt blundering methods merely because none of our fellow subjects know what is actually being accomplished by intelligent foreigners is merely asking us to cripple ourselves at the very outset of our great undertaking. Let us secure the best talent available for the experiment we are about to make, whatever we may do when electric traction comes to be applied over the whole city."

An Electric Clambake.

The annual clambake given by the American Electrical Works at Providence, R. I., took place on Aug. 21. This well known manufacturing firm has given these clambakes every year for nineteen years past, and the gatherings are looked forward to, with perhaps the greatest pleasure of any social event in electrical circles. This year the American Electrical Works entertained its friends at the Pomham Club. The company arrived at this charming spot about 10:30 in the morning and engaged in games, base ball, bowling and billiards, and enjoyed the breezes on the pleasant piazzas near an excellent orchestra. The company gathered in the dining room at 2 o'clock and partook of an excellent menu. After the dinner had been served, E. P. Phillips, president of the American Electrical Works welcomed his guests in a few pleasant words, and introduced Samuel L. Powers, of Providence, as toastmaster. Short addresses were made by Mayor McGuinness, of Providence, George R. Stetson, second vice-president of the National Electric Light Association, Samuel A. Duncan, R. F. Ross, of Boston; H. F. Woods, of the West End Street Railway, Boston, and Hon. John C. Wyman. Handsome souvenirs in the shape of natural wood canes with sterling silver heads, with the inscription "Souvenir American Electrical Works Clambake" were distributed during the dinner.

The American Electrical Works is certainly to be congratulated upon its enterprise and upon its showing of good fellowship and hospitality in these annual clambakes.

Capital Stock Authorized for the Boston Elevated Railroad.

The Massachusetts Board of Railroad Commissioners has recently authorized the issue of $10,000,000 capital stock by the Boston Elevated Railroad Company, the capital stock to be issued from time to time under approval of the Board. An issue of $500,000 was approved for immediate use to cover the deposit of $300,000 with the state as provided in the charter. The company in its original petition asked for permission to issue $15,000,000 of capital stock, $5,000,000 of which was intended to cover the extension to Cambridge. The Commissioners deferred consideration of this amount of stock, pending proposed legislation next winter. Under the Massachusetts laws, one-half of the authorized stock (or $5,000,000) must be paid up in cash before construction begins. When presenting its petition to the Board of Commissioners, the company through its engineer gave the following estimates of the cost of construction: average cost per mile of construction, including foundation, etc., but not including stations nor electrical equipment, $296,949, and the total cost of construction, covering a distance of 10.29 miles, $3,055,605; equipment, $962,000 (53 motor cars at $10,000 each, 144 trail cars at $3000 each); three terminal structures, $500,000, not including land; three power stations, $1,600,000; twenty-five stations at $25,000 each, including arrangement for transfer from subway, $637,000; electrical equipment and third rail installation, $84,436; total estimate of cost, excluding land damages, $6,946,000. Maximum land damages are figured at $5,036,786, minimum estimate $3,120,491.

Trolley and Elevated Cars to Cross the Brooklyn Bridge.

The contracts between the trustees of the Brooklyn Bridge and the officers of the two elevated railroads and the principal electric railway lines in Brooklyn, under which cars of all these companies are to be run over the Bridge to the New York terminus, were recently signed. When all the plans under consideration have been fully perfected it will be possible to take either an elevated train or an electric car at the New York terminus of the bridge and ride to any part of Brooklyn for a single fare, as the bridge fare in each case will be eliminated. Bridge trains proper on which the fare for crossing the river will still be three cents for a single trip, or five cents for two trips, will still be run, but in smaller numbers than at present, and it is quite probable that in time this service will be abandoned.

These schemes will involve a re-arrangement of the lines of travel for a considerable number of trolley lines near the bridge entrance. Just what the arrangement will be has not yet been fully determined. The contracts require that the trolley roads shall begin the work of altering the bridge for their purposes within ten days and complete the work within six months. The Brooklyn Elevated Railroad Company has to begin its work within sixty days and be ready to operate across the bridge within ten months, and the Kings County Elevated Railroad Company has a year within which it shall be ready to operate. The Brooklyn roads are to pay the cost of all alterations on the bridge.

IN the article on "Mutual Casualty Insurance for Electric Railways," on page 503 of the August issue, the statement of receipts and expenses of the company for the first sixteen months ending Aug. 1, 1897, should be as follows instead of as given therein:

Gross receipts		$61,426.72
Expenses	$16,583.31	
Claims and attorney's fees	16,918.49	33,501.80
Balance		$27,924.92
Deduct claims adjusted and in course of settlement		1,006.00
Net balance		$26,918.92

The American Institute Fair.

Those in charge of the American Institute Fair to be held Sept. 20 to Nov. 4 at the Madison Square Garden in New York City, are making every effort to secure a large exhibit of engines and machinery of all kinds, and especially of street railway and electrical apparatus. It has a system of awards for meritorious inventions and improvements which is claimed to be unsurpassed for fairness and value. These include the Gold Medal of Honor, the Special Medal (silver), the Medal of Taste (silver), Bronze Medals of Superiority, Excellence and Merit, and the Co-operator's Diploma; in addition to which special awards are often made besides.

The American Institute since its foundation some seventy years ago has been officially sanctioned and supported by the State of New York, and the Legislature supplies an annual appropriation sufficient to cover the expense of medals and other marks of merit issued by the Institute.

Applications for space should be made to Alfred Chasseaud, vice-chairman American Institute, 111 West Thirty-eighth Street, New York.

Important Patent Decision.

The United States Circuit Court of Appeals for the Second Circuit, on Thursday, July 22, rendered an elaborate and sweeping decision, reversing the decree of the Circuit Court, which had granted to the Dewey Electric Heating Company an injunction against the Albany Railway Company, to prevent the use of the Consolidated Car Heating Company's temperature regulating switch in connection with an indicating device, as being an infringement of the ninth claim of the Dewey patent No. 464,247. The court holds that this claim is entirely void for want of patentable invention, and this decision finally settles the right of the Consolidated Car Heating Company and its customers to use its temperature regulating switches with indicators as the same have been and are now constructed.

News Notes.

Auburn, Ind.—The Commissioners of DeKalb County recently granted the right of way for an electric railway between Waterloo, Auburn and Garrett, to the Northeastern Indiana Railway Company, of Auburn.

Baltimore, Md.—C. J. Wiener, of 808 Equitable Building, Baltimore, Md., who is interested in the Blue Ridge Electric Railway & Power Company, writes us that the company will probably begin work on its lines some time this fall or in the early spring. The lines will be 10½ miles in length and will need twenty cars. No contracts have been let. This is the road that is to connect several summer resorts in the Blue Mountains.

Boston, Mass.—H. M. Whitney, president of the Halifax Electric Tramway Company, is in Boston making final arrangements for the building of a system of electric railways in Kingston, Jamaica. Henry Pearson is to have charge of the construction work. The company is to have 25 miles of tracks in and about Kingston, and is to operate twenty cars. About $5,000,000 is to be invested in the work.

Bridgewater, Mass.—It is probable that the Brockton, Bridgewater & Taunton Street Railway Company will be granted a franchise to build a crosstown line to connect with the Brockton & Taunton Railway in North Raynham, a distance of about 2½ miles.

Brooklyn, N. Y.—The contract for the iron work which is necessary for the electric railway companies to construct on the Brooklyn Bridge was let on Aug. 25, to George H. Thomson & Company, of New York City, for $360,000. Work must be commenced before Sept. 1 and is to be completed within four months.

Cape Porpoise, Me.—Percy A. Richardson, of Portland, is surveying the route of the proposed electric line from Sanford ot the Cape, and it is stated work on the line will commence soon.

Chicago, Ill.—The Ogden Street Railroad Company has been given permission to lay tracks on West Twelfth Street, between West Fortieth to West Forty-Eighth Streets.

THE North Chicago Electric Railway Company has also been granted a permit to construct a trolley line on Montrose Boulevard, between Evanston Avenue and Milwaukee Avenue. Work on both extensions will be begun within a few days.

Crystal Springs, N. Y.—The long talked of project of an electric line from Savona to Penn Yan along the eastern shore of Lake Keuka, may materialize in the near future. It is also proposed to run a branch line from Weston to Dundee.

Daytona, Fla.—Notice has been given of the filing of articles of incorporation of a company, which proposes to build an electric railway from the depot at this place across the river to Seabreeze, and Ormond.

Denver, Col.—Recently the County Commissioners adopted a resolution granting a franchise to the Loretto Heights Railway Company, to be effective as soon as the the company signs the contract that will be prepared by the County Attorney. It is said that this contract will contain a provision compelling the company to grade the roads over which the line will run, and also to keep the roads in repair during the life of the franchise. Another provision will forbid the issuance of bonds for a greater amount than is actually required for the construction of the road. It is expected that these conditions will be opposed by the company.

Detroit, Mich.—The Detroit & Port Huron Electric Railway Company has been formed for the purpose of constructing an electric line along Lake St. Clair to Marine City and Port Huron via Mt. Clemens. F. T. Ranney, president; T. J. Fordyce, secretary.

Easton, Pa.—The right of way for the lines of the Easton, Palmer & Bethlehem Railway has been secured, and work will probably be begun on the road next week.

Framingham, Mass.—The directors of the Framingham Union Street Railway Company have issued a circular to the stockholders, in which they state that it is proposed to equip the Saxonville division of that road with electricity at the earliest possible moment. Recently the Framingham Center division was changed from horse to electric power.

Galveston, Tex.—The ordinance granting the Galveston, Houston & Henderson Railway Company a franchise on Mechanic Street from Thirty-seventh Street east to Twenty-seventh Street, was passed recently.

Gloversville, N. Y.—The Mountain Lake Electric Railroad Company has filed with the Secretary of State a certificate of a proposed extension of its line through certain streets in Gloversville.

Hamilton, O.—The farmers west of the city and in the village of Millville are contemplating an electric road from this city to Millville and Venice and thence to Cincinnati. Wm. Minton and H. D. Hancock, of Millville, are interested.

Hartford, Conn.—A continuous trolley line is projected for connecting the cities of Springfield and Hartford. The Southwestern Trolley Company has secured a charter to build the road, and has given assurances that the line will be completed by Nov. 1.

Kansas City, Mo.—The Kansas City & Eastern Railway Company has elected the following officers: president, Henry Pfeiffer, of 326 W. 6th Street, Kansas City; vice-president, Geo. Hoffmann; secretary, Chas. B. Adams; treasurer, John Hoffmann. The president informs us that construction work will probably be begun at once, but that the company has awarded no contracts as yet. There will be 5 miles of track and two cars operated by electricity.

Leavenworth, Kan.—The Leavenworth & Lansing Electric Railway Company has been incorporated with a capital stock of $150,000 and the following directors: C. B. Leavel and W. E. Winner, of Kansas City, Mo.; J. W. Hausserman, of Leavenworth and G. F. Neally and E. B. Merritt, of Lansing. The line is a project that is being promoted by W. E. Winner, who expects to build the line from Leavenworth to Lansing, and ultimately to extend down to Kansas City, Kan. Mr. Winner has been actively engaged in pushing the plan along for the past month, and states that the line will be completed as quickly as the work can be done.

Little Falls, N. Y.—The Little Falls & Herkimer Street Railway Company has applied for a franchise to build and operate an electric railway upon the highway from the town line of Little Falls and through the following streets: Southern Avenue, Casler Street, Lock Street, Western Avenue, West John Street, East John Street, Alexander Street, Eastern Avenue, Burwell Street, East Main Street, West Main Street, Mohawk Street, South Ann Street, East Mill Street and South William Street.

Milwaukee, Wis.—The Milwaukee Electric Railway & Light Company has purchased the franchises, tracks and all the interests of C. R. Gether in the proposed Whitefish Bay Street Railway and will at once connect the line with the Oakland Avenue extension.

Morgantown, N. C.—W. C. Ervin, of Morgantown, secretary of the Morgantown & Blowing Rock Electric Railway, of which T. K. Burner of Blowing Rock is president, writes us that the road will be 35 miles long, will operate eight or ten cars and will probably have two power houses operated by water power. Mr. Ervin also states that no contracts have been awarded for the equipment of the road.

Niagara Falls, South Ont.—The Town Council has granted a franchise to the Lundy's Lane Electric Railway to run over certain streets of the town.

Northboro, Mass.—The Aldermen of Marlboro, at their last meeting, granted the petition of the Worcester & Marlboro Street Railway Company to build its lines in the city.

Olean, N. Y.—The Olean, Rock City & Bradford Railroad was recently opened to the public.

Portsmouth, N. H.—Director Libbey, of the Portsmouth Electric Railroad, states that work will soon commence on the construction of the company's road in this city and that the line will be in operation before snow flies.

Richmond Ind.—Those interested in the project of building an electric line from Richmond to Losantsville, to connect with the Big-Four, are well pleased with the prospects for the success of the venture. A committee has been in correspondence with several concerns which contract for electric road work.

Skowhegan, Me.—A syndicate composed of R. W. Brown, E. P. Page, J. P. Clark and A. H. Weston has bought the Skowhegan & Norridgewock Railway & Power Company. It is proposed by the new syndicate to improve the line and to build a hotel in Norridgewock and a pleasure pavilion at the Pines. It is expected that the improvements to be made will cost about $40,000.

Tampa, Fla.—A suit has been brought in the United States District Court, at Tampa, by W. B. Henderson and T. C. Taliaferro, as trustees for the bondholders of the Suburban Street Railway Company to forcelose a mortgage given in 1892 by the Suburban Company to the above named trustees for the protection of the holders of the bonds of the road.

Valdosta, Ga.—A company has been organized in Valdosta to build a street railway from the Georgia Southern Railroad to Pine Park. Work will be commenced as soon as the material can be ordered, and it is expected that cars will be running by Nov. 1. The enterprise is backed by prominent business men of the city.

Webster, Mass.—E. S. Hill, a principal projector of the Webster & Dudley Electric Railway, is engaged in canvassing for stock subscriptions for his road. He states the capital stock, $50,000, can be raised in Webster and Dudley, and that the road will be built in a few months.

Williamsport, Pa.—An agreement has been entered into between the Williamsport Passenger Railway Company and the Montoursville Trolley Company, whereby the two lines will connect at the eastern limit of the city, and the cars of the latter will run over the tracks of the former.

Woonsocket, R. I.—The Slatersville extension of the Woonsocket Street Railway will be built this fall, if the North Smithfield Town Council grants the franchise.

Foreign Notes.

Annaberg, Germany.—Theo. M. Stephan, United States Consul at Annaberg, Germany, writes that the contract for the new street railway at Düsseldorf has not yet been awarded and will probably not be for three months.

Asuncion, Paraguay.—The United States Consul writes us that there is a good opening in this city for tramway concessions, or for purchase of existing tramways which are operated in a very poor and unsatisfactory manner. Concessions can be obtained without much trouble or expense.

Barcelona, Spain.—We are in receipt of information to the effect that the motive power of the tramways of Barcelona is about to be changed from mules to electricity.

Brussels, Belgium.—A company has recently been incorporated under the title of "Société des Tramways de Berditcheff," for the purpose of operating and changing the motive power of the tramways of Berditcheff, Russia, as well as extending the present system. The seat of the company is in Brussels.

Debreezin, Hungary.—A proposal to construct an electric railway between Debreezin and Nagyvarad is at present under consideration. The line would be no less than 60 kilometers long.

Germany.—In a communication to the *American Machinist* it is said that Germany is at present experiencing a boom in the machinery trade and is one of the most important foreign markets for American machine tools, engines, pumps, etc, The firm of Schuchardt & Schutte has developed a large business in handling American machinery and tools and has branch establishments in Vienna and Brussels, its principal offices and warehouse being in Berli , where seventy-six people are employed. One tool building establishment in Cincinnati is said to have disposed of 40 per cent of its products through this house.

Ghent, Belgium.—The bids for the franchise of electric railways of Ghent were opened recently. There were four bidders as follows: Compagnie Gantoise des Tramcars, at Ghent; M. Dupuich, engineer, at Brussels; Société Générale d Entreprises de Travaux Publics, at Liége; Société des Railways Économiques de Liége-Seraing et ses Extensions, Liége. The last named offered the best terms, and while it is not yet formally announced, will without doubt be awarded the franchise.

Japan.—It is stated that in the next day or two some heavy transactions in track material and rolling stock may take place for the Japanese market. Cable advices are now awaited and they will determine the amount to be purchased.

Lima, Peru.—The engineers who were sent not long ago to Peru by New York parties who contemplate the purchasing of the Lima Tramway system, and, after obtaining it, converting it into an electric railway, returned on Aug. 11 per steamer "Advance." Their report will, it is believed, be an encouraging one.

Novorossisk, Russia—A. Contessini, president of the Town Tramway Commission of Novorossisk, Russia, writes that tenders will be received for the construction of a tramway line through that town, until Nov. 13.

Para, Brazil.—The United States Consul writes that the local street railway contemplates doing away with mule power and adopting electricity, but that final arrangements are not yet fully settled. Address Companhia do Farro-Carri Urbano, Para, Brazil.

Peru.—Our Consul at Lima reports that the Peru Government has never before given such inducements to American and other foreign manufacturers to bring about favorable trade relations as at present. An industrial exposition is to be held at Lima commencing Dec. 9, next, and every effort will be made by our Consuls to excite an interest among American manufacturers to make the American section a success. All exhibits will be entered free from custom house duties as well as from consular fees. Exhibitors will have the option to show their wares for a period of six months and should a longer time be required arrangements can be made by applying to the officials in charge.

Santiago, Chile.—A German firm is negotiating for the equipment of the city tramways with electric traction, the power to be derived from waterfalls. The capital required amounts to about $7,000,000, including the lighting of the city.

Tientsin, China.—C. D. Jameson, an American civil engineer, who has been for some time resident in Tientsin, has secured an important contract for American (Carnegie) steei rails, aggregating in value $310,950, which figure is said to be by far the lowest quoted. This is understood to be the first time that American steel has triumphed over European in competition by closed tenders in the Orient.

Resignation of Joel Hurt.

At a meeting of the directors of the Atlanta Consolidated Street Railway Company, on Aug. 18, the following letter was read by President Hurt:

"Atlanta, Ga., Aug. 18, 1897.

"To the Board of Directors of the Atlanta Consolidated Street Railway Company:

"Gentlemen.—As you are aware, it has been my desire for quite a while to retire from the presidency of this company.

"In accepting the office in the spring of 1891, it was distinctly understood that I would not be expected to hold the position longer than two years. During this period however, unexpected contingencies arose and the affairs of the company seemed to need such special attention as to preclude my retiring. So it has been from time to time until I have remained with the company for more than six years.

"The system of street railways which you have in charge to-day is fully abreast of the times, and the affairs of the company seem now to be in such condition as to render it possible for me to retire with satisfaction to myself and without prejudice to the interests of the company. Therefore, I tender you again my resignation with the earnest request that you will accept same at this meeting.

Respectfully,

Joel Hurt."

The directors expressed the deepest regret at Mr. Hurt's action accepting the resignation only because they were forced to do so, and even then several voted against its acceptance.

During the last six years, Mr. Hurt has developed, from a number of straggling and disconnected street railway lines, a fine coherent street railway system which is well known in Southern and Eastern financial circles as being one of the best managed properties in the country. It is understood that Mr. Hurt's resignation is due to the multiplicity of his other business connections, among which may be mentioned, the Trust Company of Georgia and the East Atlanta Land Company, of both of which he is president, and the Atlanta Home Insurance Company of which he is secretary.

For the present, Vice-President and General Manager Ernest Woodruff will, at the request of the board of directors, act as president. S. M. Inman, one of the prominent directors, as well as Mr. Woodruff, are mentioned as possibilities for the permanent position.

Personals.

Mr. H. F. Parshall sailed from England on the S. S. "Lucania" arriving Saturday, Aug. 28.

Mr. E. J. Robinson, general manager of the Laclede Car Company, of St. Louis, was in New York recently on an extended business trip.

Mr. E. J. Wessels returned to New York from his extended European trip on Saturday, Aug. 28, by the S. S. "Lucania" of the Cunard Line.

Mr. John McGhie, of the General Electric Company, who has just been across the water for a much needed rest, returned on Aug. 18, by the Allan Line.

Mr. E. B. Hatch, of Hartford, Conn., representing the H. W. Johns Manufacturing Company, has recently returned from a visit abroad and reports the greatest activity in the electrical field there.

Mr. Robert W. Blackwell, the foreign representative of the Street Railway Journal, arrived in New York on Aug. 28, and is at the Manhattan Club. Mr. Blackwell will remain for some time in America.

Mr. N. A. Christensen, of the Christensen Engineering Company, of Milwaukee, Wis., has been in New York recently on an extended business trip. Mr. Christensen states that the business outlook is improving very rapidly.

Mr. H. H. Winsor, editor of the *Street Railway Review*, is prominently identified with the Alaska Transportation & Development Company, of Chicago, one of the many companies organized to operate in the Klondike gold region.

Mr. Godfrey Morgan, formerly manager of the Amsterdam (N. Y.) Street Railway Company, has been appointed manager of the Buffalo, North Main Street & Tonawanda Electric Railway Company, vice Mr. Albert Vickars, who has resigned to take charge of the electrical installation of the new Great Northern grain elevator in Buffalo.

Mr. John C. Dolph, has recently formed a partnership with Mr. F. E. Triacca, for the purpose of dealing more extensively in street railway supplies, as announced in another column. Mr. Dolph is very well known in the street railway field, having been engaged in the supply business for over five years. His many friends will wish him abundant success in his new venture.

Mr. Charles Y. Flanders, who has been for fifteen years associated with Morris, Tasker & Company, of Philadelphia, has resigned his position with that company in order to accept an engagement with the National Water Tube Boiler Company, as the general manager of its New York district, with headquarters at 26 Cortlandt Street, New York. Mr. Flanders' many friends among Eastern street railways will be interested in his continued success in this new field.

Mr. Franklin C. Randall, who has for the past three years filled the position of Chicago agent for the J. G. Brill Company, has recently resigned this position to connect himself with the Christensen Engineering Company as its Eastern representative. Mr. Randall is well and favorably known in the street railway field. He was born at Taunton, Mass., Sept. 5, 1857. He attended the Boston public schools, and was graduated from the Boston English High School in 1875. He then entered the motive and car department of the New York & New England Railroad, and afterwards became connected with the car departments of the Boston & Lowell and Boston & Maine Railroads. Mr. Randall was the New England agent for the J. G. Brill Company before he was transferred to Chicago.

Herr Anton Steller, engineer of the Budapester Strassen-Eisenbahn-Gesellschaft, was born at Temesvar, in Hungary, and attended the Technical High School at Budapest. He was first connected with the firm of Siemens & Halske in Vienna, which in 1888 assigned him to the construction of the Budapester elektrische Stadtbahn. After that road was completed Mr. Steller devoted himself exclusively to the construction of new electric street railways. In 1894 he superintended the construction and operation of the electric street railway in Lemberg. Since 1895 Mr. Steller has had charge of the transformation of the Budapest horse car system to electric traction, and while engaged in this work Mr. Steller also assumed the direction of the traffic and management of the electric lines already in operation.

ANTON STELLER.

HEINRICH V. JELLINEK.

Herr Heinrich V. Jellinek, manager of the Budapester Strassen-Eisenbahn-Gesellschaft (Budapest Street Railway Company), was born in Budapest. In the year 1870 he entered the service of the said company, and was elected to the managership in 1882. Herr Jellinek's efforts were constantly directed towards increasing the traffic, and after overcoming considerable opposition he succeeded in securing the transformation of all horse car roads to electric roads, and in this manner contributed in no small measure to the marvelous development of the capital city of Hungary. He also succeeded in connecting the suburbs of the city with Budapest in three different directions, by means of a suburban steam road, of which he is likewise manager. The completion of the world-famed Budapest underground railway is also partly to be ascribed to him. At the present moment Herr Jellinek is occupied with the project of a system of elevated railways, and it may confidently be expected that that this enterprise will prove as successful as all his other numerous undertakings.

Obituary.

ROBERT C. SHELMERDINE, general receiver of the Union Traction Company, of Philadelphia, died very suddenly on Aug. 24, at Abington, Montgomery County, his summer home. Mr. Shelmerdine was afflicted with heart failure, although otherwise a very robust man. He dropped dead as he was dressing, after having risen about seven o'clock. Mr. Shelmerdine was a member of the well known family of that name, being a grandson of the late Dr. Robert C. Shelmerdine. He succeeded his father, Edward K. Shelmerdine, as chief receiver of the People's Passenger Railway, eight years ago, and became general receiver of the Union Traction Company when it was formed, and was one of its most responsible officials.

AMONG THE MANUFACTURERS.

The Phosphor Bronze Smelting Company, of Philadelphia, Pa., has issued a new price list on the goods of its manufacture, including wire, plates, sheets and rods.

Charles N. Wood, of Boston, has been appointed by the American Electric Heating Corporation its exclusive sales agent for its electric car heaters in the New England States.

The Gesellschaft fuer Strassenbahnbedarf, of Berlin, Germany, has issued a neat catalogue giving full information concerning the line of everhead material which it manufactures.

The Cahall Sales Department, of Pittsburgh, Pa., has recently issued a pamphlet written in a very attractive manner, comparing advantages of its boilers with the boilers of other manufacturers.

W. T. Van Dorn Company is the name of a company recently organized as the successors to the Fitzgerald-Van Dorn Company, of Chicago. W. T. Van Dorn is now the sole owner of this entire business.

The Babcock & Wilcox Company advises that the motion for injunction in the suit of Cahall *vs.* Babcock & Wilcox, has been decided in favor of the latter in the United States Court for the Western District of Pennsylvania.

The Wells & French Company, of Chicago, Ill., has established permanent offices at 100 Broadway, New York City. Fred. Saxelby, the Eastern representative of the company, is very optimistic on the general business outlook.

The Steel Motor Company's general European agency, located in Berlin, has just issued in the German language a well printed and illustrated catalogue of the company's apparatus and is preparing to make a strong fight for business in European centers.

The John A. Roebling's Sons Company, of Trenton, N. J., has recently issued a comprehensive catalogue giving the advantages of the wire manufactured by this company, in electrical construction. A number of very interesting tables and results of tests are given.

The Joseph Dixon Crucible Company, of Jersey City, N. J., has published a neat pamphlet comparing the merits of lead paints and Dixon's silica graphite paint. This pamphlet has been issued to answer the claims of red lead manufacturers that the use of carbon, especially graphite, is injurious.

Fred. H. Koretke, brass founder and machinist, of New Orleans, La., writes that he is supplying the roads in most of the principal cities of Mississippi, Alabama and Louisiana with his castings, besides shipping a large number of street railway repair parts to England. He has found it advisable to double his former capacity within the last thirty days.

The Goulds Manufacturing Company, of Seneca Falls, N. Y., has issued a very comprehensive catalogue describing the pumps and hydraulic machinery which it manufactures. This company gives a very valuable guarantee with all its products and will replace without charge any part within a year from shipment, which bears unmistakable evidence of imperfection in materials or workmanship.

The Crouse-Hinds Electric Company, of Syracuse, N. Y., manufacturer of electrical switches, switchboards, panelboards and the "Syracuse" changeable electric headlight, reports an exceedingly good business. The demand particularly for the "Syracuse" headlight has been very large, especially so from foreign countries. The company's factory is full of orders and is running night and day.

The Western Electric Company, of New York, has issued a neat little folder calling the attention of street railway managers to the fact that it has removed to its new building at 57-67 Bethune Street near West Street, New York City. The company will open a store in this building for the sale of its electrical supplies, but will also retain its retail store in the Thames Street Building, which the company formerly occupied.

Mayer & Englund, of Philadelphia, Pa., have secured for Albert & J. M. Anderson Manufacturing Company, Boston, a large contract for knife switches, from the Union Traction Company, of Philadelphia. These switches are for the new mammoth switchboard for the Thirteenth and Mt. Vernon Street station, and are of various sizes, ranging from 600 to 3600 amperes capacity. There will be nearly 300 switches when the order is completed.

The H. W. Johns Manufacturing Company, some time ago appointed the enterprising firm of Bergtheil & Young, 12 Camomile Street, London, E. C., England, as its European representatives for electric street car heaters and trolley line vulcabeston and other insulating materials. The electrical export business of the company has greatly expanded during the last year, several large shipments of electrical materials having been made to Continental and South American countries.

The Ball & Wood Company, of New York, has just issued a handsome catalogue of its engines, illustrated by detail drawings of its special features, presented in such a way as to give a most excellent idea of the peculiarities of construction. Among the illustrations are also found handsomely executed engravings of the company's 450 h. p., 600 h. p. and 750 h. p. compound condensing vertical engines, all for railway and lighting work. Valuable tables form another feature of this catalogue.

The Consolidated Car Heating Company, of Albany, N. Y., writes us as follows: "On Aug. 2, Judge Wheeler, of the United States Circuit Court for the Second Circuit, rendered a decision in favor of the defendant in the case of the Burton Electric Company against the Union Railway of New York, which was defended by the Consolidated Car Heating Company. This decision settles the right of the Consolidated Company to use the multiple series system of wiring with its electric heaters, and is a decided victory."

The New York Electrical Works, of New York City, has recently issued a catalogue and price list of the electric railway appliances which it manufactures. This company aims to make not only the best insulation for railway purposes, but also to insure its customers a line of appliances of the highest grade in every particular. The high grade of these materials has won for them a high reputation in all parts of the world, and the company assures its patrons that this reputation will in all respects be fully maintained.

The Ohio Brass Company has adopted as a trade mark for its bell metal motor bearings, a cut of a bell on which appears the letters O. B. Co., and hereafter an outlined reproduction of this will be stamped into the metal on each bearing as a positive means of distinguishing them from those manufactured by other companies. This mark in itself will also serve as an absolute guarantee of the quality of the bearings, for the Ohio Brass Company stands ready to replace any which do not give perfect satisfaction.

John C. Dolph & Company, is the name of a new firm that has been formed by John C. Dolph and F. E. Triacca. This firm will make a specialty of street railway supplies and will carry in stock a full line of carbon brushes, assembled commutators, mica, varnish, etc. It will also handle the commutator bars, the "Protected Rail Bond" and other supplies of the Forest City Electric Company, the insulated varnish of the Sterling Varnish Company and the gears and pinions of the Catskill Foundry & Machine Company. The offices of the firm are located at 120 Liberty Street, New York City.

McCartney, McElroy & Co., contractors, Havemeyer Building, New York, have completed the 25 miles of overhead construction for the Dayton Fast Line from Miamisburg to Hamilton, O., and also the complete construction and equipping of 9 miles of track and overhead construction for the New Paltz & Wallkill Valley Railroad Company. In addition to other work, they are now building 8 miles at Sherbrooke, Que., and 18 miles extension for the Brunswick Traction Company, New Brunswick, N. J. This firm has had an exceptionally busy season and reports about all the work on hand that it can care for prior to the closing of the season.

T. N. Motley & Company, of 43 John Street, New York, announce that they have added an electrical department to their business and will carry a complete line of materials for the construction and maintenance of street railways, lighting and power plants, telegraph and telephone systems, in connection with steam railroads and general power transmission. This department will be in charge of Joseph Keefe, late with Westinghouse Electric & Manufacturing Company and the E. S. Greeley & Company. T. N. Motley & Company are one of the strongest steam railroad supply houses and their advent into the electrical field is quite a noteworthy fact.

The Central Electric Company, of Chicago, Ill., is getting excellent results from its motor bearings and feels certain that railway companies who use them will find them highly pleasing. This company has lately received some very satisfactory orders for these bearings, and states that it has yet to find one customer who does not pronounce them a superior article. This company is also furnishing large quantities of supply parts for all kinds of railway apparatus and is also making a specialty of refilling and repairing street railway motor commutators, and is supplying large quantities of mica and Billings & Spencer drop forged copper segments, as well as mica commutator rings. The officers of the company state that their business is doubling and they are looking for a very good fall trade.

The Garvin Machine Company, of New York, has issued a pamphlet presenting a number of interior views of the new building in which it is now conducting its business. The enterprise was established in 1862 and incorporated in 1889 as the Garvin Machine Company. A disastrous fire on Mar. 6, 1896, made it necessary for the company to seek new quarters, which are equipped throughout with electricity, furnishing power for driving machinery, one passenger and two freight elevators, and also lighting. Every modern convenience has been installed, including a telephone system of twenty-six stations, and call bells connecting all departments. The equipment throughout of both large and small tools is entirely modern and the company thinks its facilities for construction are unexcelled.

The Miller-Knoblock Company, of South Bend, Ind., whose electric street sprinkling cars are well known, is adding to its already large business an electrical department, which will be under the direct supervision of A. W. Morrell, an experienced electrical engineer and constructor, who has had years of experience in street railway motor work. He is particularly well known in St. Louis, Minneapolis, Indianapolis and Cleveland, where he has had charge at different times of important works. It is the intention of the company to manufacture and carry in stock ready to ship at a moment's notice, Morrell's improved assembled motor commutators for any and all standard street railway motors. It will also carry in stock armature coils for all the standard motors. A complete equipment for the rewinding of armatures has been installed.

The Ohio Brass Company, reports that arrangements were recently completed with the Northern Electric & Manufacturing Company, Ltd., of Montreal, whereby the latter takes the agency, for Canada, of the well known line of electric railway supplies manufactured by the Ohio Brass Company. The combination will undoubtedly prove of mutual advantage to both companies, and should result in increased business, as the popularity of the Ohio Brass Company's material is already established in the Provinces, and the reputation of the Northern Electric & Manufacturing Company in business circles is excellent. The Northern Electric & Manufacturing Company will carry a large and well assorted stock of goods in Montreal, and will enter into the electric railway field as active representatives of this class of material.

The Western Gear Company, of Milwaukee, Wis., has been incorporated and the new company has purchased the entire business of the co-partnership which formerly existed under the same name. Herman W. Falk, president of the Falk Manufacturing Company, has purchased a large interest in the company and is president of same. The other officers are Adolph Quentin, vice-president and treasurer, and Charles L. Jones, secretary. The company reports that its business is growing very rapidly and it will soon be necessary to increase the facilities for handling same. The process, used exclusively by this company, of forming the teeth in the casting before cutting, considerably increases the strength and life of the gears, and at the same time the teeth of gears so made are entirely free from the blow holes sometimes found in gears cut out of a solid blank.

The Standard Underground Cable Company, of New York City, is sending the following notice and guarantee to all its customers: "Our attention has been called to the somewhat extravagant pretensions put out by interested parties, wherein claim is made, in substance or effect, of an exclusive patented monopoly of paper insulated electric cables and wires. We have been manufacturing and selling wires and cables of that kind for many years, and, under advice of counsel, we have no doubt whatever as to our right to do so. We therefore advise you that as regards any such wires and cables which you may purchase from us, we will be prepared at any and all times, at our own charge and expense, to defend any suit or suits brought against you for infringement of the patent referred to, we to be promptly notified of such suit or suits, and to be allowed an opportunity to make defense therein."

The Ward Leonard Company, of Hoboken, N. J., has recently issued a very attractive catalogue giving full information concerning the line of enamel rheostats which this company manufactures. The company states that it is five years since the first enamel rheostats were placed on the market by it. This company has standardized many hundreds of rheostats for use as field regulators, motor starters, theatre dimmers, ventilating fan regulators, etc. The company has recently made a very marked reduction in the price of all its goods, the reduction averaging nearly 25 per cent, and is much more than this figure in the case of motor rheostats. The Ward Leonard Electric Company is represented in England by Veritys, Ltd., and in Berlin by S. Bergmann & Company. The officers of the company state that its business has steadily increased during the past few years, and they attribute a good deal of its success to the comprehensiveness of its catalogues, from which electrical people in this and all foreign countries have been able to order any desired rheostat with complete accuracy by a single code word or catalogue number.

Warren Webster & Company, of Camden, N. J., reports recent contracts for the installation of the Webster system of steam heating as follows: South Park Commissioners, Chicago, Ill., propagating houses, conservatory, office building, etc.; The Home, Denver, Col.; State University Building, Bloomington, Ind.; Capital Construction Company Apartment, Washington, D. C.; Turkish Bath Department, Southern Hotel, St. Louis, Mo.; Kahn's Sons & Company, Washington, D. C.; Gulf, Colorado & Santa Fe Railway Company, depot and office building, Galveston, Tex.; Iowa State Hospital, Iowa City, Ia.; Bannigan Rubber Company, Providence, R. I. This company has recently introduced an important improvement in the shape of an "automatic vacuum governor." Its purpose is to automatically control the speed of the vacuum pump, or exhausting apparatus, for the maintenance of a predetermined amount of vacuum, which in the "Webster system" is maintained throughout the return pipes, in which at the base of each unit of radiation, Webster thermostatic water and air relief valves are introduced, through which the condensation and air are withdrawn.

John C. Weaver, of New York, enjoys a large business in painting railway cars. He has devoted some fifteen or more years

to this work and is generally regarded as an expert on the subject of car painting, grinding and mixing colors. Among his recent orders he numbers one of repainting 100 20 ft. cars for the Brooklyn Heights Railway Company. In this work Mr. Weaver is changing the body color from a green to a crimson, and giving the dashes and cove panels a primrose yellow, so that the cars present a very attractive appearance. All work of this kind done by Mr. Weaver is carried on upon a system which he has worked out and in which the time required for repainting cars is reduced to twelve days. This includes burning off the old paint, putting on three coats of filler, three or four coats of body color, striping, lettering the car, and then giving it two coats of varnish. The system is based upon the idea of producing a brilliant and durable finish. While the system is guaranteed as to long life, it is also economical in its cost, being rapid in execution,and does not keep the cars out of service for any length of time.

The Buckeye Engine Company, of Salem, O., has issued a neat catalogue giving very interesting data concerning the Buckeye compound automatic cut-off engine. The catalogue is well illustrated. A reference to the record of this company shows that its first compound engine was built in the year 1879, the cylinders of this engine being 10 ins. × 18 ins. and 18 ins. × 20 ins. respectively. The test of this first engine is interesting. Steam was furnished by ordinary horizontal tubular boilers at a gage pressure of 80 lbs. Tests were conducted with care and resulted in practically 19 lbs. of dry steam per indicated horse power per hour, a performance comparing favorably with more modern construction. Since this time the Buckeye Engine Company has greatly improved its methods and facilities, and feels justified in stating that it can offer an engine which has been carefully improved upon and thoroughly tested, and may therefore be relied upon to furnish superior service, at least cost, consistent with conditions surrounding each case. The catalogue contains the results of a number of very interesting recent tests which have been made upon this engine.

The Berlin Iron Bridge Company, of East Berlin, Conn., has the contract for furnishing and erecting the steel work for an extension to the machine shops of the Newport News Shipbuilding & Dry Dock Company which is making extensive additions to its already large plant at Newport News, Va. This building, which will be 100 ft. wide and 200 ft. long, will be used for the finishing and erecting of marine engines and other large machinery used in connection with the mammoth steel vessels which the company has under way. The central portion of the building will be 50 ft. high, and will be supplied with an electric traveling crane capable of lifting and carrying a load of fifty tons. On either side of this central space will be located a gallery arranged for small machines and fitting tools. The building is to have a steel framework throughout, and the roof is to be covered with corrugated iron. The United Gas Improvement Company, of Philadelphia, is erecting at Atlanta, Ga., a water tower and tank. The tank has a capacity of 10,000 gals. and is supported on a tower 60 ft. high. It has let the contract for furnishing and erecting the tank and tower to the Berlin Iron Bridge Company.

The Mossberg & Granville Manufacturing Company, of Providence, R. I., has issued a very extensive catalogue of its roller bearings, rolling, pressing and stamping machinery, etc. The Mossberg Manufacturing Company was organized Aug. 1, 1889, buying out the Attleboro Machine Company, of Attleboro, Mass., and occupied this company's factory for one year. The company then moved to the Bates & Bacon Watch Case Works in order to obtain more space for its increasing business, and in 1893 it leased the entire three-story Bates Building. Towards the close of 1896, the Mossburg Manufacturing Company was incorporated as the Mossberg & Granville Manufacturing Company, under the laws of the state of New York, and in order to keep pace with the increased business, it was decided to locate at Providence, R. I. It entered its new quarters on Dec. 1, 1896. The company has a floor space of nearly three acres, and its factory is fitted with the best modern tools to facilitate the manufacture of its regular line of goods. The catalogue calls special attention to the improved construction of the company's power and automatic drop presses; also rolling mills for producing and furnishing brass, copper, steel, gold, silver, etc. This company also carries a large line of rolling mills, power, drop, screw and foot presses and other tools, in stock for immediate delivery.

The Pope Manufacturing Company, has recently built an electric motor carriage, called the "Columbia." It weighs from 1500 lbs. to 1700 lbs., including the batteries, which weigh 850 lbs. This weight of battery will drive the carriage on smooth, level roads about 30 miles without recharging. The cost of recharging is about fifty cents, and under favorable conditions can be reduced to ½ cent per mile. The motor has a capacity of about 2 h. p., and its speed may be taken as 15 miles per hour. The carriage is fitted with ball bearings on all the bearing surfaces; the tires are pneumatic, and 3 ins. in diameter, and are practically unpuncturable. One set is said to have run 2300 miles without deterioration, and is still in use. The experimental electric carriage was put in commission over a year ago, and since that time has been in constant use, having made a mileage of about 3500 in and around the city of Hartford over all kinds and conditions of roads, and through deep mud and snow. The normal power of the carriage, or that required to drive it at a speed of 12½ miles per hour on a level asphalt pavement, is 18 amps. and approximately 80 volts. The efficiency of the motors is 70 per cent, and assuming that the loss in the gearing of the carriage is 10 per cent, making the total efficiency of the motive mechanism 72 per cent. The capacity of the batteries had better be stated as 80 ampere hours at a discharge rate of 35 amperes.

J. Holt Gates & Company, of Chicago, Ill., report good business in the Wagner single phase alternating current motors. A number are now being installed in the West and giving great satisfaction. This company is also Western agent for the Walker Company and reports the practical completion of that part of the Suburban Railway that is operated by electricity. Mr. Gates also reports the sale of a number of large equipments to the Holland & Macatawa Railway Company; also the installation of a 50 k. w. direct connected Walker dynamo for Rector's Oyster House, Chicago; a 500 light machine for C. T. Roenitz Leather Company, Sheboygan, Wis.; a 150 light machine for S. L. Record, Peoria, Ill.; a 150 light and 180 light machine for H. S. Walker, Chicago, besides a number of motors and transformers. Also the sale of a 3000 light alternator to the Maywood Electric Light Company. Mr. Gates also reports the sale of a Walker 800 k. w. generator to the Memphis Street Railway Company and of two 200 h. p. Walker street car motors of the open type to go on a 6 ft. Baldwin truck for the Lake Street Elevated Railway. These motors will develop the maximum effective adhesion of each pair of 33 in. wheels equipped with motors under a 23 ton car, and are expected to make a speed of over 40 miles per hour with a 100 ton train, and to accelerate in 18 seconds. These are said to be the largest motors ever built for street car traction, and the motors are a matter of interest from the fact that so much power has been condensed in so small a space as within a 6 ft. wheel base truck.

Trade Catalogues.

CATALOGUE. Published by the Joseph Dixon Crucible Company, Jersey City, N. J. Eighteen pages.

BIG BOILERS. Published by Cahall Sales Department, Pittsburgh, Pa. Twenty-two pages. Illustrated.

CATALOGUE. Published by the Garvin Machine Company, New York. Forty-two pages. Illustrated.

OVERHEAD MATERIAL. Published by the Gesellschaft für Strassenbahnbedarf, of Berlin. Illustrated.

CATALOGUE. Published by the Buckeye Engine Company, of Salem O. Thirty-seven pages. Illustrated.

ENAMEL RHEOSTATS. Published by the Ward Leonard Company, Hoboken, N. J. Forty-four pages. Illustrated.

BALL & WOOD ENGINES. Published by the Ball & Wood Company, of New York. Fifty-two pages. Illustrated.

CATALOGUE. Published by the New York Electrical Works, of New York City. Twenty-three pages. Illustrated.

CATALOGUE. Published by the Mossberg & Granville Manufacturing Company, of Providence, R. I. 229 pages. Illustrated.

WIRE IN ELECTRICAL CONSTRUCTION. Published by John A. Roebling's Sons Company, Trenton, N. J. Seventy-three pages. Illustrated.

GOULDS EFFICIENCY POWER PUMPS. Published by the Goulds Manufacturing Company, Seneca Falls, N. Y. Eighty pages. Illustrated.

ELEKTRISCHE STRASSENBAHN-MOTORE UND CONTROLLER. Issued by the Europäische General-Vertretung der Steel Motor Company. Dated at Berlin, July, 1897. Nine pages. Illustrated.

List of Street Railway Patents.

U. S. PATENTS ISSUED JULY 20, TO AUG. 17, 1897, INCLUSIVE.

JULY 20.

CAR SIGNAL.—(Issued July 13, 1897.) Reuben Z. Cassel and George M. Finckel, Columbus, O. No. 586,418.

A street car system having its cars provided with horizontally movable wings or frames of such height and width or lateral extension that the frames or wings of cars passing each other on adjoining tracks shall certainly strike each other, combined with an alarm mechanism on each car adapted to be operated upon the striking together of said wings or frames.

TROLLEY GUARD.—James M. Kirker, Louisville, Ky. No. 586,556.

STREET CAR SIGN.—George E. Weis, Reading, Pa. No. 586,583.

This invention comprises a rotatable sign and a light, so constructed that while the sign can rotate freely, the light is stationary.

BICYCLE HOLDER.—George W. Douglas, San Francisco, Cal. No. 586,681.

This invention relates to a holder connected with the platform of a car to receive and hold a bicycle.

ROPE GRIPPER FOR CABLE RAILWAYS.—Elam Eaves, Derby, and Alfred J. Tonge, Bolton, England, No. 586,762.

RAILWAY SWITCH POINT CONTROLLING APPARATUS.—C. W. Munson, Toledo, O. No. 586,797.

The switch point is automatically operated by devices carried by the car.

TROLLEY POLE.—C. N. Dutton, New York, N. Y. No. 586,809.

CAR BRAKE.—W. L. Hibbard and Z. M. Hibbard, Detroit, Mich. No. 586,951.

The brake shoe in this invention acts upon the rail, making a rail brake.

JULY 27.

TROLLEY WHEEL FORK.—Samuel B. Thompson, Baltimore, Md. No. 587,047.

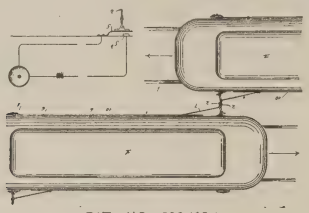
FENDER FOR STREET CARS.—Wm. S. Bowen, Philadelphia, Pa. No. 587,178.

CAR FENDER.—George W. Downing, Brooklyn, N. Y. No. 587,187.

AUG. 3.

STREET CAR FENDER.—James D. Lamb and James E. Chapman, Montreal, Can. No. 587,315.

CAR FENDER.—Horace H. Doll, Philadelphia, Pa. No. 587,430.



PAT. NO. 586,418.

BRAKE SHOE.—Wm. D. Sargent, Chicago, Ill. No. 587,493.

This shoe is made of two different kinds of metal, disposed in different planes, to provide a wearing face of a composite character.

SAFETY GUARD AND FENDERS FOR CARS.—Geo. Glennie and Ralph Boone, San Francisco, Cal. No. 587,524.

COMBINED BRAKE SHOE AND WHEEL GUARD.—M. F. Crotty, Poughkeepsie, N. Y. No. 587,648.

BRAKE SHOE.—Wm. D. Sargent, Chicago, Ill. No. 587,661.

ELECTRIC RAILWAY.—R. M. Hunter, Philadelphia, Pa. No. 587,674.

AUG. 10.

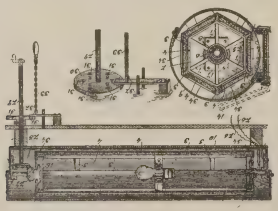
ELECTRIC RAILWAY SYSTEM.—Stephen D. Field, Stockbridge, Mass. No. 587,720.

In an electric railway system, the combination with a slotted conduit embodying metal frames, of insulators flexibly mounted on arms projecting from said frames, and a working conductor composed of magnetic metal flexibly suspended from said insulators.

TROLLEY WIRE HANGER AND SPLICER.—Chas. H. King, Mansfield, O. No. 587,740.

ELECTRIC RAILWAY.—Robert L. Caldwell, Cleveland, O. No. 587,792.

FENDER FOR STREET CARS.—James Steele, Guelph, Can. No. 587,880.



PAT. NO. 586,583.

OVERHEAD TROLLEY SYSTEM FOR ELECTRIC RAILWAYS.—S. H. Cauffiel, Johnstown, Pa. No. 588,053.

CURRENT COLLECTING DEVICE FOR ELECTRIC RAILWAYS.—R. M. Hunter, Philadelphia, Pa. No. 588,111.

AUG. 17.

ELECTRIC TROLLEY DEVICE.—Samuel Harris, Johnstown, Pa. No. 588,114.

ELECTRIC TROLLEY DEVICE AND CONDUCTOR CONSTRUCTION THEREFOR. Samuel Harris, Johnstown, Pa. No. 588,115.

CAR FENDER.—Leo Mercier, Brooklyn, N. Y. No. 588,160.

ELECTRIC CONTACT DEVICE.—David S. Shallenberger, Johnstown, Pa. No. 588,188.

FENDER OR GUARD FOR TRAMWAY CARS.—Edward S. Wilkins, Brooklyn, N. Y. No. 588,205.

CAR FENDER.—Thomas R. H. Johnson, Washington, Pa. No. 588,226.

COMBINED BRAKE AND FENDER.—Albert H. Wheeler, Warwick, R. I. No. 588,255.

SWITCH IRON.—John H. Boyer, Philadelphia, Pa. No. 588,263.

In this invention a device carried by the car operates the switch point.

ELECTRIC MOTOR CAR TRUCK.—George M. Brill and John A. Brill, Philadelphia, Pa. No. 588,391.

TROLLEY.—Frank Krabal, Pittsburgh, Pa. No. 588,448.

TROLLEY.—George W. Sell, Jr., Johnstown, Pa. No. 588,488.

CURRENT CONDUCTING RAIL FOR ELECTRICAL RAILWAYS.—L. E. Walkins, Springfield, Mass. No. 588,541.

This invention consists of a current conducting rail for electric railways, having a body of iron or steel, and having its tread side covered with a layer of copper welded thereto.

We will send copies of specifications and drawings complete of any of the above patents to any address upon receipt of fifteen cents. Give date and number of patent desired. THE STREET RAILWAY PUBLISHING COMPANY, HAVEMEYER BUILDING, NEW YORK.

Train for the Convention.

One of the best ways of reaching the convention of the American Street Railway Association at Niagara Falls from the East, will be by the superb New York Central & Hudson River route. The train on this line for the convention will leave the Grand Central Station, Forty-Second Street, New York City, on Monday, Oct. 18, at 7:30 P. M., arriving at Niagara Falls at 8:30 Tuesday morning. M. C. Roach, General Eastern Passenger Agent, 413 Broadway, New York, will answer any inquiries or give further particulars concerning this route.

From Chicago to the Convention.

The Lake Shore route will be the popular route for delegates and visitors from the West to the convention of the American Street Railway Association at Niagara Falls. This road will run a special car on its New York Express, leaving Chicago at 3 P. M., Oct. 18, for the benefit of those wishing to attend the convention. This train arrives in Niagara Falls in time for breakfast the next morning.

To the Convention—via the "Big Four Route."

The "Big Four Route" will run excursions to the convention of the American Street Railway Association at Niagara Falls, Oct. 19–22. Solid vestibuled trains with Wagner sleeping cars, buffet parlor cars and dining cars, will be run to Niagara Falls from Peoria, St. Louis, Louisville, Cincinnati, and points south and west.

New Pullman Line Between Chicago and Washington.

The Monon Route has established a new through sleeping car line between Chicago and Washington and Baltimore via Cincinnati, the C. H. & D., B. & O. S. W. and B. & O. railways. The sleeper is ready for occupancy in Dearborn Station, Chicago, at 9:30 P. M., and leaves at 2:45 A. M. daily, arriving at Washington at 6:47 and Baltimore 7:55, the following morning.

Returning, leaves Baltimore 10:45 A. M., Washington 11:45 A. M., Cincinnati 3:05 A. M., Indianapolis 7 A. M., arriving at Chicago at noon.

As the sleeper goes through without change, and as the hours of leaving and arriving are so convenient, this will prove altogether the most comfortable, as well as the most picturesque, route to the national capital.

City Ticket Office, 232 Clark Street. Depot, Dearborn Station, Chicago.

The Pittsburgh *Post* says: "The present Baltimore & Ohio management ought to be proud of the record made at Chicago, where it is openly admitted that the new Royal Blue Line trains are the finest that enter the Grand Central depot. Since the repainting and remodeling of the rolling stock, the Baltimore & Ohio has earned quite a reputation for fine looking passenger trains, but when the people at the Grand Central at Chicago openly admit that the Baltimore & Ohio has the finest trains entering the building, the managers ought to be elated. The praise given the Baltimore & Ohio at the Windy City is deserved, as the new trains are certainly very neat interiorly and exteriorly. The locomotives, too, are the finest to be seen in Chicago. Engine No. 888, which hauls the limited express, and others of the same class, are the most attractive and perfect machines running in the State of Illinois."

DIGEST OF CONTENTS.—SEPTEMBER, 1897.

Abkürzung des Inhalts—September, 1897.

Elektrische Strassenbahnen in Charleston .. . [Seite 517.]

Die Stadt Charleston, Staat Sud-Carolina, war während mehreren Jahren die einzige Stadt der Vereinigten Staaten mit einer Bevölkerung von über 35,000 Einwohnern, welche nicht die mindeste Strecke von elektrischen Strassenbahnen besass. Heutzutage ist all dies geändert, und seit Januar, 1897, hat ein vollständiges Netz von elektrischen Strassenbahnen das frühere System von Pferdebahnen innerhalb der Stadt ersetzt, und der Bevölkerung von Charleston einen weit besseren Betrieb ersichert, als vordem je möglich war. Das Bahnnetz wurde nach den modernsten Erfahrungen sorgfältig ausgeführt, und die in diesem Hefte enthaltene Beschreibung wird von grossem Werthe für Ingenieuren sein, besonders in Bezug auf eine Anzahl neuer Einrichtungen, beispielsweise eines Verfahrens für den mehrmaligen Gebrauch condensirendes Wassers, und einer Einrichtung um einen Wasserdruck zu erhalten, welcher einer hundert Fuss Oberfläche gleichgeltend ist, während der Behälter blos neun und dreissig Fuss hoch ist.

Die Chicagoer Vorortbahn . . . . . [Seite 524.]

Dieses Strassenbahnnetz ist in einer eigenthümlichen und interessanten Art gebaut. Die Gesellschaft pachtete siebzehn Meilen Dampfbahn von der Wisconsin Central Eisenbahngesellschaft, und von der Chicago & Northern Pacific Eisenbahngesellschaft, zwei bedeutende Hauptbahnen, welche von dem Herze der Stadt auslaufen und einen ausgedehnten Vorortbetrieb besitzen. Zu dieser Strecke wurden neue Zweiglinien in solcher Art beigefügt, dass das Bahnnetz mit den Hoch- und Strassenbahnen verbunden ist, welche in das Geschäfts-Centrum der Stadt einlaufen.

Der Verfasser beschreibt mehrere neuen Einrichtungen, namentlich ein Apparat für Wassererkältung für den widerholten Gebrauch von condensirendem Wasser, und zwar soll die Geräumigkeit des Apparates solcher Art sein, dass das Wasser blos einmal in je achtzig Stunden gebraucht wird.

Mittheilungen über elektrischen Strassenbahnen in Europa [Seite 526.]

Betrieb.

Elektrische Wagen, Gehäuse und Reparaturen in San Francisco, von S. L. Foster . . . . . [Seite 527.]

Dies ist ein interessanter Artikel, von dem Elektrotechniker des bedeutendsten Strassenbahn Systems der Stillen Küste und eines der grössten in den Vereinigten Staaten, nebst Beschreibung mehrerer Bauarten, so wie werthvollen Mittheilungen für den Gebrauch auf anderen elektrischen Strassenbahnen.

Elektrische Strassenbahnmotoren, von George T. Hanchett [Seite 531.]

Dies ist der dritte einer Reihe von werthvollen Artikeln über die Theorie und Praxis der Bauart von Motoren in den Vereinigten Staaten. Der besondere Gegenstand des gegenwärtigen Artikels ist die Behandlung von Armaturen, eine Fortsetzung des vorigen Monates.

Anlagen für Vergnügungslokalen, von Warren H. Manning [Seite 534.]

In diesem, durch einen berühmten Architekt geschriebenen Artikel welcher ein Fachmann in dieser Art von Bauten ist, werden zwei allgemeine Methoden für die Anlage von Strassenbahnparken beschrieben, durch welche die besten Erfolgen erlangt werden können; auch sind verschiedene Arten von zweckmässigen Vergnügungen angegeben.

Briefe und Mittheilungen von Fachmännern.

Die Richtige Behandlung von Controlleuren, von G. W. Knox & J. R. Cravath . . . . . [Seite 538.]

Diese Bestreitung, wel he besondere Aufregung unter Ingenieuren erwach, wird in dieser Nummer fortgeführt. Die Streitfrage besteht lediglich aus diesem Punkt: Soll der Strom schnell zugelassen werden, um die Ersparniss in Kraftverbrauch zu ergrössern? G. W. Knox, elektrische Ingenieur der Chicago City Railway Company, erklärt verschiedene mit Controlleuren erstatteten Versuche, und J. R. Cravath ergänzt seine in der Juli-Nummer veröffentlichte Mittheilung.

Schwerer elektrischer Betrieb auf Dampfbahnen in Ohio. [Seite 540.]

Mittheilung nebst Beschreibung eines grösseren Motorwagens und dessen Dienst für das Weichen von Ausflugszüge von einer Dampfbahnlinie auf eine andere.

Belohnungen für Angestellten . . . . . [Seite 540.]

Mittheilung über die liberale Belohnung von Angestellten durch eine Strassenbahngesellschaft in Salt Lake City.

Statistik einer Zentralstation in Philadelphia . [Seite 541.]

Dies ist eine Veröffentlichung, durch die Hestonville, Mantua & Fairmount Passenger Railway Company, der Betriebskosten der Zentralstation für Arbeit und Heizmaterial.

Statistik über Zahnrädern in Omaha . . . . [Seite 541.]

Rechtswesen . . . . . [Seite 542.]

Leitartikeln.

Besonderer Gebrauch eines Systems für Buchführung [Seite 544.]

Beziehungen von Strassenbahn Angestellten mit dem Publikum [Seite 544.]

Disconto für Baarzahlung auf Rechnungen . . [Seite 544.]

Ueber die Möglichkeit der Vertheilung von Gewinnsten in Strassenbahn Betrieb . . . . . [Seite 545.]

Wohnungen für Angestellten in Wagengehäusen . [Seite 545.]

Verstadtlichung gegen Privat-eigenthum von Strassenbahnen [Seite 546.]

Oberbau.

Drahtseilbahn auf den Mount Tom . . . [Seite 547.]

Der höchste Gipfel der Holyoke Gebirgen, in dem Staate Massachusetts, wurde neulichst durch eine 4900 Fuss lange Drahtseilbahn erobert; die Höhe des Berges ist 700 Fuss, die Maximalkrümmung 21½ prozent, die Minimalkrümmung 7 prozent, und die Mittelkrümmung 14 prozent. Dieser Artikel enthält eine ausführliche Beschreibung der Bahn, nach Mittheilungen deren Ingenieuren.

Wagengraben in New Orleans . . . . . [Seite 547.]

Die Chicagoer "Union" Hochbahn . . . [Seite 548.]

Beschreibung der neuer schleifenartigen Hochbahn welche in dem Geschäftsbezirk Chicagos errichtet wurde, und durch sämmtliche Hochbahnen als Endpunkt benutzt wird, um die Unbequemlichkeit der Weichen zu vermeiden. Etliche der Baueigenthümlichkeiten dieser Bahn sind von grossem Interesse.

Neue Reklame für Strassenbahnen . . . . [Seite 550.]

Beschreibung einer neuen Art von Reklame vermittelst des Vorderbrettes eines Wagens.

Brücke über den Schuylkill-Fluss in dem Fairmount Park. [Seite 550.]

Beschreibung eines eleganten Viaduktes welcher zwei Anlagen eines Parkes in Philadelphia verbindet.

Lampeneinrichtung . . . . . [Seite 551.]

Beschreibung eines Verfahrens für die Prüfung von Lampen in Zentralen und Zweigstationen.

Verhältnissmässige Länge der bedeutendsten Unterpflasterbahnen der Welt . . . . . [Seite 552.]

Elektrische Kraftübertragung von dem Flusse St. Lawrence. [Seite 552.]

Beschreibung einer bedeutenden Bauunternehmung, welche die Benutzung des St. Lawrence Flusses in Massena, N. Y., für Wasserkraftübertragung bezweckt. Theil des dazu erforderlichen Kapitals wurde in Europa erlangt.

Neue Wagen und Bremsenschuhe in Chicago . [Seite 553]

Der Gegenwärtige Stand von Elektrischen Heizern . [Seite 554.]

Beschreibung verschiedenen elektrischen Heizern von Amerikanischem Fabrikats, so wie deren leitenden Constructions-gattungen. Die Heizungsfrage ist eine der bedeutendsten für Strassenbahnen. Das Amerikanische Publikum hässt den Rauch, den Staub und die Luftänderung der Kohlöfen und obschon die Kosten der Aenderung von Kohle in elektrischer Triebkraft durch Mittel von Kesseln, Maschinen, u. s. w., sehr hoch kommen, erweist sich elektrische Heizung als sehr begehrenswerth.

Der Feeder und verschiedene andere Systemen von Vertheilung in dem elektrischen Strassenbahnbetrieb . . [Seite 556.]

Abzug einer Streitfrage welche durch eine Mittheilung von A. K. Baylor vor dem Institute der elektrischen Ingenieuren in London hervorgerufen wurde.

Uebernahme und Betrieb der Strassenbahnen durch Städtlichen Obrigkeiten contra Besitz und Betrieb derselben durch Privatgesellschaften. Eine Uebersicht der Erfolgen und Möglichkeiten, von Edward E. Higgins . . [Seite 558.]

Dieser Artikel, welcher durch den Redakteur des STREET RAILWAY JOURNAL, für "Municipal Affairs" geschrieben wurde, und gleichzeitig in dieser Nummer erscheint, vertheidigt den Besitz und Betrieb von Strassenbahnen durch Privatgesellschaften gegen die stets steigernde Agitation für deren Verstadtlichung von dem Standpunkte der Oekonomie und des sozialen Vortheils.

Wissenschaft. — Baukunst. — Erfindungen.

Ein Neuer Regulator . . . . . [Seite 567.]

Beschreibung eines neuen Regulators für Dampfmaschinen, aus einem Stücke gebaut, und auf einem Drehgestell errichtet, um eine Minimalreibung zu erreichen.

Elektrisch betriebene Zugbrücke . . . . [Seite 567.]

Beschreibung der Art und Weise in welcher eine 80 m. lange Zugbrücke in Toronto vermittelst einem 12½ P. S. elektrischen Motoren betrieben wird. Der Motor befindet sich nicht an dem Pfeiler, sondern ist am Ende der Brücke angebracht, und betriebt die letztere durch das Auf- und Abwinden einer sich entlang des Ufers austreckenden Kette. Dies ist durch den Umstand ermöglicht, dass der Pfeiler sich nicht in der Mitte der Brücke befindet.

Fernere Versuche mit dem Sprague System in Schenectady [Seite 568.]

Beschreibung der Erfolgen eines in Schenectady stattgefundenen Versuches. Es wurden sechs Hochbahn-Motorwagen, mit je zwei elektrischen Motoren versucht.

Elektrische Schutzvorrichtung . . . . [Seite 569.]

Dieses Verfahren besteht aus zwei Theilen, dessen Aeussere, so wie es betroffen wird, der inneren, schaufelartigen Theil elektrisch auf die Bahn auswirft.

Achsenluftdruck für Luftdruckbremsen . . . [Seite 569.]

Diese neue Einrichtung besitzt eine Anzahl von werthvollen Innovationen.

Ersparniss in einer Zentralstation in Paterson . [Seite 569.]

Diese Station liefert 300 kw. Stunden pro Pfund Kohle.

Versuch eines Luftdruck-Motorwagens auf der Manhattan Hochbahn in New York . . . . . [Seite 570.]

Dieser Versuch wurde nicht für Geschwindigkeit gemacht, obschon die Züge über der gegebenen Zeit liefen. Mehrere weitere Versuche werden stattfinden.

Deoxydirtes Babbitt-Metall . . . . . [Seite 570.]

Mittheilungen uber Strassenbahnen.

Die kommende Versammlungen . . . . [Seite 571.]

Kurze Mittheilung über die kommenden Versammlungen des Amerikanischen Vereins der Strassenbahnen und des Vereins der Strassenbahnen des Staates New York.

Versammlung des Amerikanischen Institutes von Elektrischen Ingenieuren . . . . . [Seite 573.]

Mittheilung über eine interessante in Eliot, Me., stattgefundene Versammlung, in Verbindung mit der Feier der ersten, vor fünfzig Jahren durch Moses G. Farmer in den Vereinigten Staaten aufgeführten Ausstellung einer elektrischen Strassenbahn.

Neuliche Aenderungen in Liverpool . . . [Seite 574.]

Table des Matières—Septembre 1897.

Chemins de fer électriques à Charleston . . . [Page 517.]

La ville de Charleston, dans l'État de la Caroline du Sud, a été pendant plusieurs années la seule aux États-Unis, avec une population d'au dessus de 35,000 habitants, sans posséder dans son enceinte un seul kilomêtre de tramway électrique. Tout cela est changé maintenant, et depuis Janvier, 1897, un système complet de tramways électriques a remplacé les anciens tramways à chevaux de la ville, donnant ainsi un service bien plus satisfaisant aux habitants de Charleston qu'il n'existait jusqu'ici. Le nouveau système a été installé d'après les derniers perfectionnements, et la description qui en est donnée dans cet article sera d'un intérêt considérable pour les ingénieurs, en raison du grand nombre de nouveaux dispositifs qui ont été introduits, parmi lesquels peut être citée une méthode d'emploi renouvelé de l'eau condensée, avec un arrangement spécial pour le refroidissement, et un système pour l'obtention d'une pression d'eau équivalente à une surface de 100 pieds avec un réservoir qui ne mesure que 39 pieds de hauteur.

Le chemin de fer suburbain de Chicago . . . [Page 524.]

Le système de cette ligne est organisé d'une façon intéressante et originale. La compagnie a loué 17 milles de voie de chemin de fer à vapeur appartenant à la Compagnie du Wisconsin Central et à la Compagnie du Chicago et Northern Pacific, deux lignes importantes partant du centre de Chicago et desservant les banlieues de la ceinture. De nouvelles lignes ont été ajoutées et les anciennes rallongées, formant de cette façon un débouché pour le transport général de la ville même de Chicago, et reliées avec des lignes importantes de chemins de fer élevés et de tramways partant du centre des affaires de la ville. Cet article décrit certaines particularités de construction, notamment un appareil de refroidissement de l'eau pour l'usage d'eau condensée constamment à nouveau, la contenance de cet appareil étant telle que la même eau peut être utilisée pendant quatre-vingts heures.

Notes sur les tramways électriques en Europe . [Page 526.]

Service.

Cars électriques, remises et réparations de voitures à San Francisco, par S. L. Foster . . . . . [Page 527.]

Ceci est un article très intéressant, par l'électricien d'un des systèmes les plus étendus de tramways sur la Côte du Pacifique, et de l'un des plus considérables aux Etats-Unis, décrivant un certain nombre de méthodes d'opération employées par cette ligne, et contenant certains conseils de valeur qu'il serait facile d'appliquer au service de tramways électriques dans d'autres villes.

Moteurs de tramways électriques, par George J. Hanchett. [Page 531.]

Ceci forme le troisième d'une série d'articles de valeur sur la théorie et la pratique en fait de construction de moteurs aux États-Unis. Le sujet spécial du présent article consiste en diagrammes d'enroulement d'armatures, et forme la continuation de l'article publié le mois dernier.

Architecture de lieux d'amusement, par Warren H. Manning. [Page 534.]

Dans cet article, un architecte bien connu, qui a fait une étude spéciale de ce sujet, décrit deux méthodes générales pour le tracé de parcs de tramways dans le but d'obtenir les meilleurs résultats, et fait mention de quelques-uns des amusements spéciaux qu'il y aurait lieu d'introduire avec advantage dans ces parcs.

Lettres et communications diverses.

Sur la propre manière de faire usage du contrôleur, par G. W. Knox et J. R. Cravath . . . . . [Page 538.]

Une discussion, qui a soulevé un grand intérêt parmi les ingénieurs, est continuée sous ce titre, le sujet de la discussion étant la question de savoir si le courant doit être lancé brusquement ou lentement en mettant en marche les voitures électriques, dans le but d'obtenir la plus grande économie en couvrant une distance donnée dans un temps donné. G. W. Knox, ingénieur électricien de la Chicago City Railway Company, explique certains essais qu'il a faits avec des contrôleurs, et J. R. Cravath donne des détails complémentaires à ses arguments sur ce sujet, publiés dans le numéro de Juillet.

Service électrique sur des chemins de fer dans l'Ohio . [Page 540.]

Communication décrivant une voiture motrice de dimension exceptionnelle et son service en transbordant des trains d'excursion de divers chemins de fer à vapeur à d'autres.

Services d'employés récompensés . . . . [Page 541.]

Communication décrivant le traitement généreux accordé à ses employés par une compagnie de tramways de Salt Lake City.

Tableau de statistique de pignons et d'engrenages à Omaha. [Page 541.]

Rapports de stations centrales à Philadelphie . . [Page 541.]

Compte rendu des dépenses d'opération pour combustible et main d'œuvre pendant six mois dans la station de force motrice de la Compagnie du Hestonville, Mantua & Fairmount Passenger Railway.

Jurisprudence . . . . . [Page 542.]

Articles de Fond.

Escompte sur paiement comptant de factures. . . [Page 544.]

Usage spécial d'un système de comptabilité . . [Page 544.]

Rapports des employés de tramways avec le public . [Page 544.]

Logements d'employés dans les remises . . . [Page 545.]
La possibilité du partage des bénéfices dans les tramways. [Page 545.]
Exploitation municipale et privée de tramways . [Page 546.]

Construction.

Chemin de fer incliné sur le Mount Tom . . [Page 547.]

Le sommet le plus élevé des Montagnes de Holyoke, dans l'État de Massachusetts, vient d'être conquis par un chemin de fer à plan incliné de 4900 pieds de longueur, avec une élévation de 700 pieds, une pente maximum de 21½ pour cent, un epente minimum de 7 pour cent, et une pente moyenne de 14 pour cent. Cet article donne une description détaillée de ce chemin de fer, d'après des renseignements communiqués par les ingénieurs.

Fossé pour voitures de tramways à la Nouvelle-Orléans [Pág. 547.]
Le chemin de fer élevé "Union" à Chicago . . [Page 548.]

Description du nouveau chemin de fer élevé dans le centre du quartier des affaires de Chicago, dont il sera fair usage comme terminus par tous les chemins de fer élevés de la ville, afin d'éviter des aiguillages encombrants. Quelques-uns des détails de construction de ce rond-point sont fort intéressants.

Nouveau moyen de réclame pour tramways . . [Page 550.]

Description d'une réclame faite au moyen d'annonces sur le devant des cars électriques.

Pont sur la rivière du Schuylkill dans le parc de Fairmount. [Page 550.]

Description d'un viaduc d'architecture élégante mettant en communication deux allées d'un parc de Philadelphie.

Contrôle de lanternes . . . . . [Page 551.]

Description d'un dispositif pour l'essai de lanternes dans les stations de force motrice et les circuits de distribution.

Dimensions relatives des principeaux chemins de fer souterrains au monde . . . . . [Page 552.]

Énergie électrique du fleuve St. Laurent . . [Page 552.]

Description d'un ouvrage fort important récemment entrepris á l'effet de produire l'énergie électrique en utilisant les eaux du fleuve St. Laurent à Massena, N. Y.; les fonds pour cette entreprise ont été souscrits en Europe en partie.

Nouvelles voitures et sabots de freins à Chicago . [Page 553.]

La situation présente des chauffeurs électriques . [Page 554.]

Description d'un certain nombre de chauffeurs électriques de première classe en ce moment sur le marché Américain, donnant une idée des différentes méthodes de construction employées. Le problème du chauffage est l'un des plus importants pour les compagnies de tramways. Le public Américain deteste les poêles à charbon accompagnés de fumée, de poussière, et de changements de température considérables, et malgré les frais de transformation du charbon en énergie électrique au moyen de chaudières, de machines à vapeur et du système de distribution, le chauffage électrique s'est démontré comme une nécessité indispensable, qu'il est impossible d'ignorer.

Le feeder et différents autres systèmes de distribution pour le service de tramways électriques . . . . . [Page 556.]

Extrait d'un argument soulevé par la lecture d'un article par A. K. Baylor devant l'Institut des Ingénieurs Électriciens de Londres, il y a quelques semaines, ayant particulièrement rapport aux diverses manières d'établir une distribution d'energie économique pour le service lourd de chemins de fer électriques, tel qu'il est en usage sur le chemin de fer souterrain central de Londres, pour le service de banlieue, etc.

Propriété municipale et privée et service de tramways. Une étude sur les résultats et possibilités, par E. E. Higgins. [Page 558.]

Article écrit pour la revue "Municipal Affairs" (et paraissant simultanément dans ce numéro) par le rédacteur du STREET RAILWAY JOURNAL, en défense de la propriété et de l'exploitation de tramways par des particuliers, contre l'agitation croissante en faveur de la propriété et l'exploitation municipales, du point de vue économique et des advantages sociaux.

Science — Génie — Inventions.

Un nouveau régulateur . . . . . [Page 567.]

Description d'un nouveau régulateur de machines à vapeur, fait d'une seule pièce, et monté sur pivot, de manière à réduire la friction au minimum.

Pont tournant actionné par l'électricité . . . . [Page 567.]

Description de la méthode employée à Toronto, Canada, pour la manœuvre d'un pont tournant de 80 mètres de longueur, au moyen d'un moteur électrique de 12½ chevaux. Le moteur n'est pas fixé à la pile, mais se trouve à l'extrémité du pont et l'actionne par l'enroulement et le dévidage d'une chaîne qui s'étend le long d'un sentier sur la rive. Ceci est rendu possible par le fait que la pile ne se trouve pas au milieu du pont.

Détails complémentaires faits à Schenectady avec le système Sprague. [Page 568.]

Description des résultats d'un essai fait à Schenectady avec six voitures motrices de chemin de fer élevé, équipées chacune avec deux moteurs électriques de 55 chevaux.

Économie dans une station centrale à Paterson . . [Page 569.]

Cette station produit 300 k. w. heures par livre de charbon.

Fender électrique . . . . . [Page 569.]

Ce fender consiste en deux parties; dès que la partie extérieure se trouve atteinte, la partie intérieure, en forme de pelle, est projetée électriquement sur la voie.

Compresseur d'essieux pour freins à air comprimé . [Page 569.]

Ce nouveau compresseur possède une quantité d'innovations de grande valeur.

Essai d'une voiture motrice à air comprimé sur le chemin de fer élevé de New York (Manhattan Elevated Railway. [Page 570.]

Il n'a pas été fait d'essai de vitesse dans ce sens, bien que les trains aient marché en-dessous du temps déterminé. Les essais d'économie se feront plus tard.

Métal Babbitt déoxydé . . . . . [Page 570.]

Faits Divers.

Les conventions à venir . . . . . [Page 571.]

Compte-rendu abrégé de ce qui se fera au cours des réunions de l'Association Américaine des Tramways et de l'Association des Chemin de fer de l'État de New York à Niagara Falls, et de la réunion de l'Association des Tramways de l'État de Pennsylvanie à Allentown, Pa.

Réunion de l'Institut Américain d'Ingénieurs Électriciens. [Page 573.]

Compte rendu d'une assemblée intéressante tenue à Eliot, Me., en rapport avec le semi-centenaire de la première exposition d'un chemin de fer électrique faite aux États-Unis par Moses G. Farmer.

Changements récents à Liverpool . . . . [Page 574.]

Lista de Materias—Setiembre 1897.

Tranvías Eléctricos en Charleston . . . . [Pág. 517.]

La población de Charleston, en el Estado de Carolina del Sur, fué durante varios años la única ciudad en los Estados Unidos con más de 35,000 habitantes que no tenía en sus limi es un solo kilómetro de tranvía eléctrico. Hoy es cambiado todo eso, y desde Enero de 1897, un sistema completo de ferrocarriles eléctricos funciona en esta ciudad en lugar de los antiguos tranvías con tracción animal, y han provisto los habitantes de Charleston con un servicio mucho mejor que fué posible anteriormente. El sistema ha sido instalado cuidadosamente, según los perfeccionamientos más recientes, y la descripción dada en este artículo será de mayor interés para los ingenieros, por motivo de varios nuevos dispositivos. Entre otros puede ser mencionado un método para usar el agua de condensación repetidas veces, con provisión especial para el enfriamiento y un método para obtener una presión de agua equivalente á una sobrefaz de ciento pies con un algibe de solo trientinueve pies de altura.

El ferrocarril suburbano de Chicago . . . [Pág. 524.]

Este sistema de ferrocarril es construido en un modo curioso é interesante. La compañía arrendó unas diez y siete mílas de vía de ferrocarril á vapor perteneciendo á la compañía ferroviaria del Wisconsin Central, y al Chicago & Northern Pacific, dos líneas importantes saliendo del corazón de Chicago y teniendo un servicio suburbano en la parte exterior de la ciudad. Extensiones y nuevas líneas han sido juntas, de tal modo due forma esta red una salida para el tráfico general de la población, y una conexión con ferrocarriles aéreos y tranvías urbanos importantes, que tienen sus terminos en el centro comercial de Chicago. Este artículo describe ciertos detalles de construcción, incluyendo un aparato de enfriamiento de agua, para usar el agua de condensación repetidas veces, la capacidad del aparato siendo de tal modo que el agua está usada solo una vez en ochenta horas.

Notas sobre los tranvías eléctricos en Europa . . [Pág. 526.]

Operación.

Coches eléctricos, cocheras y reparaciones en San Francisco, por S. L. Foster . . . . . [Pág. 527.]

Eso es un artículo interesante, por el eléctriciano del sistema de tranvías más importante sobre la costa del Pacifico, y uno de los más largos en los Estados Unidos, describiendo varios datos y detalles de construcción en usa por esta línea. y conteniendo ciertos informes valiosos, que pueden ser aplicados á la operación de tranvías eléctricos en otras ciudades.

Motores para tranvías eléctricos, por George T. Hanchett. [Pág. 531.]

Eso es el tercero de una serie de artículos valiosos sobre la teoría y la práctica en la construcción de motores en los Estados Unidos. El sujeto especial, "armaduras de inducción," es una continuación del mes pasado.

Arquitectura de lugares de diversión, por Warren H. Manning. [Pág. 534.]

En este artículo describe un arquitecto bien conocido, que ha hecho una estudia especial de este sujeto, dos métodos generales para colocar parques de tranvías de modo que se obtienen buenos resultados, y mención es hecha de unas diversiones especiales que pueden ser introducidas en esos parques con major ventaja.

Varias Comunicaciones.

Sobre el propio modo de manejar contralores, por G. W. Knox y J. R. Cravath. . . . . [Pág. 538.]

Una discusión, que ha excitado muy interés entre ingenieros, está continuida bajo este título, el sujeto de la discusión siendo la cuestión "si la corriente debe ser lanzada bruscamente ó lentamente al accelerar coches eléctricos al fin de obtener la mayor economía en su uso cuando cubre una cierta distancia en un cierto tiempo." G. W. Knox, ingeniero eléctrico de la Chicago City Railway presente ciertos ensayos que ha hecho con contralores, y J. R. Cravath continua su argumento sobre el sujeto, publiado en el número de Julio del JOURNAL.

Operación eléctrica pesada sobre ferrocarriles en Ohio. [Pág. 540.]

Comunicación describiendo un largo coche motor, y su servicio para trasladar trenes de excursión de varios ferrocarriles de vapor á otros.

Servicios de empleados reconocidos. . . . . [Pág. 541.]

Communicación describiendo la generosidad de una compañía de tranvías de Salt Lake City para sus empleados.

Registración de estaciones de fuerza motriz en Filadelfia. [Pág. 541.]

Cuadro estatistico de piñones y engranajes en Omaha . [Pág 541.]

Datos, cubriendo seis meses, de los gastos de operación para labor y combustible de la estación de fuerza motriz de la Compañia ferroviaria de Hestonville, Mantua & Fairmount Passenger Railway.

Jurisprudencia. . . . . . [Pág. 542.]

Artículos de la Redacción.

Rebaja sobre facturas pagadas con dinero contante . [Pág. 544.]

Uso especial de un sistema de cuentas . . . [Pág. 544.]

Relaciones de los empleados de tranvías con el público . [Pág. 544.]

Residencias de empleados en cocheras . . . [Pág. 545.]

Posibilidad de la repartición de beneficios en la explotación de tranvías . . . . . [Pág. 545.]

Explotación municipal y privada de tranvías . . [Pág. 546.]

Construcción.

Ferrocarril inclinado á la cima de Mount Tom . [Pág. 547.]

La cima más alta de lás Montañas Holyoke, en el Estado de Massachusetts, ha sido recientemente conquista por un ferrocarril de plano inclinado, de 4900 pies de longitud, con una elévación de 700 pies, una pendiente maxima de 21½ pies por ciento, una pendiente minima de 7 por ciento, y una pendiente media de 14 por ciento. Ese artículo contiene una descripción cuidadosa de esta ferrocarril, según informes provistos por los ingenieros.

Patio de coches en Nueva Orleans . . . . [áPg. 547.]

El ferrocarril aéreo "Union" de Chicago . . [Pag. 548.]

Eso es una descripción del nuevo ferrocarril aérea en forma de ojal construido en el centro del districto comercial de Chicago, y que será empleado como terminal por todos los ferrocarriles aéreos de la ciudad en modo que evitar traslaciones. Algunos detalles de construcción de esta línea son muy interesantes.

Nuevo modo de aviso para tranvías . . . . [Pág 550.]

Descripción de un aviso hecho por medio del frente de coches eléctricos.

Puento sobre el rio Schuylkill en el parque de Fairmount [Pag 550.]

Desczipción de un viaducto de arquitectura elegante, el cual junta dos aevnidas de un parque á Filadelfia.

Registracion de lámparas . . . . . [Pág 551.]

Descripción de un dispositivo para el ensayo de lámparas en estaciones de fuerza motriz y circuitos de distribución.

Tamaños relativos de los principales ferrocarriles subterráneos del Mundo . . . . . [Pág. 552.]

Energia eléctrica del rio St. Lawrence . . . [Pág. 552.]

Eso es una descripción de una obra de construcción importante, es decir, la producción de energia eléctrica del rio St. Lawrence, á Massena, N. Y., el capital por cuya obra hubiendo sido en parte obtenido de Europa.

Nuevos coches y zapatos de frenos á Chicago . . [Pág. 553.]

La situación actual de los calentadores eléctricos . [Pág 554.]

Descripción de una cierta cantidad de calentadores eléctricos de primera clase en el mercado Americano.

El feeder y varios otros sistemas de distribución para el servicio de tranvías eléctricos . . . . . [Pág 556]

Extracto de un argumento leido por A. K. Baylor á la junta del Instituto de Ingenieros Electricianos en Londres.

Propiedad municipal y privada y operación de tranvías. Un estudio de resultados y probabilidades, por Edward E. Higgins . . . . . [Pág. 558.]

Eso es un artículo escrito por la revista "Municipal Affairs" (apareciendo simultaneamente en este número), por el redactor del STREET RAILWAY JOURNAL, en defensa de la propiedad privada y operación de tranvías, contra la tendencia que va creciendo en favor de su propiedad y operación por los municipalidades, del punto de vista economico y de ventajas sociales.

Ciencia. — Ingenieria. — Invenciones.

Nuevo Regulador. . . . . . [Pág. 567.]

Descripción de un nuevo regulador para máquinas de vapor, hecho de una pieza única, y montado sobre pivote, para disminuir la friccion al punto minimo.

Puente levadizo operado por electricidad . . [Pag. 567.]

Descripción de un método empleado á Toronto para operar electricamente un puente levadizo de 80 metros de longitud, por medio de un motor eléctrico de 12½ caballos. El motor, en lugar de ser fijado al estribo, está colocado á la extremidad del puente, y opera el último por medio de una cadena que se extende al costado de la rivera. Eso es hecho posible por el facto que el estribo no está colocado en el centro del puente.

Detalles ulteriores sobre el sistema Sprague.. . . [Pág. 568.]

Descripción de resultados hechos á Schenectady con seis coches motoros de ferrocarriles aéreos, cada uno siendo provisto con dos motores eléctricos.

Compresor de eje para frenos pneumáticos . . [Pág. 569.]

Ese nuevo compresor posee varias disposiciones de valor.

Fender eléctrico . . . . . [Pág. 569.]

Descripción de un fender que consiste en dos partes; cuando la parte exterior está tocada, la parte interior, en forma de pella, está proyectada eléctricamente sobre la via.

Ensayo de un coche motor de aire comprimido sobre el ferrocarril aéreo de Manhattan á Nueva York . . . [Pág. 570.]

No fué heche ningún ensayo de velocidad, pero el coche motor hizo un viaje regular á menos tiempo que ordinairo. Ensayos económicos serán hechos ulteriormente.

Metal Babbitt deoxidido. . . . . . [Pág. 570.]

Novedades.

Las convenciones futuras.. . . . . . [Pág. 571.]

Breve relación del programa de las convenciones de la Asociación Americana de Tranvías y de la Asociación de ferrocarriles del Estado de New York, á Niagara Falls, así como de la Asociación de Tranvías del Estado de Pennsylvania á Allentown, Pa.

Junta del Instituto de Ingenieros Elétricianos Americanos. [Pág. 573.]

Cuenta da una junta interesante tenida á Eliot, Me., en relación con el cincuentenario de la primera exposición de un ferrocarril eléctrico hecha en los Estados Unidos por Moses G. Farmer.

Cambios recientes en Liverpool . . . . [Pág. 574.]

Financial Notes.

Asbury Park, N. J.—Henry S. Terhune, of Monmouth County, has been appointed receiver of the Asbury Park & Belmar Street Railway Company by Judge Kirkpatrick to succeed the late William L. Dayton.

Atlanta, Ga.—W. J. Kendrick has been appointed temporary receiver of the Atlanta Electric Railway Company on the petition of J. F. Leary, who holds a claim of $10,000, with interest, against the company.

Baltimore, Md.—The receivers of the Baltimore & Catonsville Construction Company, which contracted to construct the Columbia & Maryland Railway, have been discharged by the court, and the reorganization committee of the Railway Company will immediately have the work of construction resumed.

Boston, Mass.—The Railroad Commissioners have authorized the Boston Elevated Railway Company to issue $10,000,000 capital stock, of which $500,000 may be issued at once and future amounts as required by expenses.

THE committees of the West End Street Railway Company and Boston Elevated Railway Company are, at the present time, having frequent conferences regarding the lease of the West End road to the last named corporation.

Brooklyn, N. Y.—General James Jourdan is expected soon to retire from the receivership of the Kings County Elevated Railroad Company, and, it is said, he will be succeeded in that capacity by James H. Frothingham. Action is soon to be taken to foreclose upon the property of the railroad and reorganize it. Circulars have just been sent to the holders of the first mortgage bonds of the company by the bondholders' committee, August Belmont, Walter G. Oakman and William A. Read, asking for power of attorney authorizing the committee to act in order to bring about a foreclosure and the appointment of Mr. Frothingham.

JUSTICE DICKEY, of the Supreme Court in Brooklyn, has granted Receiver Fred. Uhlmann, of the Brooklyn Elevated Railroad Company, permission to sign the contracts made with the various electric railway companies and the Kings County Elevated Railway Company, by which all the lines shall cross the Bridge.

Canal Dover, O.—The Tuscarawas Electric Company, operating the electric railway 3½ miles in length, between Canal Dover and New Philadelphia, has changed hands and is now owned by L. P. Wentz, of Sutton, Neb., Theodore Wentz, cashier of the First National Bank, and David King, of Canal Dover.

Charleston, W. Va.—The lines of the Charleston Street Railway Company, which have been in the hands of the court for two years, were sold recently to a Cleveland (O.) firm for $21,000.

Chicago, Ill.—The Chicago Passenger Railway Company has filed for record a blanket mortgage for $2,000,000 given by it to the Equitable Trust Company. The bonds were issued to fund its floating indebtedness of $1,000,000 and to provide for the necessary improvements in its equipment and roadbed. Of the indebtedness there is $600,000 of 6 per cent, forty year bonds, issued June 1, 1897, and $400,000 of first mortgage, 6 per cent bonds, issued July 7, 1885, and maturing in 1903.

IT is announced that a traffic arrangement has been made by the Lake Street Elevated Railroad Company with the Suburban Railroad Company which will undoubtedly prove a valuable feeder. The Lake Street "L" already is closely connected with the Cicero & Proviso Electric Railway and the Suburban will give direct connection with LaGrange, Grossdale, Hollywood, Riverside, Berwyn, LaVergne, Clyde, Morton Park, Harlem, Oak Park and Austin. The Suburban's franchises permit the transportation of express and mails, and the road is constructed for the rapid transportation of cars of unusual size.

THE Metropolitan Traction Company, which has a franchise to operate electric railways on most of the county roads, has negotiated a loan of $2,000,000 thirty year 5 per cent gold bonds, with the Equitable Trust Company as trustee, and the State Trust Company as co-trustee, to secure money to be used in building and equipping its various lines. Some of its county lines, which are to cross all parts of the district outside the city limits, are expected to be in operation by Mar. 1, 1898.

Cleveland, O.—The Lorain & Cleveland Railway Company has increased its capital stock from $500,000 to $1,000,000.

East Wareham, Mass.—Application has been made to Judge Hardy in the Superior Court to have a receiver appointed for the East Wareham, Onset Bay & Point Independence Street Railway.

Elgin, Ill.—The Elgin, Carpentersville & Aurora Railway Company has been organized with a capital stock of $500,000, all of which is subscribed for, to purchase all the property and rights of the Elgin City Railway Co. and the Carpentersville, Elgin & Aurora Street Railway Company, including the lighting plant. The incorporators are William Grote, George P. Lord, David B. Sherwood, James B. Lane, F. Dunbar Waldron, George M. Peck and Alfred B.

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Church. The company will also furnish light, power and heat, and sell electrical appliances. It is proposed to extend the lines possibly to Lake Geneva, Wis. The company now has 30 miles of track.

Exeter, N. H.—At a meeting of stockholders of the Exeter Street Railway Company held recently it was decided to apply to the Railroad Commissioners for permission to issue $25,000 more bonds and $25,000 additional capital stock, the proceeds to defray the expenses incurred in building more track.

Kansas City, Mo.—The East Side Electric Railway Company recently filed articles of incorporation at Jefferson City. The stockholders are Joseph Heim, Ferd. Heim, Michael Heim and C. S. Palmer, and the capital stock is $2000. This will be increased as soon as a franchise is obtained. The purpose of the new company is to operate an electric line on East Fifth Street from Walnut Street to Lydia Avenue, north to Guinotte Avenue, east to Otis Avenue and north again to Nicholson Avenue. A franchise has been asked for and as soon as it is obtained the company will begin the construction of the road.

Lewiston, Me.—Among those who recently purchased the lines of the Lewiston & Auburn Horse Railroad Company are Galen C. Moses, of Bath; I. C. Libby, of Waterville, and Amos F. Gerald, of Fairfield, Me. $150,000, it is understood, was the purchasing price. Several extensions and improvements will be made.

McKeesport, Pa.—The deal has been closed for the transfer of the Versailles traction road to the Second Avenue Traction Company. The Versailles line will be used in connection with the road which the Second Avenue people contemplate building to West Newton.

The McKeesport, Duquesne & Wilmerding Railway has been sold at receiver's sale to Horace G. Crosby, assistant general manager of the National Tube Works Company, and a heavy stockholder in the road.

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Milwaukee, Wis.—The Milwaukee Electric Railway & Light Company has purchased the Waukesha Beach Electric Railway for $65,000.

Newburgh, N. Y.—It is reported that the Newburgh Electric Railway Company and the Middletown-Goshen Traction Company will be consolidated, and an electric railway built between Walden and Goshen, thus uniting the two systems.

New York, N. Y.—A meeting of the stockholders of the Metropolitan Traction Company will be held at the office of the company on Sept. 14, 1897, for the purpose of voting upon a proposition to dissolve the company and wind up its affairs.

THE Third Avenue Railroad Company has declared a quarterly dividend of $2 per share, payable Aug. 30.

THE Metropolitan Street Railway Company has leased the 135th Street line of the Union Railway Company.

Norfolk, Va.—The Portsmouth Street Railway Company has given a second mortgage of $100,000 to the United Security Life Insurance & Trust Company, of Philadelphia, to complete the road.

Oakland, Cal.—The Realty Syndicate Company, which recently secured control of the California Improvement Company, the California Railway Company and the Alameda, Oakland & Piedmont Electric Railroad Company, has elected E. A. Heron vice-president of the three companies, and S. P. Taylor secretary.

Olean, N. Y.—The Olean Terminal Railway Company has been incorporated to construct an electric road in Olean. Capital, $25,000. The directors are Frank E. Lowe, of Greenfield, Mass.; H. S. Sortwell, J. H. O'Brien, George Fobes, of Olean, and others.

Oshkosh, Wis.—Negotiations between the Citizens' Traction Company and the Oshkosh Street Car Company are about completed for the sale of the horse car company's effects to the former company for $40,000, part of which is to be taken in stock of the electric company.

Philadelphia, Pa.—The Fairmount Park Transportation Company will issue $500,000 bonds to be secured by a mortgage on its franchises and equipment.

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Pittsburgh, Pa.—The Second Avenue Traction Company is negotiating for the purchase of the West Newton & Northern Street Railway Company's charter and franchise in order to secure a franchise through West Newton.

Saginaw, Mich.—Homer Loring, of Boston, and George B. Morley, of Saginaw, Mich., have been appointed receivers for the Union Street Railway Company of Saginaw upon the application of the Boston Safe Deposit & Trust Company, which has also asked that a temporary injuction be issued against the city restraining it from disposing of the street railway franchise.

Salem, O.—The Salem Electric Railway Company has made its annual report to the railroad commissioner, showing 2 miles of track, $100,000 capital stock, $50,000 bonded indebtedness, $4642 operating expenses, $5213 gross earnings.

San Francisco, Cal.—The East Oakland Railroad was sold under foreclosure recently for $60,500. The road carried an indebtedness of over $250,000. The purchaser was the Realty Syndicate, which is gradually absorbing all the lines on this side of the bay.

Tampa, Fla.—On application of the Central Trust Company, of New York, Judge John A. Pardee, of the United States Circuit Court, has appointed Chester W. Chapin receiver of the Consumers' Electric Light & Street Railroad Company.

New York State Convention—via the Erie.

The Erie Railroad will arrange special accommodations for delegates and visitors to the convention of the New York State Street Railway Association to be held Sept. 14-15 at Niagara Falls. The principal trains for Niagara Falls via the Erie are: Train No. 7, which leaves New York daily at 7.25 P.M., arriving at Buffalo 7.15 A.M. and Niagara Falls 8.08 A.M. Train No. 1, which leaves New York daily at 8.55 A.M., arriving at Buffalo 8.00 P.M. and Niagara Falls 9.22 P.M. D. I. Roberts, New York, is General Passenger Agent.

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· STREET · RAILWAY · JOURNAL ·

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THE · ELECTRIC · RAILWAYS · OF · THE · · · · · · · · · NIAGARA · RIVER · REGION

TO properly understand the commercial character and future possibilities of the territory situated between Lakes Erie and Ontario it is necessary to briefly review the conditions which have affected its industrial growth up to the present time. The city of Buffalo, which in 1895 had a population of 336,000, is located at the extreme western end of Lake Erie; at this point the waters of the four great lakes, Superior, Michigan, Huron and Erie, enter the Niagara River and flow first northwest, then north a distance of 36 miles to Lake Ontario. In this distance the river makes a total descent of 326 ft., about 50 ft. in the rapids above the falls, 166 ft. at the falls and 110 ft. in the lower rapids. The commerce of the upper lakes, therefore, finds its eastern terminus at Buffalo, comparatively little passing through the Welland Canal to Lake Ontario. This city has naturally become, therefore, an extensive entrepôt for the grain, minerals, lumber and other products of the great Northwest and at the same time the vast trans-shipping point for the freight brought by rail from the East for transmission on the lakes.

VIEW AT CORNER OF MAIN AND NIAGARA STREETS, BUFFALO.

The extent of the commerce carried on on these inland bodies of fresh water is surprising to those who have not had their attention called to the fact. The lakes cover an area of 84,000 sq. miles and have 3600 miles of navigable shore line, which is but 200 miles less than the entire U. S. coast bordering on the Atlantic and Pacific Oceans, and their commerce exceeds by 2,000,000 tons

annually the total foreign and coastwise commerce of the Atlantic, Pacific and Gulf seaboard of the United States. The port of Buffalo during the season of navigation is said to be as large as the port of London, which is the largest in the world. Added to this it should be mentioned that twenty-six railroads enter Buffalo, which, with the location of the city at the lake terminus of the Erie Canal, gives unequaled transportation facilities to the East and South.

VIEWS AROUND BUFFALO HARBOR.

These favorable conditions for shipment, combined with the proximity of the city to the Pennsylvania and Ohio coal mines and the natural gas fields of Pennsylvania and Ontario, and its nearly central position in an easterly and westerly direction with the center of population east of the Rocky Mountains, has made Buffalo the center of great manufacturing interests. The development of the water power at Niagara Falls and its transmission by electrical means to the city has recently still further stimulated the manufacturing interests of the community, and while the majority of the new factories using Niagara power will undoubtedly be located nearer the Falls, yet the industrial development of the city cannot but be greatly stimulated by the reduction in the cost of power which the introduction of the transmission circuits from the Falls has accomplished. Among the industries for which Buffalo has become famous are the manufacture of engines and railroad supplies, marine machinery, agricultural implements, hardware, bridges, etc.

The exploitation of Niagara power in Buffalo is being undertaken by the Cataract Construction Company, which is now engaged in extending the transmission line into the heart of the city at an expense of over $150,000. The only user of the power in Buffalo is the Buffalo Railway Company, but the owners of Great Northern Elevator have contracted for 1250 h. p. in that huge structure, now being built; the Electric Grain Elevator will employ

600 and the Buffalo General Electric Company 3000 h. p. The latter company will use this power in lighting the city, and expects to have its apparatus in readiness by Nov. 15. In all 10,000 h. p. of Niagara power will be in use in Buffalo, it is thought, by the coming winter.

The climatic conditions of the city compare favorably with those of others in the same zone. The proximity to Lake Erie tempers the extreme variations in temperature experienced further inland, and greater heat than 80 degs. in summer or more severe cold than 10 degs. above zero in winter is comparatively unknown.

The site of the city is comparatively level, and in the residential section most of the houses are surrounded by considerable ground. As a consequence the area per inhabitant is large compared with many other cities of the United States, being 164 sq. miles per 1000 inhabitants. A good idea of the density of the population of New York, Chicago, Cincinnati and Cleveland as compared with Buffalo can be gained from the engraving on page 591 showing the relative area per capita. The business district is comparatively small and in it a large number of very handsome office buildings have been erected during the past five years. Among the largest and most expensive are the D. S. Morgan Building, Guaranty Building, Mooney & Brisbane Building, Erie County Bank Building and Ellicott Square Building. The latter, which is claimed to be the largest office building in the world, fronts on four streets, one of them Main Street, and the cost, including site, is said to have been $3 350,000. The corridors and central space are tiled with marble mosaic, and the latter is roofed with glass, making a splendid arcade around which the stores and offices are grouped. The building was completed in 1896.

The city also contains a very handsome City and

1.—Guaranty Building.
2.—City and County Hall.
3.—Ellicott Square Arcade.
4.—Ellicott Square Building.

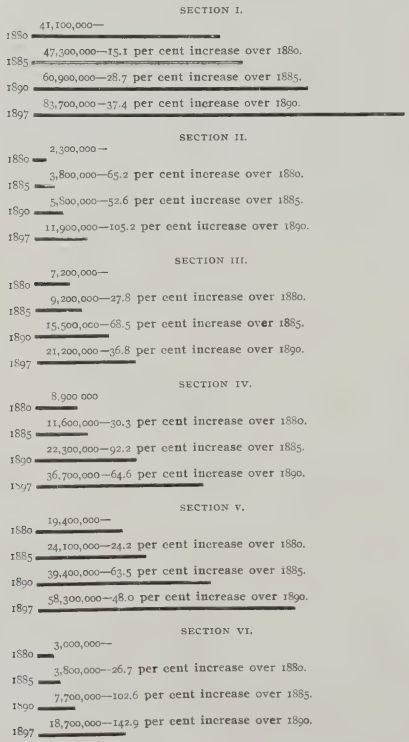
OFFICE AND MUNICIPAL BUILDINGS IN BUFFALO.

County Hall, recently completed at a cost of $1,500,000, two large public libraries, Music Hall, and other fine public buildings.

The large area over which the city extends has had an important stimulating effect upon the development of its street railway system. All the lines within the city limits were operated up to within a short time by the Buffalo Railway Company, which with the Crosstown Street Railway Company, whose lines it operates, is the successor of the original systems of the city. Most of the lines of this company run for some portion of their routes over Main Street, the principal thoroughfare which divides the city into two sections, locally called the East Side and the West Side. The ownership of the street railway system in Buffalo is in progressive hands and in many instances the lines have been extended in advance of the population into portions of the city which have been built up as a result. The relation between the development of the street railway system and the increase in property valuations is shown in an interesting way in the series of diagrams on page 589. In the maps the railway system as it existed in 1880, 1885, 1890 and at present is given, and the increase in valuations in the different districts in the same years is graphically represented by lines below.

Section 1 is the business district of Buffalo into which all the street railway lines converge. The business district proper is exceedingly small in area considering the large area which it serves, and as a matter of fact, a portion of Section 1, on the west, lying along the Niagara River, is residential in character. Naturally enough this section, though small, has by far the largest assessed valuation of the six, but its progressive increase in valuation since 1880, though material, is proportionally smaller than in all the other sections.

REAL ESTATE VALUATIONS IN BUFFALO, BY SECTIONS, SHOWING PER CENT INCREASE.



Section II is largely given over to railroads and dock facilities, and in it is considerable waste and unoccupied land together with residential areas of the poorer kind. This section was the last of all within the city limits to have electric railway facilities and it is now at a comparatively early stage of development although its assessed valuation is nearly five times that of 1880 and has increased since 1890 105 per cent.

Section III is a combined railroad, manufacturing, residential and business district. Its resident population is largely dependent on its factories, and the business sections are purely local in character. Extending electric railway facilities has here caused a progressive increase in assessed valuation along normal lines, the valuation to-day being about three times that of 1880, and showing an increase of 37 per cent over that of 1890.

Section IV is an almost purely residential district taken up in a large measure by the German American citizens of Buffalo. The valuation of this section has largely increased and is at present over four times greater than in 1880, and 65 per cent greater than in 1890.

Section V is also a purely residential district of the best class found in Buffalo, containing on the one hand a few such streets as Delaware Avenue, with their costly and elegant houses, and elsewhere large areas in houses ranging in value from $5000, to $30,000. This district has always been quite well served by street railways, so that the room for improvement in assessed valuation has not been so great as in other sections; nevertheless, the valuation to-day is three times that of 1880, and 48 per cent greater than that of 1890.

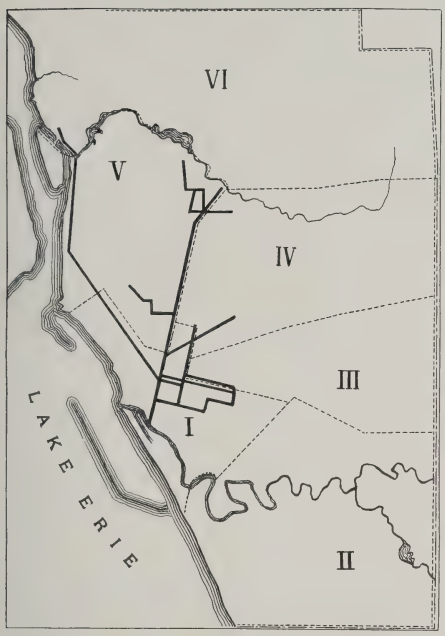
Section VI contains Buffalo's beautiful park, together with large areas of land until recently unoccupied. Here electric railway facilities have done more than in any other section to improve real estate values, and it is seen that the valuation in 1897 is over six times that of 1880, and 143 per cent greater than in 1890.

Summarizing the results in all these sections forming the entire city area of Buffalo, it will be seen that no section has failed to show a substantial increase in assessed valuations during any five year period since the old horse railway days; the business section has increased less in value than the others, and the outlying and comparatively unsettled sections have shown the largest proportional increase.

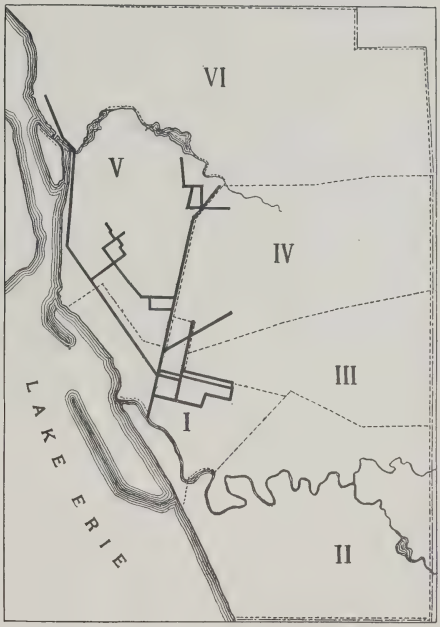
The Buffalo Railway system, especially in its operating features, is a high example of a modern city road, as is evinced by the fact that during the year ending June 30, 1896, the cost of power per car mile was .0078 cents, less than that of any other electric line in New York State reporting to the State Board of Railroad Commissioners. As the station and some parts of the line were built in the early days of electric railroading, the company does not enjoy the full benefits which modern engineering knowledge has made possible, but all of its recent construction has been of the most approved and modern type.

The only other company operating an entirely inde-

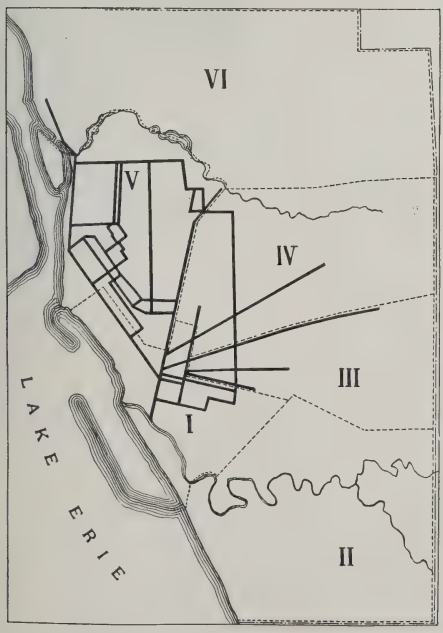
Buffalo Railway System in 1880.



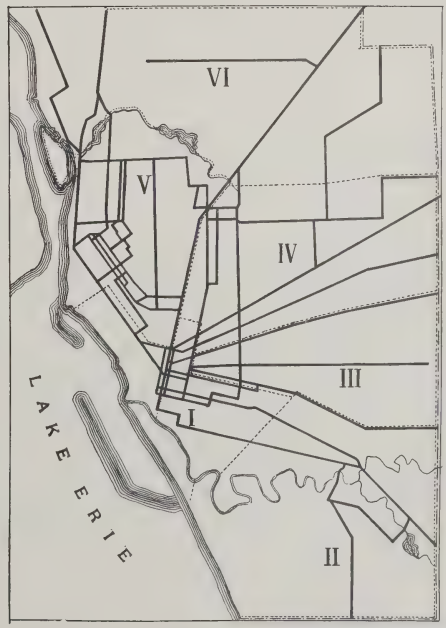
Buffalo Railway System in 1885.



Buffalo Railway System in 1890.



Buffalo Railway System in 1897.



DIAGRAMS SHOWING GROWTH OF BUFFALO STREET RAILWAY SYSTEM.

pendent system in the city of Buffalo is the Buffalo Traction Company, whose lines were to have been put in operation the first part of October. This company is a recent

MAIN STREET DURING G. A. R. CELEBRATION.

organization of local capitalists and has received a franchise for an extensive system in Buffalo, embracing over 66 miles of street, although at present only about 15 miles of track have been built. The streets covered by its franchise are not so valuable from a traffic standpoint as those of the Buffalo Railway Company, whose lines already occupy the chief radiating avenues and streets.

A good instance of the carrying possibilities of the Buffalo Railway Company's system was shown during the convention in that city, during August last, of the Grand Army of the Republic. At that time it was estimated that 300,000 strangers visited the city, and during one day of the encampment the Buffalo Railway cars carried, without mishap or accident, more then twice the number of passengers than on any two consecutive days in its previous history. The traffic on several other days during encampment week averaged nearly as many passengers. The engraving on this page will give a general idea of the gala appearance of the city at that time.

VIEW OF RESIDENTIAL PORTION OF CITY FROM MORGAN BUILDING.

BUFFALO SUBURBAN LINES.

The fact that the Buffalo Railway Company has no suburban lines of its own has led to the establishment of a number of suburban lines reaching from Buffalo city limits to neighboring towns and villages. These are eight in number, and are owned by the following corporations :

Hamburg Railway Company.
Buffalo, Gardenville & Ebenezer Railway Company.
Buffalo, Bellevue & Lancaster Railway Company.
Buffalo & Williamsville Electric Railway Company.
Buffalo, North Main Street & Tonawanda Electric Railway Company.
Buffalo, Kenmore & Tonawanda Electric Railroad Company.
Buffalo, Tonawanda & Niagara Falls Electric Railroad Company.
Buffalo & Niagara Falls Electric Railway Company.

Of the lines owned by these companies that of the latter is the most extensive and important.

Taking these lines up in the order mentioned, the

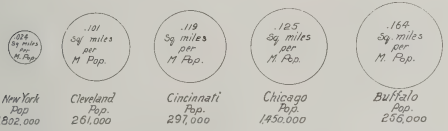
VIEW OF HARBOR FROM GUARANTY BUILDING.

Hamburg Railway is a 2½ mile single track line extending south from the city line of Buffalo to Blasdell. It has been recently built, having been put in operation Aug. 23, 1897, and it is the intention next year to extend it some 8 miles to Woodlawn Beach, an attractive shore resort on Lake Erie.

The Buffalo, Gardenville & Ebenezer Railway connects at the city line with the Seneca Street branch of the Buffalo Railway Company, and extends east to Gardenville, then south through Ebenezer to Lyon's Grove, a popular private outing resort on Cazenovia Creek. The line, which has 4⅔ miles of single track, was built mainly to give means of transportation to a territory hitherto in-

accessible except by infrequent steam railroad train service. It is operated partly by steam power and partly by water power.

The Buffalo, Bellevue & Lancaster Railway starts at the city line and the terminus of the Broadway branch of the Buffalo Railway Company, and immediately strikes off over private right of way easterly, crosssing the Delaware, Lackawanna & Western, Erie and Lehigh Valley Railroads toward Bellevue. This is a little village which has grown up around the power station and car houses of the company and the manufacturing plant of the National Radiator Manufacturing Company. Here is established, in a bend of the Cayuga River, the company's park, "Bellevue", and east of this river, which is crossed by the railway, lies "Railway Grove," also the company's property. One mile east of Bellevue the road branches, one side continuing through Depew and the other turning south through Woodlawn into the south side of Lancaster. Depew is a manufacturing town of 2800 inhabitants and has been recently built, containing in 1893 only 100 people. It has been made the site of the New York Central Railroad shops and locomotive works, and also contains a number of other factories including those of the Union Car


1 Sq. mile per M. Pop.
.101 Sq. miles per M. Pop.
.119 Sq. miles per M. Pop.
.125 Sq. miles per M. Pop.
.164 Sq. miles per M. Pop.
New York Pop. 1,802,000
Cleveland Pop. 261,000
Cincinnati Pop. 297,000
Chicago Pop. 1,450,000
Buffalo Pop. 256,000

DIAGRAMS SHOWING RELATIVE AREA PER 1000 POPULATION IN BUFFALO AND OTHER CITIES.

Company, Gould Coupler Company, Buffalo Forge Works, National Car Wheel Company, Buffalo Brass Works and others. The northern line runs from Depew through Lancaster to the north and connects with the southern branch in the center of that village. Lancaster is also a manufacturing town and contains 3800 inhabitants. In addition to the two parks mentioned, there are two others on the line of the railway, and several others proposed. The cars make a speed of 25 miles per hour between stops on the company's own right of way, and by a traffic arrangement with the Buffalo Railway Company run into the center of the city. Since February, 1894, the company has also carried the mail between Buffalo and Bellevue, and Lancaster and Bellevue, at a profit to the company. The line has a length of 13 miles of main track and 2 miles of second track and sidings.

The Buffalo & Williamsville Electric Railway extends a distance of 4½ miles from the north end of Main Street, Buffalo, to Williamsville, and was put in operation Apr. 5, 1893. The majority of the stock is owned by residents of Williamsville, which is a small town with a few manufactures and a considerable agricultural and residential community.

The Buffalo, North Main Street & Tonawanda Electric Railway has its southern terminus near the northern end of the Main Street line of the Buffalo Railway Company, and extends to Tonawanda, a distance of 6 miles. The line was built several years ago during a period of inflated land values. Although the only line from Tonawanda connecting with Main Street, Buffalo, probably the most desirable line in that city from a traffic standpoint, the line has not been a profitable one. Important improvements in roadbed and rolling stock are now being projected by the owners, however, by which it is hoped the larger part of the valuable traffic between Tonawanda and Buffalo will be secured.

SOLDIERS' MONUMENT AND BUFFALO LIBRARY.

The Buffalo, Kenmore & Tonawanda Electric Railroad is another line built in the early days of electric railroading, and connects at the Buffalo city line with the Delaware Avenue line of the Buffalo Railway Company. It was also built during the boom times and its apparatus is not now up to the standard of modern construction. The property has recently been acquired by the Buffalo Traction Company, so that the outlook is favorable towards its reconstruction and improvement. With the Elmwood Avenue & Tonawanda Electric Railway, which it operates, it has a mileage, all single track, of 9 miles.

The Buffalo, Tonawanda & Niagara Falls Electric Railroad, the third line connecting Tonawanda and Buffalo,

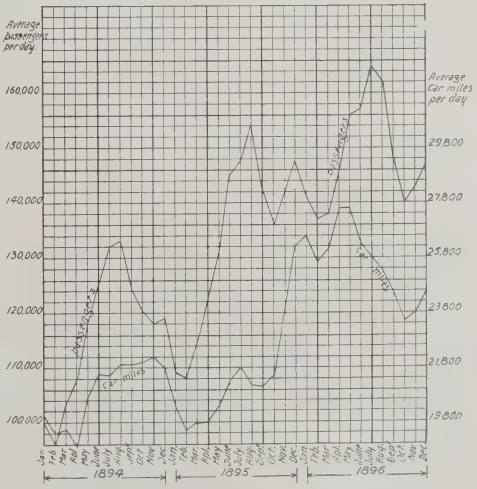
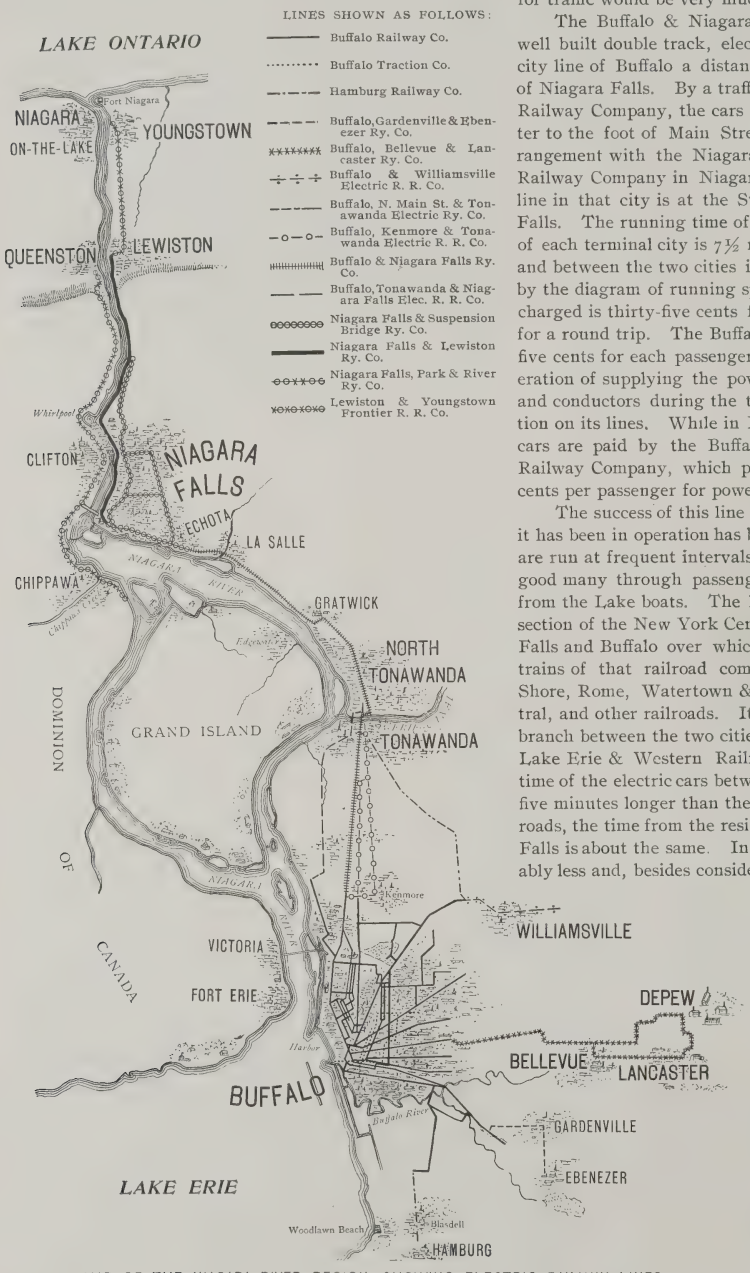


DIAGRAM OF PASSENGERS CARRIED AND CAR MILES RUN—BUFFALO RAILWAY SYSTEM.

connects at the latter city with the Niagara Street line of the Buffalo Railway Company. This line was a consolidation of the Tonawanda Street Railway Company and the Tonawanda Electric Railway Company, and was originally

projected to reach to Niagara Falls, and had this been done, the company would have secured a considerable part of the through traffic which, of course, it now misses. The roadbed and station are somewhat primitive in character, but the cars are comparatively modern in type and in good condition. It is stated that the owners project the extension of the line to Lewiston, in which case the opportunity for traffic would be very much improved.



MAP OF THE NIAGARA RIVER REGION, SHOWING ELECTRIC RAILWAY LINES.

The Buffalo & Niagara Falls Electric Railway is a well built double track, electric line extending from the city line of Buffalo a distance of 17 miles to the city line of Niagara Falls. By a traffic agreement with the Buffalo Railway Company, the cars run over the tracks of the latter to the foot of Main Street in Buffalo, and by an arrangement with the Niagara Falls & Suspension Bridge Railway Company in Niagara Falls, the terminus of the line in that city is at the State Reservation close to the Falls. The running time of the cars within the city limits of each terminal city is 7½ miles an hour including stops, and between the two cities is 20 miles an hour, as shown by the diagram of running speeds on page 593. The fare charged is thirty-five cents for a single trip, or fifty cents for a round trip. The Buffalo Railway Company receives five cents for each passenger carried on its lines in consideration of supplying the power and paying the motormen and conductors during the time while the car is in operation on its lines. While in Niagara Falls the crews of the cars are paid by the Buffalo & Niagara Falls Electric Railway Company, which pays the local company three cents per passenger for power and the use of its tracks.

The success of this line during the two years in which it has been in operation has been large. Combination cars are run at frequent intervals, and the company receives a good many through passengers from steam railroads and from the Lake boats. The line parallels a double track section of the New York Central Railroad between Niagara Falls and Buffalo over which run the through and local trains of that railroad company, as well as of the West Shore, Rome, Watertown & Ogdensburg, Michigan Central, and other railroads. It also parallels a single track branch between the two cities belonging to the New York, Lake Erie & Western Railroad. Although the running time of the electric cars between terminals is about thirty-five minutes longer than the express trains on the steam roads, the time from the residence district of Buffalo to the Falls is about the same. In addition, the fare is considerably less and, besides considerable through traffic, the line carries a great many local passengers.

TONAWANDA

This place, which lies midway between Buffalo and Niagara Falls, is divided into two districts by the Erie Canal, North Tonawanda and Tonawanda, each of which maintains a distinct municipal government. It is said to be the second greatest lumber market in the world. Its manufacturing interests are also important and include those of iron, canal boat supplies, agricultural instruments and carrousels, while the towns are rapidly growing in population, having increased from 1400 in 1880, to about 18,000 at present. The district is

being rapidly built up between Tonawanda and Buffalo with which the former place will probably ultimately be united. The terminus of the Erie Canal is in Tonawanda.

The only place of importance between Tonawanda and Niagara Falls is La Salle, 17 miles from Buffalo. This town possesses an historical interest from the fact that it was at this place that the early French explorer, Robert

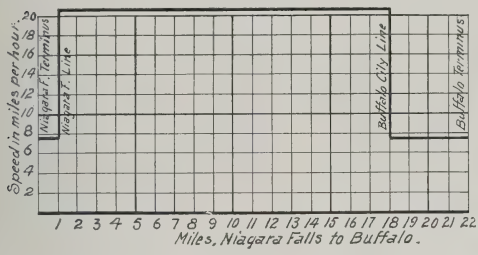
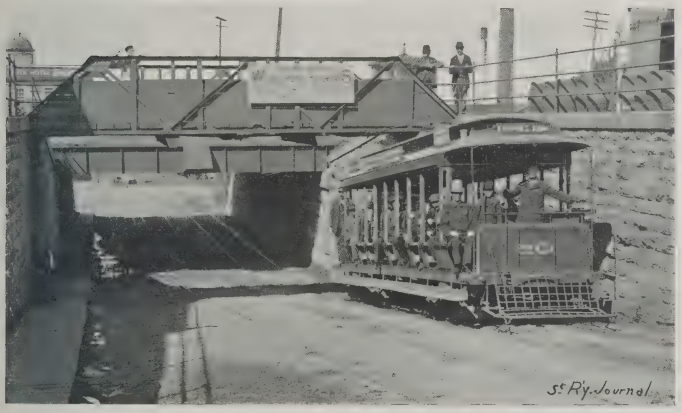


DIAGRAM SHOWING CAR SPEEDS—BUFFALO & NIAGARA FALLS RAILWAY.



13 PER CENT GRADE IN CUT—NIAGARA FALLS & SUSPENSION BRIDGE RAILWAY.

De La Salle built, in 1679, the first boat made by a white man that sailed on the Lakes. The town is the center of a rich fruit bearing region and close to it in the Niagara River, lies Cayuga Island, the site selected by the Pan-American Exposition Company for its exposition in 1899.

HYDRAULIC POWER STATION—NIAGARA FALLS POWER CO.

· · NIAGARA · FALLS · ·

This spot has been an object of interest and admiration to the civilized world ever since the announcement of its discovery by French explorers early in the sixteenth

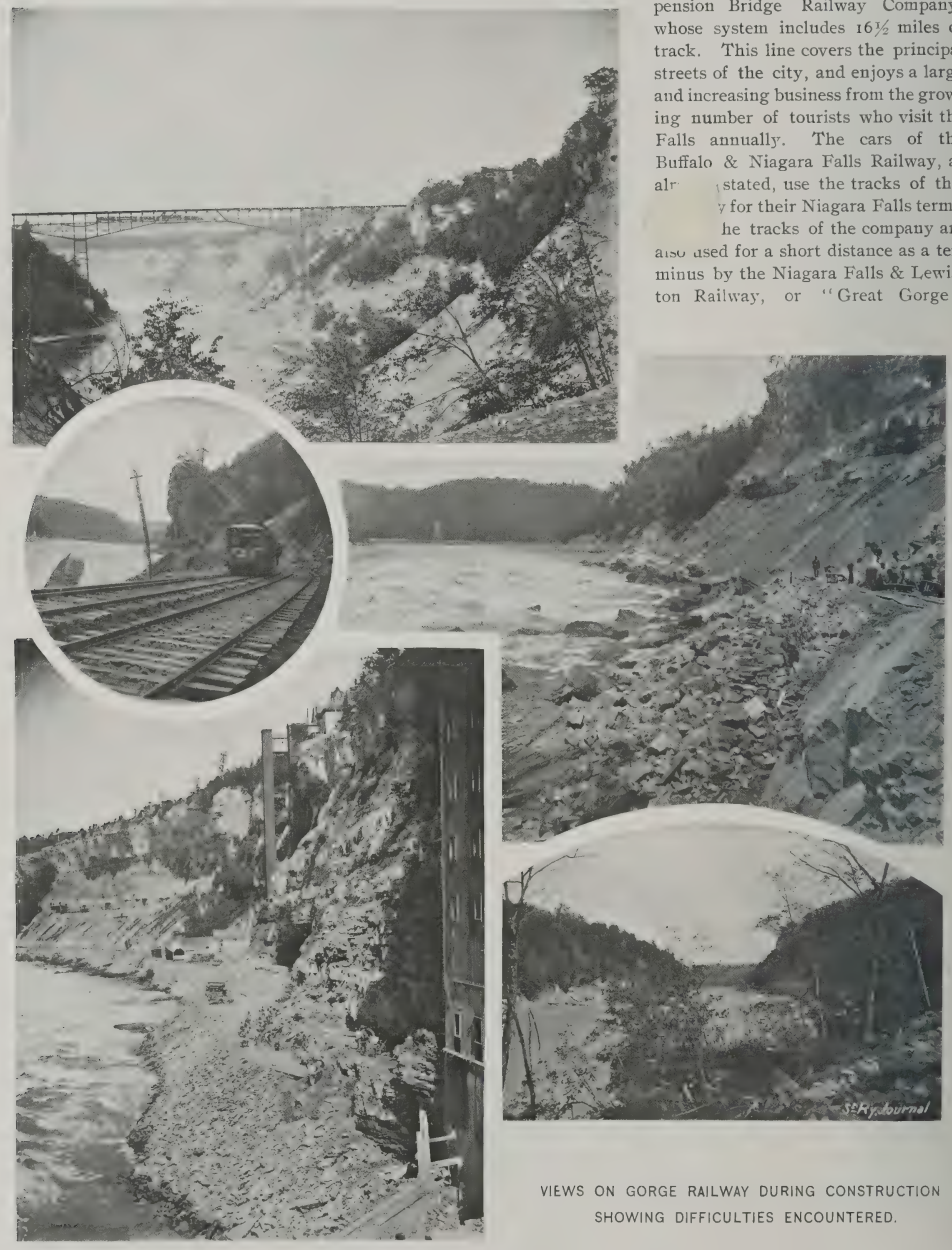
FORT NIAGARA, ON LAKE ONTARIO.

century. It is annually visited by thousands of sightseers from all parts of the world who have found an inexpressible charm and grandeur in its many varying aspects in summer and winter. In 1883, the Legislature of the State of New York passed an act to authorize the selection of a State Reservation in the village of Niagara Falls to preserve the scenery at the Falls, and in 1885 an act to provide for the payment of awards for the land selected. The Reservation comprises a tract of 107 acres, including Goat Island and Prospect Point, the main places of vantage on the American side, and this insures perpetual immunity against encroachment upon the points of greatest interest to visitors. In 1885, the Legislature of the Province of Ontario, Canada, passed an act providing for the appointment of commissioners to select a park on the Canadian side, and Queen Victoria's Niagara Falls Park, which covers an area of 154 acres, extending along the Canadian side of the Falls, was opened in 1888.

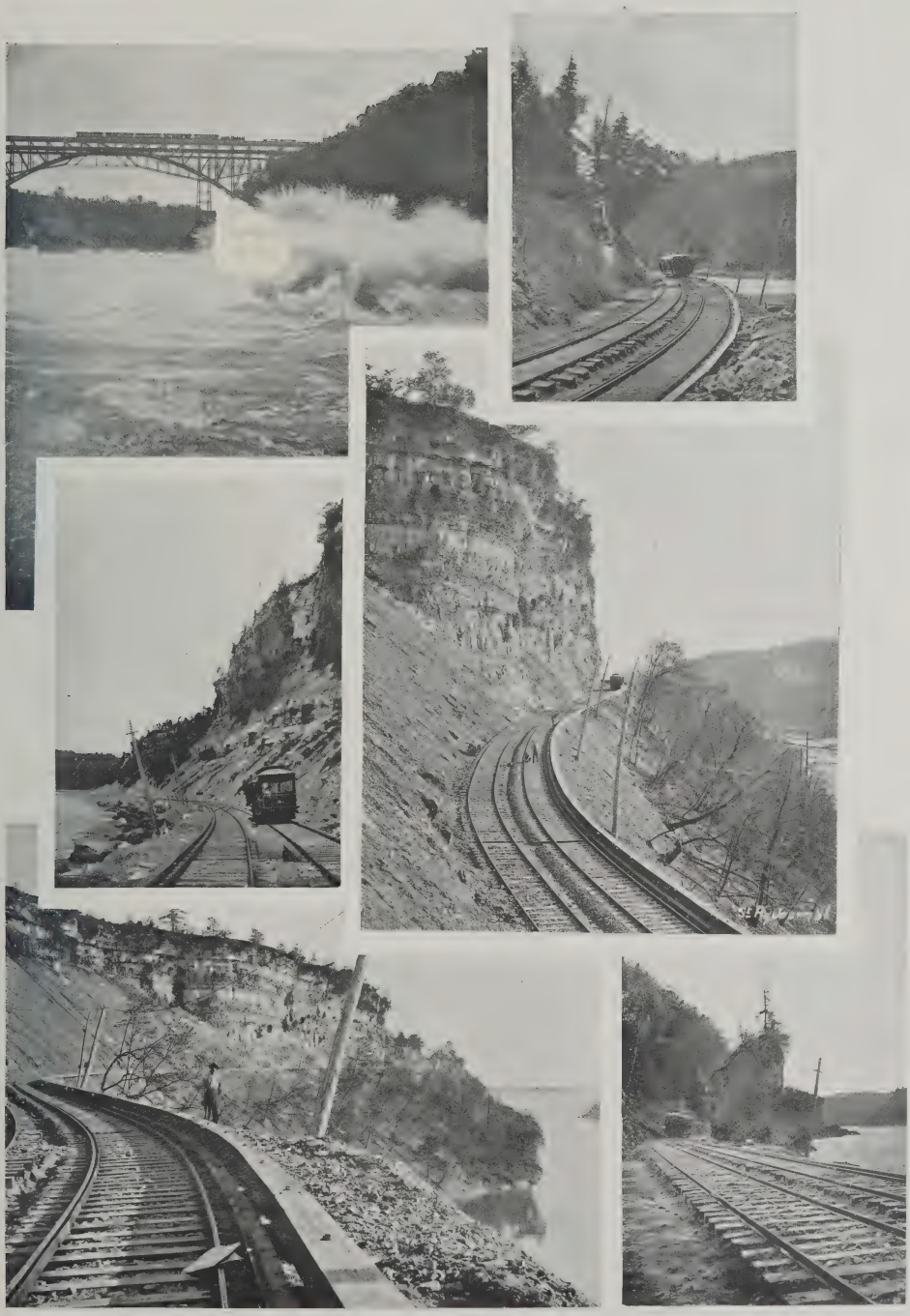
Up to within about ten years ago the extortionate prices charged sightseers for transportation to the interesting points about Niagara Falls were famous. The opening of the State Park and establishment under the authority of the State Commissioners of a cheap and well regulated system of stages at the points included in the State Reservation did

considerable to mitigate the evil. During the last five years, however, the other points of scenic interest have been made most accessible by the establishment of electric railways, so that it is now possible for visitors to the Falls to visit all the points of interest for a reasonable charge, and in a much more satisfactory way than ever before.

The electric railway system in Niagara Falls itself is operated by the Niagara Falls & Suspension Bridge Railway Company, whose system includes 16½ miles of track. This line covers the principal streets of the city, and enjoys a large and increasing business from the growing number of tourists who visit the Falls annually. The cars of the Buffalo & Niagara Falls Railway, as already stated, use the tracks of this company for their Niagara Falls terminus. The tracks of the company are also used for a short distance as a terminus by the Niagara Falls & Lewiston Railway, or "Great Gorge" route. This line, undoubtedly the greatest scenic electric railway in the world, extends the entire length of the



VIEWS ON GORGE RAILWAY DURING CONSTRUCTION SHOWING DIFFICULTIES ENCOUNTERED.



VIEWS ON THE GORGE RAILWAY.

Niagara River Gorge, on the American side for the most of the way within 20 or 30 ft. of the river, and is double tracked throughout. No better way to see the whirlpool and lower rapids which exist in the Niagara River can be imagined than by a trip over this line, and the number of passengers carried is enormous.

The engineering difficulties in the construction of this line were great, and it is undoubtedly the most expensive and difficult piece of surface electric railway construction which has ever been attempted. The line starts from the Tower Hotel opposite the State Reservation in the village of Niagara Falls and descends through a deep cut under the New York Central tracks to the face of the Niagara River canyon below the Falls which it descends until close to the river's edge.

SPAN GIRDER BRIDGE ACROSS NIAGARA RIVER.

The line is a little over 7 miles in length and consists of a series of grades and curves, there being only 700 ft. of level track. The steepest grade is 9 per cent. The construction was begun at Lewiston, Apr. 11, 1895, and completed to the Buttery elevator in seventy-five days, when operation was commenced. The cost of construction and equipment was $500,000, and the right of way, owing to the necessity of purchasing the properties of the elevators at the whirlpool, lower rapids and other points, $530,000. In spite of the expense of construction, the company showed a surplus of earnings from July, 1895, to January, 1897, one and one-half years, $85,000. From January, 1897, to July, 1897, there has been a net gain compared with the same months of the previous year of $13,000.

Across the river from the Niagara Falls & Lewiston Railway, lies the system of the Niagara Falls Park & River Railway, a Canadian corporation. This line, which is doubled tracked, skirts the edge of the Canadian bank from Queenston to Chippawa, a distance of 13½ miles, and is largely patronized by excursionists on account of the beautiful views which it affords.

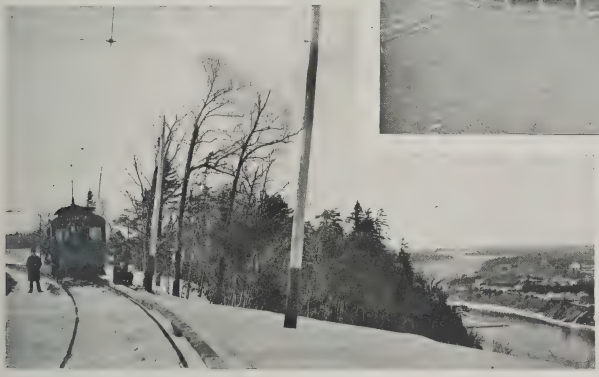
Outside of the railways there are many points about Niagara Falls to attract the engineer. Of these, the two immense power plants are probably of the greatest interest. As is well known, the hydraulic power of Niagara Falls is made available in two ways. The latest power station, that of the Niagara Falls Power Company, is located at Echota, distant about a mile above the Falls. At this point a wheel pit, 18 ft. in width and 178 ft. in depth, has been sunk. The present length of the wheel pit is 140 ft., but it is intended ultimately to extend it to a length of about 400 ft. From the foot of this pit a tunnel through the solid rock, 6700 ft. in length, 21 ft. in height and 18 ft. 10 ins. in width, leading into the Niagara River below the Falls, was constructed. This tunnel has a capacity for acting as a tailrace for 100,000 h. p. The present equipment of the station is three units of 5000 h. p. each, but other units are being added to increase the capacity to 50,000 h. p. The difficulties of obtaining good insulation at the turbines necessitated the extension of the shafts the entire height of the penstock to the surface of the ground where the generators are installed. The generators themselves are of the two-phase type, with a frequency of 25 cycles per second and 2400 volts. Part of the electric power generated at this station is being used, as will be described, by the Buffalo Railway Company, the Buffalo & Niagara Falls Railway Company and the Niagara Falls & Suspension Bridge Electric Railway Company.

The Niagara Falls Hydraulic Power & Manufacturing Company is the owner of another power plant situated on the Niagara River a short distance below the Falls, the

water being conducted to the power house by a canal 4400 ft. in length, 100 ft. in width and 14 ft. in depth. The company is now furnishing about 11,000 h. p. to a number of users, including the "Gorge" railroad and the Lewiston & Youngstown Frontier Railroad, and when the work on its canal is completed will have a capacity of about 100,000 h. p. with the present depth of the canal.

The electric power station is located at the foot of the cliff and close to the river, and is a handsome stone building, 100 ft. wide and 120 ft. in length, but capable of extension to 180 ft. in length. It contains at present four horizontal Leffel wheels of 2000 h. p., each operating under a head of 196 ft. Each is connected to two 600 k. w. General Electric generators. One generating unit operates at 550 volts for railway and miscellaneous power service, the other three are used by the aluminum works and are of the alternating type 280 volts and 2000 amps. each. The present penstock is the largest in the world and is 8 ft. in diameter and is made of 1 in. steel tube. The penstock for the addition now being built is 11 ft. in diameter and composed of 1½ in. steel tubes. The company is now installing a 2500 h. p., double, horizontal wheel which will be directly connected to two generators. The Lombard governors are used on all the turbines in this station and are giving very good satisfaction.

The three bridges spanning the gorge below the Falls come next in interest from an engineering standpoint. The latest, the steel arch bridge, was recently completed by the Pennsylvania Steel Company for the Grand Trunk Railway, taking the place of the original railway suspension bridge.



VIEWS ON THE LINE OF THE NIAGARA FALLS, PARK & RIVER RAILWAY.

LEWISTON

Lewiston stands at the head of navigation below Niagara Falls, with which it is connected by the Niagara Falls & Lewiston Railway, and the New York Central steam line. It is also connected by a boat line with Toronto across Lake Ontario, and by ferry with Queenston across the river on the Canadian side. It is a pretty old fashioned village with many historic associations. Among those who have been residents of the town are General Win-

field Scott, Daniel Webster, who held court here at one time, and James Fenimore Cooper who laid here the scene of one of his novels. The town is at the foot of the Niagara escarpment, and from this point to Lake Ontario, a distance of 7 miles, the region is low and fertile and noted for its production of fruit.

From Lewiston to Youngstown, which is at the mouth of the Niagara River, the only means of communication is furnished by the Lewiston & Youngstown Frontier Railroad, an electric railway built within a year. The road is an air line, and with scarcely a curve the cars speed by miles of apple, peach and pear orchards, until they reach Youngstown, an historic settlement and full of old Colonial architecture. This line does a considerable freight business in addition to its passenger business, employing for this purpose an electric locomotive.

Power . . Stations

The subject of the generation of electric power for railway service in Buffalo and Niagara Falls is extremely interesting from the fact that Niagara power is already used to a considerable extent and promises to meet with rapidly increased adoption. As yet, however, most of the lines outside of the city of Niagara Falls are generating power in their own stations. The exceptions are the Buffalo Railway Company which, in addition to its own steam plant, has now in use two 400 k. w. rotary converters, and is installing two others, and the Lewiston & Youngstown Frontier Railroad Company, which is taking all of its

1.—Buffalo, Bellevue & Lancaster Railway.

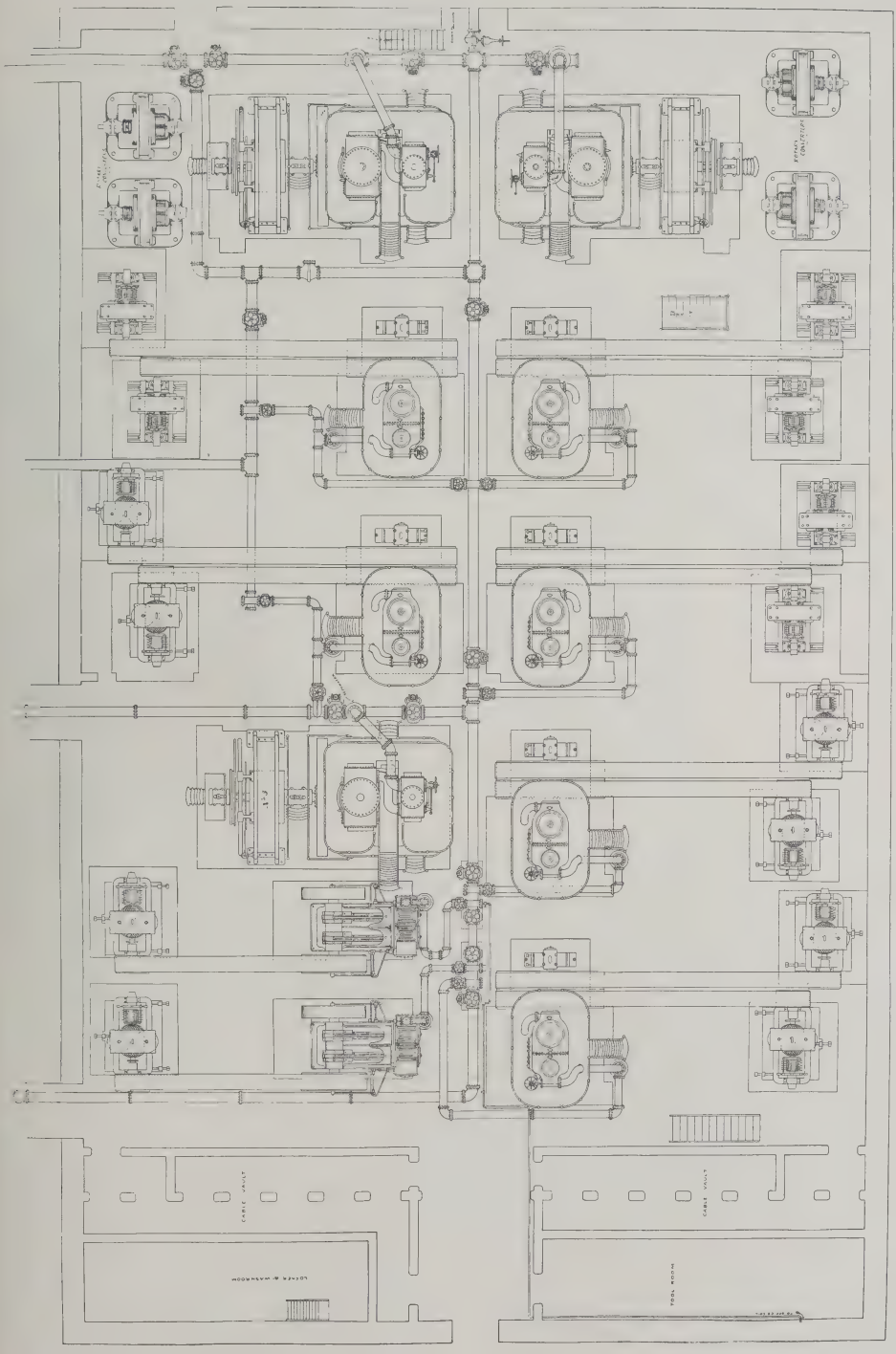
2.—Buffalo & Niagara Falls Railway.

3.—Buffalo Railway.

4.—Buffalo, Tonawanda & Niagara Falls Railway.

5.—Buffalo, N. Main St. & Tonawanda Railway.

GROUP OF STEAM POWER STATIONS.



PLAN OF ENGINE ROOM, SHOWING PIPING AND CONVERTORS—BUFFALO RAILWAY.

power, about 200 h. p., from a direct current circuit from the power station of the Niagara Falls Hydraulic Power & Manufacturing Company, without the use of converters.

The systems in Niagara Falls using hydraulic power, are the Niagara Falls & Suspension Bridge Railway, and the Buffalo & Niagara Falls Electric Railway, from La Salle to the Falls, which take power from the Niagara Falls Power Company, and the Niagara Falls & Lewiston

ent arrangement had to be made on account of the long distance of transmission—26 miles.

In the exploitation of the power of the Falls in Buffalo, two companies are concerned, both offshoots of the Niagara Falls Power Company, which generates and disposes of the electric power. The Cataract Construction Company attends to all the construction work in connection with the power, and the Cataract Power & Conduit

VIEWS IN THE POWER STATION OF THE BUFFALO RAILWAY.

Railway which takes its power from the Niagara Falls Hydraulic Power & Manufacturing Company. The usual arrangement made with the power companies is for the latter to supply the current at the pressure required (500 to 550 volts) and for the railway companies to supply the necessary feeders to take the current away from the stations. The price charged for this service by the power companies is not announced, but is in the neighborhood of $25 per average horse power per year.

In the case of the Buffalo Railway Company, a differ-

Company, as stated, controls its distribution within the limits of Buffalo. The latter, in the case of the Buffalo Railway Company, supplies the transformers and appurtenances, but the rotary converters and appurtenances are the property of the Buffalo Railway Company. While the price paid for the power is not announced, it is safe to say, from the fact that new converters are being installed, that it is less than the cost of generating electricity by steam power in the same station.

Full particulars of the transmission circuit transform-

ers and rotary converters were described in the STREET RAILWAY JOURNAL for December, 1896, and July, 1897. The line between Niagara Falls and Buffalo, which was built by J. G. White & Company, uses the three phase system, with a pressure of 10,000 volts, converted at Buffalo by step-down transformers to 370 volts, at which pressure it is changed by the six pole rotary converters to continuous current of 500 volts for connection to the feeder lines of the railway company. The actual number of kilowatt hours consumed by the Buffalo Railway during May—July, 1897, is shown by the following table:

MAIN GENERATOR ROOM—NIAGARA FALLS POWER CO.

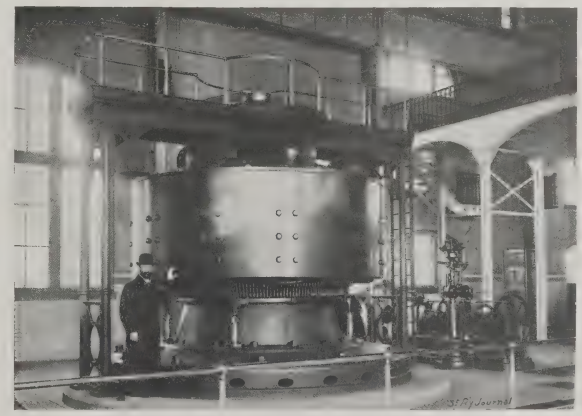
	May.	June.	July.
Kilowatt hours, steam . . .	696,749	677.937	771,699
Kilowatt hours, converters .	465,142	459,645	459,970
Total	1,161,891	1,137,582	1,231,669
Lbs. of coal burned.	3,610,000	3,134,000	3,368,000
" " " per steam k. w. h.	5.18	4.62	4.36

The power station of the Buffalo, Gardenville & Ebenezer Railway is supplied partly by water power and partly by steam power, and the Niagara Falls & Lewiston Railway is considering the proposition of installing its own hydraulic power station, taking power from the Niagara River at the Whirlpool. Twenty-five feet of head can be secured here in less than 3000 ft., and, of course, the volume of water is practically unlimited.

A view of a number of the steam power stations of the different roads is given on page 598. Most of them were built six or seven years ago, and all, with the exception of the Buffalo Railway Company's station, employ horizontal high speed engines connected by belts to generators. In this class of station the Ball engine is most popular, these engines being used in the stations of the Buffalo & Niagara Falls Railway, Buffalo, Bellevue & Lancaster Railway, Buffalo, North Main Street & Tonawanda Electric Railway and the Hamburg Railway Company. The Buffalo Railway Company has also two 300 h. p. Ball units in its power station. The Noye engines are used by the Buffalo, Tonawanda & Niagara Falls Electric Railroad, the Buffalo, Kenmore & Tonawanda Electric Railroad, the Buffalo & Williamsville Electric Railway and the Buffalo, Gardenville & Ebenezer Railway. The power station of the Buffalo Railway Company is equipped throughout, with the exception of the two 300 h. p. units already mentioned, with Lake Erie direct connected vertical engines. Of these the company has furnished three of 1250 h. p. with cylinder dimensions 20 ins. and 44 in. × 30 in. stroke each driving an 800 k. w. generator, and six of 600 h. p. with cylinder dimensions 17 ins. and 33½ in. × 28 in. stroke, each driving by belts two 200 k. w. generators. The vertical engines are reported to be giving good satisfaction, and one objection sometimes urged against their use—the difficulty of reaching the controlling throttle—has been avoided by the employment of an extension handle from the header valve reaching to near the floor. General Electric generators are used exclusively by all the companies.

The power station of the Buffalo Railway Company is equipped throughout with Babcock & Wilcox boilers, with the exception of one unit of return tubular boilers. The boilers are fitted with Roney stokers supplied by Westinghouse, Church, Kerr & Company. The Buffalo, Bellevue & Lancaster Railway uses one battery of Babcock & Wilcox boilers. The other stations are all equipped with return tubular boilers.

Arrangements are made in the case of the largest stations for receiving the coal directly from the steam roads by means of spurs. The Buffalo Railway Company has a most complete coal handling plant by which the fuel is conveyed from a dump, into which the cars discharge the fuel, by an electrically operated bucket chain elevator to a storage room immediately in the rear of the power station, having a capacity of 2500 tons. From this point it is raised by a second bucket conveyor, also operated by an



5000 H. P. GENERATING UNIT—NIAGARA FALLS POWER CO.

electric motor, to the top of the boiler room, and thence by a mechanical belt to a hopper of five tons capacity. From this hopper the coal is drawn into a second hopper, of one ton capacity, mounted on wheels and running along elevated tracks in front of the boilers by means of electric

way Company uses Snow pumps and Worthington condensers, Stratton and Cochrane separators, Goubert heaters; the Buffalo & Niagara Falls Railway, Worthington condensers, Snow and Buffalo pumps, and Phœnix heaters; the Buffalo, Bellevue & Lancaster Railway, Berryman

VIEWS ABOUT THE PLANT OF THE NIAGARA FALLS HYDRAULIC & MANUFACTURING CO.

power. This hopper dumps directly into the stoker hoppers. An ash conveyor carries the ashes to the rear of the station where they are dumped directly into cars and hauled away. Full particulars of this coal conveyor are given in the STREET RAILWAY JOURNAL of November, 1895.

Among the miscellaneous appliances, the Buffalo Rail-

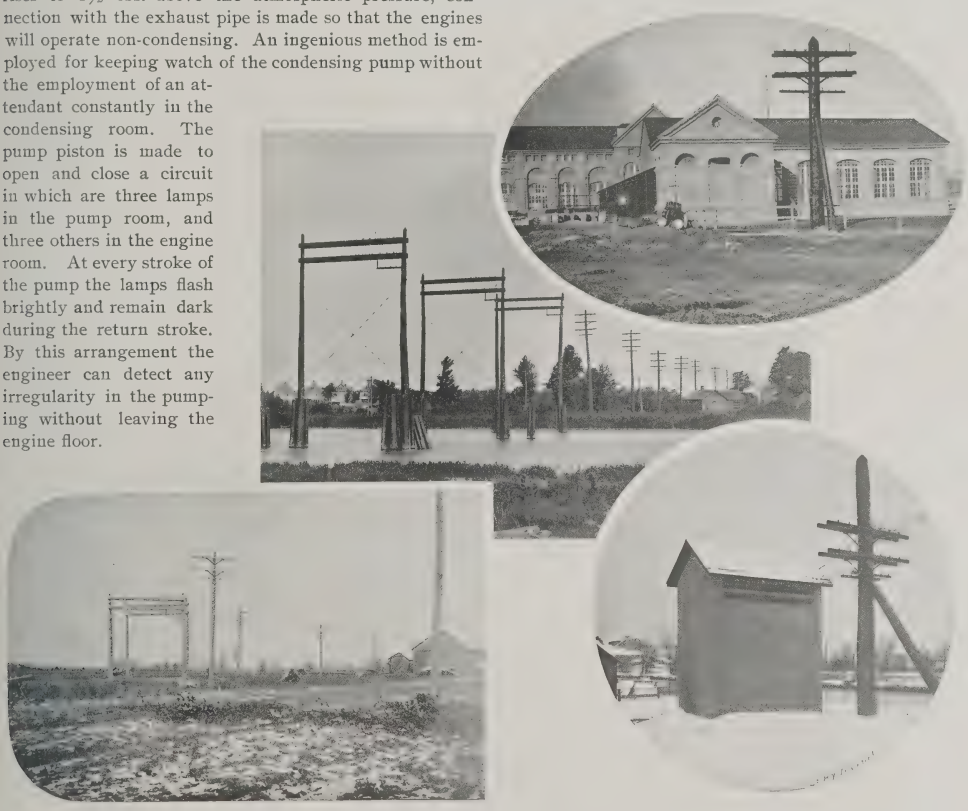
and Canadian heaters, Snow pumps, no condensers; the Buffalo, North Main Street & Tonawanda Electric Railway, Snow pumps and Goubert heaters, no condensers or separators; the Buffalo, Kenmore & Tonawanda Electric Railroad, Barr pumps, Goubert heaters; the Buffalo, Gardenville & Ebenezer Railway, Worthington condensers, Worthington and Snow pumps, and Otis heaters; the

Buffalo & Williamsville, Smith-Vaile pumps and Wainwright heaters.

A complete ground plan of the engine room of the Buffalo Railway Company's power station is given on page 599. The station's condensers and pumps are located in a special room whose floor is 45 ft. below that of the engine room. The well is 10 ft. in diameter and 25 ft. deep, and the water for condensing is drawn from the Erie Canal, 200 ft. away. In case of any accident to the condensing apparatus, an automatic valve is arranged in the exhaust pipe so that as soon as the pressure in the exhaust main rises to 1½ lbs. above the atmospheric pressure, connection with the exhaust pipe is made so that the engines will operate non-condensing. An ingenious method is employed for keeping watch of the condensing pump without the employment of an attendant constantly in the condensing room. The pump piston is made to open and close a circuit in which are three lamps in the pump room, and three others in the engine room. At every stroke of the pump the lamps flash brightly and remain dark during the return stroke. By this arrangement the engineer can detect any irregularity in the pumping without leaving the engine floor.

Track Construction

The track of railways composing the system under discussion presents almost every conceivable variety in character possible, the Buffalo lines being a good example of modern city construction, the lines between Buffalo and Niagara Falls of interurban construction, and the Gorge road that of special construction made necessary by peculiar conditions.

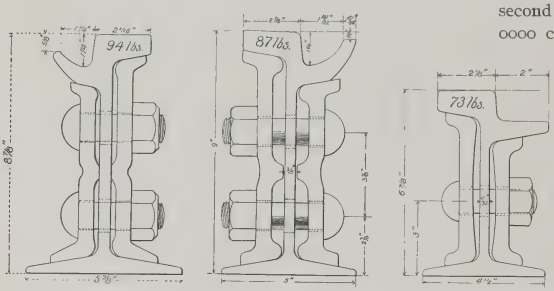


VIEWS OF THE ELECTRIC POWER TRANSMISSION LINE—NIAGARA FALLS TO BUFFALO.

The two rotary converters at present in use and which are of 850 k. w. each, are located in the northwestern corner of the power station and with their switches and all appliances occupy a space of only 24 ft. × 14 ft. In the corresponding space in the southwest corner of the building a duplicate equipment is now being installed. The transformers, which are three in number, are directly underneath the converters. The maintenance of these transformers at a temperature which would not be injurious to the insulation was an important problem and has been solved by artificially cooling them by means of a rotary blower driven by a 5 h. p. multipolar, direct current motor. The air is admitted to the interiors of the convertors and passes out through openings provided for it.

The standard track construction of the Buffalo Railway Company includes the use of a special 9 in. semi-grooved girder rail, weighing 94 lbs. to the yard, laid on yellow pine or white oak ties spaced 2½ ft. centers, with 32 in., twelve bolt angle plates. The bonds are of a special type invented by the master mechanic of the company, Robert Dunning, and are illustrated on page 604. They are attached to the base of the web. The standard special work is of steel, with hardened centers, and that in use was supplied by Wharton and Johnson. A number of manufacturers are represented in the track construction, the last order having been given to the Johnson Company. While most of the Buffalo Railway track is on ties, several miles have recently been laid on concrete stringers without

the use of ties. This construction has been used on streets paved with asphalt. The method employed is to excavate a longitudinal trench for each rail, 24 ins. wide at the top, 15 ins. wide at the bottom, and 17 ins. deep. The rails are laid along the line of route, then bolted together, bonded and tied together with tie rods, for which transverse trenches are made. The rails are then suspended over the trenches by special devices in the position in which they are to finally be, are lined and surfaced. The concrete, which consists of fine broken stone, sharp sand and Portland cement, is then tamped under the rails up to and over the base of the rails. The stone



Buffalo Railway Co. Buffalo Traction Co. Buffalo & Niagara Falls Electric Railway Co.

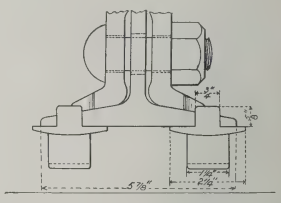
SECTIONS OF RAILS IN USE.

toothing is then put in on each side of the rails, set in concrete or rich mortar, and grouted. This construction is found to cost about $2000 a mile less than tie construction in streets already paved, and so far as the experience of the company has yet shown is quite as durable and satisfactory. The return circuit is very complete, and underground return feeders are extensively used.

During 1891 and 1892, the Buffalo Railway Company installed about 12½ miles of feeder conduits. Each conduit contained from eight to twelve ducts. Two types of duct were used—wooden pulp pipe of the Indurated Fibre Company, and cement lined pipe of the Standard Underground Cable Company. The pipes are imbedded in concrete, grouted and terminate in manholes located about 400 ft. apart. All manholes drain into sewers. The feeders used are the best rubber covered cables of the General Electric Company. No extension of the original conduit construction has been made, although additional feeders have been drawn into some of the ducts, which were at first unused. The general manager of the company states that as compared with overhead feeders he much prefers the latter on account of the lower cost of maintenance.

The rails of the Buffalo Traction Company are laid on steel ties which rest on concrete foundations. Under each rail is a concrete stringer 6 ins. deep and 12 ins. wide which affords a continuous bearing for the rail throughout its length. Across these concrete stringers are rolled steel channel bars, 5 ft. 9 ins. long and about 7 ins. wide on top. They are laid flat side up, with the flanges resting on concrete and are spaced 10 ft. apart, center to center. The rail is held to these joints by forged steel brackets. After the track is laid and bolted to the ties the space between the top of the concrete stringer and the base of the rail is filled with a mortar composed of one part Portland cement, two parts sand and five parts stone chips put in place from one side and pushed under the rail with tamping bars until exposed about 4 ins. outside of rail base. This mortar is then shaped trough form on each side of rail and the trough is poured with Portland cement grout until the base of rail is covered. The concave side of channel ties are also poured full with this grout. The rails are grooved, 9 ins. high, and weigh 87 lbs. per yard. The curves have circular central portions with transition curves at both ends. The initial radius in plain curves is 300 ft., compounded every 3 ft. The inner rail only of each track is a guard rail. The rails and special work were supplied by the Pennsylvania Steel Company. The rail joints are 32 ins. long and have twelve 1 in. bolts. The rails are 60 ft. long. Each second pair of rails in each track are cross connected by No. 0000 copper bonds and in double track line the tracks are similarly cross connected not more than 250 ft. apart. At each joint are two No. 0000 short copper bonds fastened into the rail web under the angle plate. In about twenty-five different places along the lines are return cable taps of 500,000 c. m. cable connected to all the rails at that point and led in ducts designed to prevent electrolytic corrosion of the cable to the side of the street and there connected into an insulated overhead return cable. The return cable taps are connected to the rails with special bond terminals having not less than double the capacity of the cable. The overhead appliances are of the General Electric type. The trolley wire is No. 00 hard drawn copper. The span wires are ⅜ in. galvanized iron stranded.

The Buffalo & Niagara Falls Electric Railway Company uses throughout a 73 lb. 6⅞ in. girder rail of the type shown on this page. It was rolled by the Cambria Iron Company. The section was particularly designed for use on this road, the object sought being the greatest economy of material in the height decided upon with no more waste material in the tram than was absolutely necessary to provide a running surface for vehicles, as imposed by the municipal franchises. The rails are laid on white oak ties of standard steam railroad size, and spaced 24 in. centers. All track is laid on a 2 in. ring broken stone ballast. This on unpaved streets is laid for a width of 18 ft. and from within 3 ins. of the top of the rail to a depth of 6 ins. below the rail, making a total depth of 15 ins. well tamped. A top dressing is made of gravel. Throughout the greater part of its length the track ballast is drained by means of 6 in. to 8 in. tile pipes laid end to end, and connected with the sewer mains or other drains. They are laid in broken stone in the bottom of a trench midway between the two

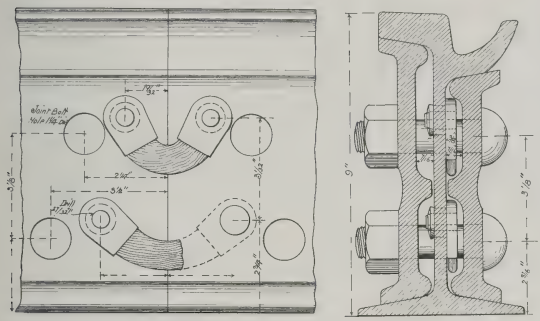


SECTION OF RAIL BASE WITH BONDS —BUFFALO RAILWAY.

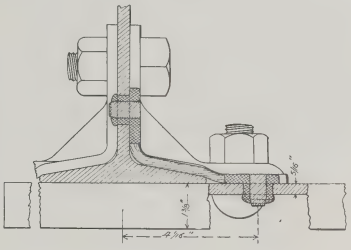
BOND—BUFFALO RAILWAY.

tracks and separated from the base of the track ballast by a layer of cinders.

The Buffalo, Bellevue & Lancaster Railway has also a stone ballasted track with from 45 lb. to 56 lb. T rail, and 1½ miles of 94 lb. girder rail. The ties are 6 in. × 8 in. × 8 ft., laid 2½ in. centers. One mile of track has been laid with opposite joints, but broken joints are considered preferable. The present joints break 8 ft. apart, but 15 ft. is considered more desirable. Chicago and Syracuse bonds are used; the latter are employed on recent work as they are located under the angle plates, and the company does not suffer from their loss through theft.



SECTION AND SIDE ELEVATION OF JOINT WITH BOND—BUFFALO TRACTION CO.

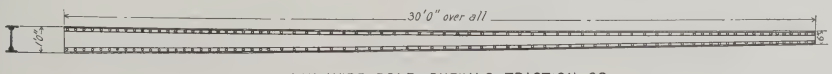


METHOD OF BONDING TO CROSS TIE—BUFFALO TRACTION CO.

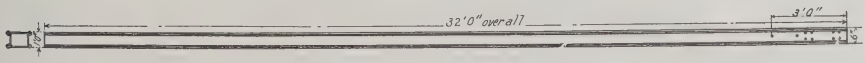
With the exception of the Buffalo & Niagara Falls Railway, all of the interurban lines use T rail in their suburban stretches, the weight running from 45 lb. to 60 lb. to the yard, and for the most part the track is unballasted.

The track construction of the Niagara Falls & Lewiston Railway is the most interesting from an engineering standpoint, on account of the immense amount of special problems presented during the descent from Prospect Park to the grade line established near the base of the Niagara Canyon, and the continuation of the line along the Gorge. In the construction of this road a path was first graded, following as nearly as possible a little above the proposed grade line. The material, of which the talus at the foot of the Gorge is composed, is loose rock accumulated by contributions from the cliff above, with only sufficient earth to fill the spaces between the stones. As it was impossible to determine accurately the quantity of material which would have to be removed, the contract for the track construction was let for 10 per cent of the labor employed, and as soon as this was done, from 600 to 1000 men were put to work at a number of different points along the route. The construction from the Buttery elevator to the city of Niagara Falls was much the most difficult and treacherous of any part of the work. The rock gangs were lowered with ropes from the top of the bank to the first ledge, which in most instances was 100 ft. above the grade line. Blasting operations were carried on mostly by hand, as it was difficult to get steam drills in position to work. Fortunately there was no difficulty in disposing of waste material, this all being thrown into the river without appearing in any way to disturb the same or in the slightest particular to change the form of the rapids below. The vertical cutting averaged nearly 100 ft., and the engineer estimates roughly that about 100,000 cu. yds. of rock were thrown into the Niagara River. At different points along the route a considerable amount of retaining wall had to be built, and at several points embankments had to be projected into the river.

The most difficult point of all was undoubtedly that near the foundation of the Grand Trunk steel arch bridge where the removal of the loose earth and stone was objected to by the bridge authorities, and two sustaining walls, ranging in height up to 27 ft., were constructed, one to keep the earth above the electric track from falling on it, and the other to prevent the earth from under the electric track from sliding into the river. The blasting here had to be carried on with a great deal of circumspection, and a series of holes was drilled back of each set of blast holes before any blast was fired. The track is carried under the bridge piers on a plate girder bridge composed of two spans 54 ft. and 72 ft. in length. The footings, of course, of the abutment and piers of this bridge are under water and are laid on bags of hydraulic cement placed between the boulders and rammed into the crevices. As a further precaution, rods of iron were drifted several feet into the rock and left standing to be built into the masonry. On the inner shore tie walls were built into the bank. There are also a number of trestles along the road. At several points the upper edge of the cliff overhangs the track, but the amount of this is not large and no accident or serious interruption to traffic has been occasioned by slides. Such events are always preceded by premonitory symp-



STANDARD SPAN WIRE POLE—BUFFALO TRACTION CO.



STANDARD PULL-OFF POLE—BUFFALO TRACTION CO.

toms and can be watched for and guarded against. The rails are bonded with Brown plastic bonds. On the side nearest the river the outside rail is protected by a 6 in. × 8 in. guard stringer, extending the full length of the line. Each section of this guard is mitred into the adjoining and is fastened to every alternate tie by lag screws.

The track of the Niagara Falls & Suspension Bridge Railway, the local line in Niagara Falls, is laid with 60 lb. to 73 lb. Johnson girder rail, laid on white oak ties 6 in. × 9 in. × 8 ft. The track is bonded with Chicago bonds and ballasted.

VIEWS ON THE LINE OF BUFFALO & NIAGARA FALLS ELECTRIC RAILWAY CO.

Overhead Construction

The overhead construction on the lines in the territory under discussion is mostly span wire, although the Buffalo Railway Company and the Niagara Falls & Suspension Bridge Railway Company have double bracket poles on certain portions of their lines and one or two of the suburban lines use single bracket construction. The bracket poles on the modern lines are almost universally equipped with flexible hangers. The city lines almost throughout use iron poles, which in Buffalo are of the composite construction, this having been found cheaper and more satisfactory than tubular poles. The Buffalo Railway Company originally used lattice poles, but its standard span wire pole is now a channel pole consisting of a center web tapering to the top and two outside flanges on each side riveted to the web. In the heavier poles a box construction is employed. Somewhat similar poles are used by the Buffalo Traction Company. They are supplied by the Buffalo Bridge & Iron Works and are of four types as follows:

	Length.	Set in concrete.	Maximum deflection at top of pole.
Type No. 1, single track side pole.	30 ft.	6 ft.	4 ins.
" No. 2, double track side pole.	30 "	6 "	4 "
" No. 3, pull-off pole.	32 "	7.5 "	4 "
" No. 4, heavy strain pole.	33 "	7.5 "	8 "

The side poles are set 125 ft. apart on straight line work and the maximum deflection of span wires in straight line construction is 10 ins. in 40 ft. spans, and proportionately in greater or less spans. The cross arms are of cast

iron with bolts clamped around the poles with wrought iron screw pins cast into the arm. The poles on the Buffalo & Niagara Falls Electric Railway are octagonal yellow pine in the towns, and stripped cedar in the country, and are spaced 125 ft. apart, and span wire construction is used. The poles are set 6 ft. in the natural soil and are tamped, and painted with tar asphalt to a height of 6 ft. from the ground, and with white lead above.

The wooden poles used on the different suburban lines

Rolling . . Stock

Almost every variety of electric car is used on some one of the roads in the territory between Lake Erie and Lake Ontario. The shortest are 16 ft. in body length, and cars of this kind are employed on the Tonawanda Division of the Buffalo, Tonawanda & Niagara Falls Electric Railroad and on the

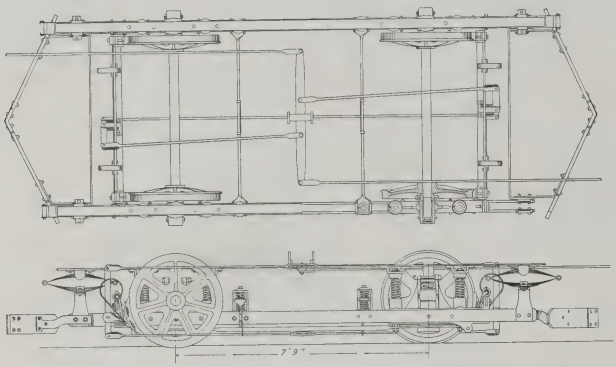
STANDARD TYPES OF CARS—BUFFALO, NIAGARA FALLS AND VICINITY.

leading from Buffalo are generally of cedar or pine, and in some cases have not been painted. The bad results of this are evident in the resulting deterioration of the poles.

On the Gorge road where span wire construction is used, the cliff end of the span wire is usually attached to stakes driven deep into the slope. The company is seriously considering the employment of the third rail instead of the overhead system of distribution; first, because the settlement of the slope throws the overhead line out of adjustment, and second, because of the scenic advantages of getting rid of an overhead construction.

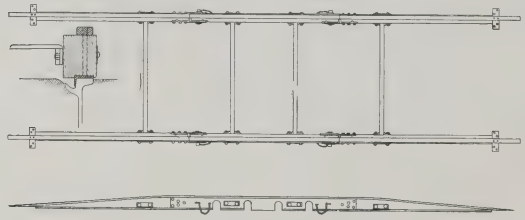
Buffalo, North Main Street & Tonawanda Electric Railway. The standard single truck car of the Buffalo Railway Company is 21 ft. in body length, with 4 ft. platforms, and the general manager of that company considers this size to be as long as can be well used with a four wheel truck. The seats are longitudinal, and in some cars the entrance is at the side of the platform nearest the steps. The tendency of the Buffalo Railway Company is, however, toward the use of long double truck cars. The management has found that as many long cars can be run on a given trackage as short cars and that they can be as easily handled by the same number of men, so

that as they have a greater carrying capacity there is a distinct advantage in their use. The standard eight wheel car of the Buffalo Railway Company has a 24 ft. body and measures 33 ft. over all. Cross seat cars are not considered



STANDARD FOUR WHEEL TRUCK—BUFFALO RAILWAY CO.

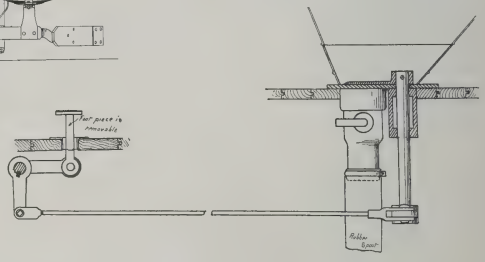
desirable for city traffic by this company. The standard cars of the Buffalo & Niagara Falls Electric Railway are 28 ft. in length over end panels at sill, and 36 ft. over all. They are 8 ft. wide, which allows space for transverse seats and a center aisle. A number of these cars are fitted with baggage and smoker compartments at one end. The cars



HOSE BRIDGE—BUFFALO RAILWAY CO.

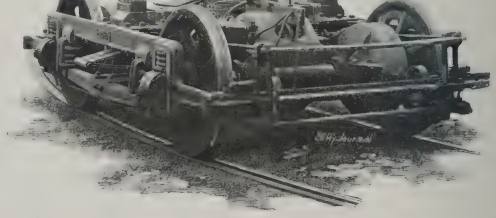
of the Buffalo, Bellevue & Lancaster Railway vary from 24 ft. to 31 ft. body length. The Hamburg Railway cars are 18 ft. body length. The closed cars of the Niagara Falls & Lewiston Railway are almost duplicates of the cars in operation on the Buffalo & Niagara Falls Electric Railway, and have tables between the seats for picnic purposes. The Niagara Falls & Suspension Bridge Railway operates both open and closed cars and also two combination cars, which, however, have not proved very popular for the service in Niagara Falls, where either the open or the closed compartment, depending upon the weather, is most popular. The Lewiston & Youngstown Frontier Railroad uses double truck cars exclusively, of both the open and closed types. The Niagara Falls, Park & River Railway has several observation cars with longitudinal seats arranged like theatre tiers, so that passengers can view the Gorge and Falls more easily. The Buffalo Traction Company is using 21 ft. single truck cars, finished generally after the style used on the cars of the Buffalo Railway.

The cars used throughout the different systems are nearly all of Brill manufacture—a high testimonial to the satisfaction which the construction of this company has given in service. The Jackson & Sharp Company was the manufacturer of the cars on the Buffalo, Gardenville & Ebenezer Railway, and some on the Niagara Falls & Suspension Bridge Railway. The Laclede Car Company also built a number of short single truck closed cars of the Buffalo Railway and the Buffalo & Williamsville Railway, and J. M. Jones' Sons are represented by the closed cars of the Hamburg Railway and the open cars of the Niagara Falls & Suspension Bridge Railway. The cars of the Niagara Falls, Park & River Railway are of Canadian manufacture. Spring rattan seats are used very gener-



SAND BOX—BUFFALO RAILWAY CO.

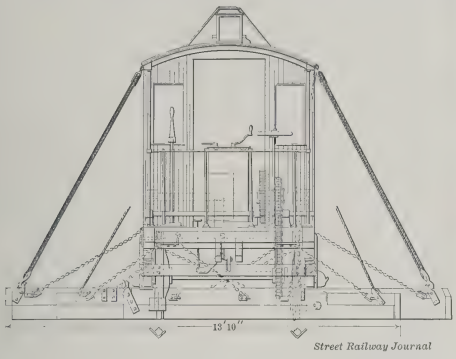
ally. They are of the Hale & Kilburn and Scarritt manufacture. The Railway Register Manufacturing Company supplied the registers used by the Buffalo Railway, Buffalo & Niagara Falls Electric Railway and several other lines. The New Haven Car Register Company, Meaker Manufacturing Company and Sterling Supply & Manufacturing Company are also represented. In the way of swivel trucks the Brill maximum traction truck and the Brill No. 27, seem to be the most popular, the former for the city lines, the latter where high speed is a requisite. The No. 27 truck has been given a very careful test on the Buffalo & Niagara Falls Electric Railway where the conditions in the way of high speed and heavy loads have been most severe. The cars are noticeable for their very easy riding quali-



NO. 27 TRUCK—BUFFALO & NIAGARA FALLS RAILWAY CO.

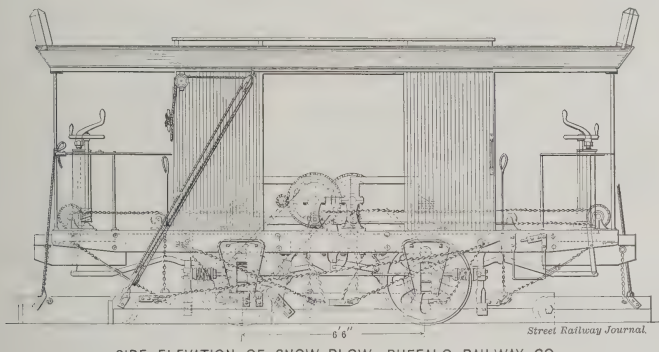
ties, especially on curves, and the management cannot speak in too high terms of their merits. It is noticeable that all the curves having a radius of 95 ft. or greater are traversed at full speed, and none except those leading on

and off the bridges and off switches has guards even on the inside rail. The outer rail of the curves, however, is elevated according to the same formula as that used as in steam railroad construction. The new single truck cars of the Buffalo Traction Company are equipped with the Peckham truck. The four wheel trucks of the Buffalo Railway are manufactured in the shops of the company from designs of its master mechanic and have given such good satisfaction that they have been adopted as standard for future work. The chief merits are simplicity and cheapness. The side bars are of rolled steel separated by an I beam under each pedestal. There are also two McGuire trucks on the Buffalo, Bellevue & Lancaster Railway.



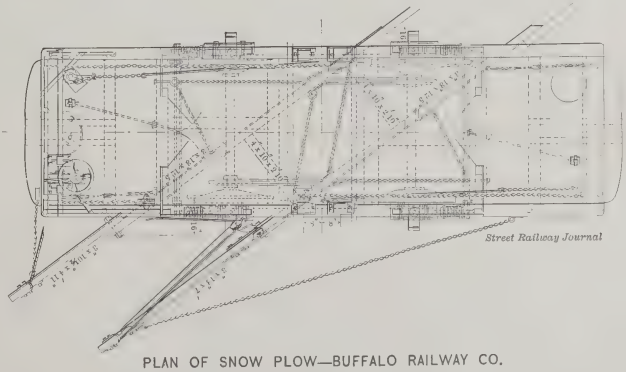
END ELEVATION OF SNOW PLOW—BUFFALO RAILWAY CO.

SNOW SCENE—BUFFALO & NIAGARA FALLS RAILWAY.



SIDE ELEVATION OF SNOW PLOW—BUFFALO RAILWAY CO.

Ruggles rotary plows are used by a number of the different lines. The Buffalo Railway Company and the Buffalo & Niagara Falls Electric Railway have also share plows of their own manufacture which are giving good service. Plans of the former are given on this page.



PLAN OF SNOW PLOW—BUFFALO RAILWAY CO.

The Lewiston & Youngstown Frontier Railroad, and the Buffalo, Bellevue & Lancaster Railway operates each an electric locomotive with satisfactory financial results. That of the former is of 200 h. p., is equipped with General Electric motors and was built by the J. G. Brill Company. That of the latter was originally intended for a snow plow and is equipped with two W. P. 50 motors with twelve turn armatures. It has been in daily use since January, 1893, and the average load hauled is 24 tons, not including the weight of the cars, itself weighing 6½ tons. It has hauled fifteen flat cars around a curve of 75 ft. radius and has hauled 101,000 lbs. up a 4 per cent grade around a 50 ft. radius curve. It is used principally for hauling crushed stone for street purposes from a quarry owned by the company and for transferring coal to the company's power station.

Electric heaters are generally employed, those of the Consolidated Car Heating Company's type being the most numerous.

Almost every type of General Electric motor is represented, and this make is used exclusively by all the roads except the Niagara Falls & Lewiston Railway, part of whose cars are equipped with Westinghouse motors. On the Buffalo & Niagara Falls Electric Railway a special controller had to be employed from the fact that

four G. E. 1000 motors are used on each car, and a low maximum speed with full number of points was desired within the city limits of Buffalo and Niagara Falls, whereas between these points the cars had to make a much higher speed. The result was accomplished by the use of a K 4-12 controller which is fitted with two controller handles, one for the high speed and one for the low speed. The change of controller handles is made at the city limits in each case, the motorman depositing one controller handle in a box, under the supervison of an inspector, before taking the other handle. This precludes the surreptitious use of wide tread or longer hubs required by some companies. The wheels are manufactured almost exclusively by the New York Car Wheel Works, whose wheels give very high records so far as life of wheels is concerned. The Buffalo Railway Company has each of its wheels cast with a small boss on one end of the spokes on which a serial number is stamped,and gives 50,000 as the average life of its wheels; the Buffalo, Bellevue & Lancaster Railway, whose wheels have a less severe service, gives the average life of its New York car wheels as 108,000 miles with a maximum record of 144,000 miles. The Buffalo & Ni-

Interior—Buffalo & Niagara Falls Electric Railway. Exterior—Buffalo & Niagara Falls Electric Railway.

Forest Avenue—Buffalo Railway. Niagara Falls, Park & River Railway Hertel Avenue—Buffalo Railway.

VIEWS OF CAR HOUSES.

the high speed handle within the city limits by motormen who are anxious to make up lost time—an important point in evidence in possible damage suits.

Air brakes have been used on a number of lines, and the manager of the Buffalo Railway Company speaks very highly of their value. This company uses on its Niagara Street line, the axle driven Genett air brake now manufactured by the Standard Air-Brake Company and has also a few Christensen equipments. Thirty-three inch wheels are used almost exclusively by the different companies, and the wheels of this diameter all weigh about 360 lbs. each, slight additions to this being caused by unusually agara Falls Electric Railway has not as yet worn out any wheels, so cannot quote any mileage.

The fenders used on the different cars are of the Buffalo type, and all cars are equipped with fenders except those of the Niagara Falls & Lewiston Railway Company. The Dunning drawbar is used on all the Buffalo Railway cars.

The Buffalo Railway Company is using an ingenious form of sand box, invented by the company's master mechanic and designed to prevent the trouble from freezing up of the sand in winter. The arrangement of the box is shown on page 608; the chief feature is that the valve

is arranged to move inside the car instead of underneath the floor. A hose bridge of the same company is also shown. This consists of several parts which can easily be fitted together. One is illustrated on page 608.

In all repairs of its old cars, and in all new cars which it builds, the company combines on the platform the sockets for the gong, sand box and scraper levers and the brake staff in one malleable iron casting which is set into the platform floor. By this means uniformity in the location of these appurtenances on the platform is secured and the latter is rendered stronger than if separate holes were bored for each rod.

Another device which has been found useful by the Buffalo Railway Company is an emergency truck. This is of the bogie type with 16 in. wheels and is made light so that it can easily be carried in an emergency wagon. It is so arranged that it can be slipped under the front platform of a car which has become temporarily disabled by a broken spring or axle, enabling the car to be quickly hauled to the car house or repair shop.

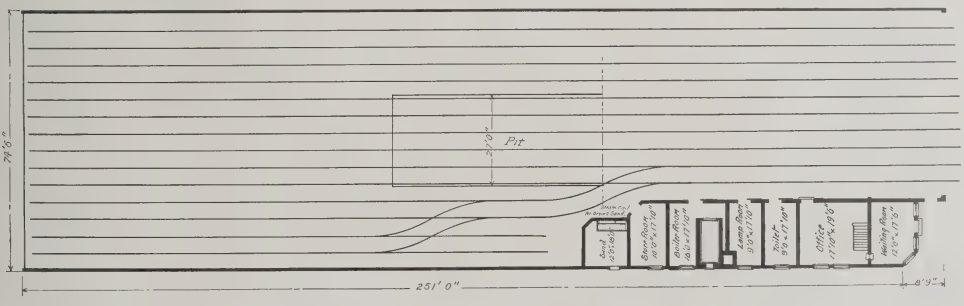
CAR . . . . HOUSES

General views of several of the car houses of the different systems are given on page 610. Of these one of the largest is that of the Buffalo & Niagara Falls Electric Railway, whose car house is located at La Salle. It is 370 ft. × 72 ft. and contains seven T rail tracks with room for forty cars and pits for twelve cars. The floor is concreted throughout and the western or rear end of the car house is arranged so that it can be closed off in winter by means of sliding doors to provide a warm compartment for the cleaning of cars, inspection of motor equipment, etc. The offices are located at the right of the entrance. The roof is of corrugated iron with 1 in. sheating. Heavy iron doors are avoided by making the doors only large enough to accommodate a car, the trolley passing into and out of the building through special slots over the doors. These are provided with double spring doors so that they close after the passage of a car.

The Hertel Avenue car house of the Buffalo Railway Company is the latest built by that corporation and is an excellent example of modern car house construction. It is a steel and brick structure with temporary corrugated iron back for removal in case of the extension of the building in that direction. The entrance tracks are all gauntleted to make the riding of the cars on the main line more easy. The floor, which has not yet been made, will be of concrete. The whole house is heated in winter with

MOTORMEN'S ROOM—HERTEL AVENUE CAR HOUSE.

hot water pipes from a boiler room extending all around the walls and pits. All of the car houses of this company which are equipped with transfer tables use electric transfer tables. The largest two car houses of the Buffalo Railway Company are those at Forest Avenue and Cold Spring. Close to the latter car house are located the repair shops of the company. These are very complete as the company manufactures a great deal of the material used, repairs its own car bodies, paints them, etc. In this connection a valuable feature of practice may be mentioned. The date of the revarnishing and repainting of a car is always marked on the car in an inconspicuous place. An official of the company can readily tell therefore on noticing a car in the street how recently it has been repainted and when revarnished.



PLAN OF HERTEL AVENUE CAR HOUSE—BUFFALO RAILWAY CO

All of the car houses of the Buffalo Railway Company contain special accommodations for the employes, and the comfort of the latter is looked out for in a variety of ways. The rooms for motormen and conductors are fitted with individual lockers, tables at which games can be played, punching bags, and in some cases Indian clubs and boxing gloves, and the men are encouraged to spend their spare time in these quarters.

Engines for Electric Railway Power Stations

By Charles E. Emery, Ph. D.

I HAVE consented to describe for the readers of the Street Railway Journal a number of the more prominent steam engines for operating electric railway generators, and in connection therewith, to make some remarks on the general subject of engine building. The article will, I trust, present a general view of the present state of progress of this important industry in much the same way as if the engines themselves were actually erected for inspection at an international or local technical exhibition. I shall, however, fall short of the opportunities given, in fact of the duties which custom imposes in connection with public exhibitions, if I fail to draw from the general features of the various exhibits, conclusions as to the advances which have been made since the industry has become an important one, or to state the improvements which, in the opinion of the writer, are still desirable and possible. Improvement involves criticisms of the structures improved, but this can be confined to engines in general rather than to the work of any particular person or firm. I propose first to discuss general questions and afterward to attempt to describe without preference, or reference to previous criticisms, such special features as may be observed in the construction and operation of the several exhibits.

The right to speak on this subject can be claimed, perhaps, on account of practical work done in all its branches, and I have been, in a sense, a martyr in the cause. Twenty-seven years ago I was dismissed from the position of consulting engineer of a large flouring mill because I urged the substitution of a compound engine for the antiquated engines therein. The result was brought about, it finally transpired, by the advice of a brother engineer who coached the dignified proprietor to say, after a preface acknowledging the value of previous services, that he lamented my adhesion to a system which had been tried years before and abandoned, the revival of which, with attendant consequences, would not only injure me, but reflect on the engineering profession. I did not succeed then, but did afterward, and to-day where are not compound engines? The old heads which had "figured it out" in their own way and found that no more power could be obtained with a compound engine than would be exerted, with the same expansion, in the large cylinder of the same engine, and declared, therefore, that "the other cylinder only introduced multiplicity of parts, extra friction and loss of effective pressure," can now glibly state that, "while all this is true, the distribution of the difference of temperature through two cylinders is conducive to reduced internal cylinder condensation and materially reduces the steam consumption," almost in the same language as published by me nearly thirty years ago. I was commissioned to build compound engines for the Revenue and Coast Survey services and, with the Navy Department, tested them. The early Navy compound engine practice was based on these experiments. A paper on the subject was published in all languages. I found it, one day, being studied by a prominent Eastern manufacturer of stationary steam engines. The modern compound stationary engines as we find them now were developed from that incident. Much of the general arrangement, and many of the details of our work in the station of the New York Steam Company, are seen copied in the modern electric stations. I know that at least one feature placed there and described in print for the benefit of the profession ten years ago has been patented by an engineer who makes a specialty of electrical construction, and that station managers are paying royalty to him. I feel, therefore, that I have had some influence on the development of modern steam engineering, and claim the right to say, "I told you so," and accept the opportunity to lay the foundation for more sayings of the same kind. Fortunately we can base criticism on a better foundation than that prince of critics, Ruskin. He dealt with art and architecture, largely matters of opinion, modified by precedent, whereas the opinions of engineers are, or should be, founded upon natural laws, at least as to mechanical construction. The strain on every part can be accurately computed. Some details require special study, and new applications require both study and experience, but it will be shown that there is work yet to be done along rational lines, which involves only the application of the simplest elementary principles.

REQUIREMENTS FOR ENGINES FOR ELECTRIC RAILWAY STATIONS.

It is well understood that an engine to operate electric dynamos under the conditions of electric railway practice must mechanically be one of the most substantial of its kind. The loads vary from near the minimum to the maximum and *vice versa*, shift for a moment to an intermediate position and again go through the extremes, making instant changes with startling frequency. An engine must not only regulate under these conditions, but, in its entire construction must be proportioned to stand the racking due to the continued repetition of shocks. In fact, it must be designed as if for rolling mill practice, with the expectation that in many cases the application of the heavy loads will be as much quicker than is due to rolling mill practice as electricity is quicker than ordinary mechanical movement. The strains are greatly mitigated by indirect driving, for instance where the dynamos are operated by belting from an engine in the same way as other machinery. In such case the variations in load exist as before, but their intensity is very materially modified by the flexibility of the belts used for transmission. It may be said that any engine of good substantial design

*We have taken the liberty of slightly changing the manuscript of this article so as to read in the first person singular, believing that in the direct form it will be more readily understood and appreciated by a majority of our readers.—Eds.]

will answer to operate dynamos through belts if it has had its details perfected by actual use in other branches of manufacture and if, on trial, it shows that it has the strength of parts and the arrangement of mechanism to stand continuously the changes of load.

For engines directly connected to dynamos, or "engine dynamos" as we called them at the Columbian Exposition, new conditions arise. Within the space between the bearings on the main shaft usually occupied in great part by the belt pulley, there is located an armature consisting of a simple mass of iron plates and covered copper conductors which is revolved in space without gearing, belting, or any contact with other parts, but which by cutting invisible magnetic lines from the surrounding pole pieces and connecting yokes, generates sufficient energy to absorb the whole power of the great engine to which it is attached, the energy being in such form that it is conducted away to perform useful work elsewhere by simple copper bars, rods or wires of apparently insignificant size. In the presence of such a machine one feels like taking off his hat, much the same as the steam engineer, who, after worrying to place a certain power in the contracted hold of a steamship, sees a locomotive dashing by which develops more power in less space and under conditions in some respects far more trying. But since a locomotive is not adapted for marine purposes, so some engines as ordinarily built are not adapted to form part of an engine dynamo. However, no change of principle is necessary and many of the parts of engines are, in regular practice, constructed of sufficient strength for this kind of work, so that it is simply necessary that particular details be designed for the special duty.

WEAK POINTS OF ENGINE DYNAMOS.

The principal features affected are the main shaft, its bearings and the supports therefor. If everything has been preliminarily balanced and the periphery of the armature run truly concentric with the pole pieces, when the electric current is generated the strains on the engine will simply be those due to variations in load, proportioned to the demand for electric current. If, however, for any reason the armature varies from its central position between the pole pieces, when electric current is being generated the magnetic attraction on the side towards which the armature approaches becomes at once very much greater than that on the other, and if there is the slightest yielding of the parts the armature will be drawn still further out of center. If a permanent eccentricity has been developed the strain and wear on the bearings is enormously increased, and if the action is due to weakness of any kind, an alternating straining action takes place, tending to bend the field yokes or displace the engine bearings. A steam engine cannot be operated without some trifling slack in the bearings, and it is possible that as the wear continues the slack will all be taken up the same way, but any irregularities caused by these facts are small compared to those resulting if the shaft be relatively weak and springs so as to cause the armature to be shifted out of center, whereby the air gap between the same and the pole pieces is lessened in one place and increased on the opposite side so that the magnetic attraction augments the eccentricity. The attractive force of field magnets, forming part of an electric generator, of sufficient size to absorb the whole power of an engine, is relatively very great, and with a weak shaft induces conditions of a destructive character. The difficulties were not fully appreciated in mounting the armatures on the shafts of engines with small power. The torsional resistance of a shaft, which enables it to transmit power, varies as the cube of the diameter, and the transverse resistance at the same rate, consequently for loads corresponding to the strengths of the shafts the deflections would be substantially the same for the same lengths. Since, however, the larger shaft would have greater spread between bearings the deflections would be increased in that proportion. We are, consequently, not surprised to learn that one of the most prominent difficulties early encountered with large engine dynamos was the weakness of the main shaft.

One cannot relate information given by a manufacturer for personal information, neither is it proper to recount the failures of particular manufacturers, but in this case some one manufacturer had to be first in the field, and his misadventure, long since corrected, was for the benefit of all, so it seems proper to say that certain rumors were prevalent, after the first large engine dynamo was started, that on two occasions the armature and field poles were pulled together and ground the one upon the other, making continued operation impossible. Whether in this case the yoke joining the pole pieces was not properly secured to the foundation and increased the difficulty due to a shaft too small for this kind of duty is not known. No one felt like revealing experiences of this kind at the time, but it is hoped that they may come out voluntarily now that the difficulty has so long been overcome. Many manufacturers, by the simple application of a pocket rule to executed work, know that certain changes have been made, without having clear views as to the reason. Evidences of the springing of the shaft may be seen in the operation of many engine dynamos. In some cases with overhanging armatures the motion merely causes their faces to run "out of true" without causing material eccentricity with the pole pieces. In other cases we have seen the springing transmitted through an intermediate bearing by a sort of wave motion, and as the armature was in this way thrown closer to one pole piece than another, the yokes actually bent inward at particular points with every stroke of the engine, so that the motion was discernible with the eye.

It is believed that another rumor, not received in confidence, will be of decided interest. It appears that the competition for the engines of the Central London Underground Railway was decided by this very question. It is reported that the bid of an English firm was the lowest and that of an American firm but little higher, and that the engineer of the American firm simply called attention to the fact that the main bearings provided for in the English engine were only 14 ins. in diameter and 24 ins. long, whereas his were 20 ins. in diameter and 36 ins. long, and he added in a joking way that he "knew by experience his were not large enough." We give the rumor as we heard it, though it may have been modified as it progressed. The engines ordered are authoritatively reported to be of only 1300 h. p. each. Three plans of 2000 h. p. horizontal engines for engine dynamos furnished for this article show main journals 22 ins. in diameter, and the length varies from 40 ins. to 48 ins. In three other plans the journals are smaller. Attention may be called to the fact

that the shafts would be somewhat stiffer if both the journals and the shafts were shortened, even though the space between the journals, and therefore the room around the dynamo, remain exactly the same. The question after all is not one of size of journal, if sufficient wearing surface is provided, but one of size of shaft between bearings, which should be such as to give sufficient stiffness for the purpose. We suggest the use of hollow tempered steel shafts for the purpose.

MASSIVENESS OF APPEARANCE.

The demand for a substantial engine for electric railway service has brought out many of massive appearance. The weight of the framing is in general very much increased and the material is disposed so as to give an imposing and not unpleasant impression in some instances and a contrary one in others. Without referring to any particular case, it may well be inquired whether the extra weight of material, particularly of cast iron, has not been put in some of these engines rather to make an impression than to serve any useful purpose. In every case computation will show where extra material is required and it certainly cannot be right if one designer puts it in one place and another in another.

The proportions of some kinds of machine have been developed from a series of failures. If a part broke down it was made stronger until finally all parts of the machine stood the strains to which they were subjected; yet all engineers can recollect instances where the weakness, or perhaps only springing of one part caused failure in another and realize that, if the first had been corrected originally, the second would have been strong enough.

Many men, are, however, naturally conservative; along the lines indicated is one of Delamater's stories relative to Napier and Ericsson. The latter always calculated the strength of every part, which being referred to, Napier is reported to have said in substance: "Well, John, I find if I make a thing too strong I don't know it," and the response was, "Aye, man, but if you make it too weak?" "Aye, aye, John, then we do know it."

When business is brisk and desirable prices can be obtained, the services of an engineer are not appreciated in competition with a method of designing which simply makes things so heavy that it is never known whether they are weak or not, but weaknesses are frequently overlooked in the effort to put in material so that the apparatus will have a massive appearance. We say without hesitation that the framing of very many engines is altogether heavier than is useful or necessary. There has been, ever since long stroke horizontal engines were constructed, a weakness in the structure as a whole, which permitted slight lateral movements of cylinders, and this constructors have tried to avoid by putting in more metal, and, by increasing the foundations proportionally, the result being that they have finally secured operation without the decided tremors which appear to show weakness. The increase of weight could have been largely avoided if one had stopped following the practice of another, in the line of Napier's makeshift and simply gone back to first principles, which admit of no dispute.

ECONOMICAL DESIGN.

The secret of economical design is to *dispose the material in the line of the strains* as nearly as practicable. As soon as pressure is to be transmitted out of a direct line the question of transverse resistance is raised, requiring much heavier parts and bringing in at once the principle of a common spring. If we support a beam at the ends and load it, it springs. A certain amount of spring is admissible, for instance in floor beams, but if too much were allowed, the deformation of the floor would be noticed and cause distrust; therefore beams are selected not for their ultimate resistance, but by their deflections. In a steam engine when there are transverse resistances the spring is reversed at every stroke, so the parts must be made stronger than in other cases to reduce the motion to a minimum. If there is a lateral motion about the frame or cylinder it follows that there are unbalanced transverse strains. The principal cause of such motions is that the engines are not "self-contained." That is, the forces are not all balanced within the structure itself. In a steam boiler the strains are self-contained, for the reason that the pressure on one head is exactly balanced by that on the other transmitted through the shell, and the composition of the several radial pressures produces direct tensile strain on the metal along every diameter so that the pressures on one semicircle are balanced absolutely by those on the other. Every engine with a double crank and bearing on each side of the crank is self-contained, for the strains on the cylinder head at one end are balanced by the strains in the boxes on each side at the other. Vertical engines are generally self-contained, as they have at least two main bearings on one frame. It is not so always with single crank horizontal engines. The crank pin must overhang the main bearing brass to a certain definite extent and this tends to produce lateral movements which in some cases are, and in others are not, met in the engine proper, and in the latter case movements have resulted which have led to an unreasonable increase in the amount of material at points where it had very little to do with the question.

In the sketch, if $x\,x$ represent the line of main shaft; $v\,v$, a line normal thereto passing through the center of the cylinder, $w\,w$, a line parallel with the latter through the effective center line of engine main bearing, considering spring of shaft and frame; $y\,y$, the center line of outer bearing and A, the crank pin, then if W equal the total maximum pressure on the piston, and m the overhang or distance between lines, $v\,v$ and $w\,w$, the moment or force acting at one foot distance which tends to bend the shaft and spring frame, E, from right to left is represented by Wm or the pressure on piston multiplied by the overhang, for evidently the pressure on the piston is resisted on line $w\,w$, and that on the cylinder head on line $v\,v$, the latter tending to spring the engine laterally around the center, O, of engine main bearing, B; the former tending to displace the outer bearing, D, with a force equal to $Wm \div n$, in which $n =$ the distance between effective center lines of bearings. At any instant the forces tending to displace the engine radially with reference to the center, O, of main bearing is at the same radius equal and opposite to the force tending to displace the outer bearing, D, so if these bearings are connected mechanically, by the main frame for instance, the tendency to displace one is neutralized by that of the other, the engine is self-contained and no motion can take place other than that due to the springing of the parts. In computing these strains it is important to ascertain the effective overhang, m. With

the old fashioned long stroke engines where the main pillow block is merely secured to the frame by two bolts placed vertically one above the other in the center of the bearing and held by keys and nuts, the joint actually opens and closes at every stroke, when the engine is heavily loaded, as is shown plainly if oil has accidentally entered such joint. In such case the effective center of the main bearing is at its actual center and the overhang should be measured from such center to the center of the crank pin in calculating the moment tending to bend the shaft. This distance, compared with the distance *n*, between the centers of the two main journals, gives the relative proportion of the pressure of the piston which tends to shift the outer bearing, *D*, and the moment, *Wm*, divided by the distance to the point of support of the cylinder or guides, gives the pressure tending to displace the engine laterally at that point. With more modern engines, in which the main bearing is better connected to the frame and foundation and the shaft relatively heavier, the effective overhang, *m*, becomes much less; that is, it

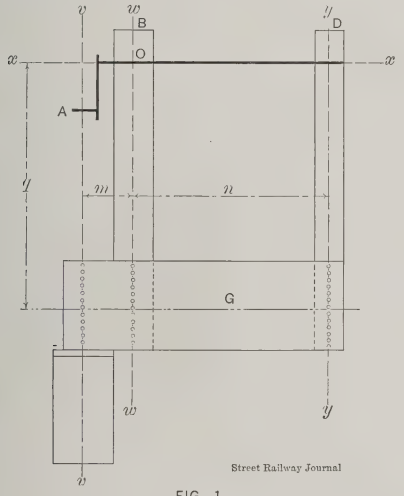


FIG 1.

may be considered not at the center of the bearing, but nearer the crank. In the first case the lateral force tending to shake the engine on its foundation may be in extreme cases as high as one-fourth the pressure on the piston; in the latter case the diverting force may be reduced to one-tenth, but even one-tenth of the maximum pressure on the piston for the distance between bearings is, for a large engine, very important, particularly where the main bearings are not connected either by a bedplate or arm on the frame so as to make the engine self-contained. In vertical engines and in some of the short stroke high speed engines, such a connection exists, both the engine and outer bearing being on the same bedplate, but with long stroke engines, where the flywheel cuts a deep slot between the engine and outer bearing, there are usually two independent foundations for the engine bed and outer bearing, occasionally connected by a low wall or bed of concrete, but generally not connected at all. The side thrust on the engine frame is at the level of the center of the cylinder. It may be resisted where the bedplate or legs of the engine frame join the foundation, if that be immovable, but it is comparatively narrow and frequently rests on earth, which is slightly flexible, instead of rock, so that the lateral force, relatively small though it be, operating at a height of 8 to 12 ft. above the base of the foundation, does rock the foundation and the engine upon it slightly in a lateral direction, or at least give them a perceptible lateral jar, as full pressure steam is taken at the beginning of a stroke. In this way the lateral component of the diverting moment is transmitted from the engine bed to its foundation, thence to the earth below it and through intervening soil to the foundation of outer bearing and through that to the bearing itself, and in this roundabout, or rather down and around way, the pressures are returned and balanced. It appears that in order to make such an engine self-contained it must include as part of itself not only the engine bed and the outer bearing, but the two foundations and the ground beneath them, a construction not very creditable as an illustration of scientific design, but excusable as a matter of expediency and from the fact that it has been followed ever since such engines were first constructed.

It may be said that single crank engines are already operating satisfactorily, although not self-contained, so that the question arises, How has this difficulty been overcome? Simply, as previously indicated, by giving enormous spread and weight to the foundations and widening the engine bed so that it takes hold of the foundation at a large number of points. When this is done the lateral tremor due to taking steam at high pressure at the beginning of the stroke is distributed through so much mass, with so great a base, that the motion is insignificant. In the more modern long stroke engines, the base has been practically shortened by the adoption of a flattened spool-like casting forming the guides and connecting the cylinder to the pillow block bedplate so that all the twisting and rocking strains are practically received by the latter and transmitted to that part of the foundation.

Engines are now being constructed for such severe duty and such high powers that more direct means should be taken to eliminate lateral strains than by connecting independent foundations through the ground; that is, such engines should be self-contained. It will hardly be possible to do this by setting pillow blocks and cylinders on an enormous bedplate, which would, of course, overcome the difficulty, and it is unnecessary, as much simpler devices will answer the purpose. Referring to Fig. 1, *G* may represent the top one of a pair of transverse girders, secured above and below the guides of a horizontal engine, and at the outer ends to a beam connected to outer bearing, *D*, or to the frame of the other engine, if double. Evidently if these girders be of sufficient stiffness and be connected rigidly to the frame along the lines, *v v*, and *w w*, and bearing, *D*, through longitudinal strut on the line, *y y*, the excess of pressure on bearing *B*, compared with that on the main piston caused by by the overhang, *m*, will be transmitted direct to the girders at a distance from the center line equal to the overhang and balanced by two forces, to wit: the pressure on the cylinder head and the pressure on the outer bearing, making the engine self-contained. In practice it will not in general be practicable to put cross girders above and below the guides of a horizontal engine, as this space is very much required for other purposes. They are referred to simply to show the principle, and since attention has been called to the subject I have no doubt that numerous prac-

tical methods will be brought forward to accomplish the purpose. I forbear to give my own views as to the details, for the reason that, having pointed out the difficulty, it is proper to recur to the object of this article which is, principally, to describe the work of others without reference to criticism.

GENERAL PRINCIPLES OF PROPORTIONING ENGINES.

At this point it will be of interest to call attention to the principles affecting the strength of parts of a well constructed engine. The pressure on the piston develops three kinds of strain and the weight of the parts a fourth kind. These are, first, the "projectile" strains which will be explained in a moment; second, the direct strains due to the pressure on the piston; third, the transverse strains resulting from such direct strains, and fourth the strains due to the weight of the parts, such as the crankshaft and flywheel, including, for an engine dynamo, the tractive force of the field magnets due to eccentricity. By the "projectile force" is meant that required to start and stop the piston and its direct connections. In starting the piston the force required to bring it and its attachments up to velocity is not imparted either to the crank pin or main bearings. It is stored as kinetic energy in the moving parts, but the reaction of the pressure on the head of the cylinder tends to move the frame in a direction opposite to that of the crank. That is, as the shot goes one way the gun tends to "kick" back in the other. Toward the end of the stroke these stored forces give up their energy to the crank pin, in excess of the direct pressure derived from the steam, so that there is a tendency to throw the engine as a whole the other way, and this is emphasized when the moving parts are started in the reverse direction. These projectile forces become important only in high speed engines and their effect can be largely neutralized by a counterbalance in a crankwheel. Charles T. Porter, at one of the early Paris expositions, showed a high speed engine in which the piston had purposely been made very heavy so it would absorb energy at the beginning of the stroke and give it out at the end to nearly impart a uniform pressure on the crankpin, although the engine was operated with a very short cut-off, and the Porter engines of to-day in part embody the principle. In all engines the unbalanced projectile action tends to displace the frame back and forth and some part of the engine must be fastened to a suitable foundation with sufficient security to prevent longitudinal motion from this cause. Independent of this projectile action every properly constructed engine should stand on its foundation under the heaviest loads without shifting its position in the least, much less springing or jarring laterally on account of unbalanced strain.

The whole power passes through the piston rod, and in fixing the size of that there is at once given a fair idea of the proper size and strength of other parts required to resist the direct strains due to the performance of work in the cylinder. If it were possible to fasten a horizontal beam to the rear cylinder head of a horizontal engine and extend it laterally opposite to the main bearings, it would only be necessary to connect the main bearings with this beam by struts sufficiently larger than the piston rod to provide for difference in material, alternate tension and compression strains and the greater length. That is, the cross girder would connect the double bearings so as to make the engine self contained, and with some small rods run out to take care of the projectile strains and properly supported guides the engine would run without other foundation than the blocking required to support its weight. The main bearings have, however, to carry also the weight of the shaft, crank and flywheel, and in an engine dynamo, that of the armature or revolving field, also in the latter case, part of the tractive force of the magnets if eccentricity occurs, so such bearings must have considerable width, and in order that they may be equally valuable throughout their entire length, both for weight and propelling strains, they should be well supported and be backed up by a frame of practically the width of the bearing. This frame will naturally be carried back to the cylinder, but the whole section need not, for direct strains, be greater than that of the piston rod plus additions required for difference in material and to keep the girder stable under compression strains. The angularity of the connecting rod, however, introduces a vertical component of strain which must be met by a crosshead with slides running in guides, and either the depth of the frame must be sufficient to resist this vertical component, without appreciable springing, as was attempted originally by Corliss, or the frame under or at the end of the guides must be bolted to the foundation to obtain vertical stiffness, as is the common practice to this day. Each of these several strains is readily calculated, except the liability of excess of strain due to the dynamo, which makes it necessary to fix the size of shaft by experience, and it would be impossible to break down an engine in which the parts were made as light as calculated if all the strains were provided for in the design. In a vertical engine the projectile force is absorbed in the foundation in any case, and it is only necessary to support the cylinders on columns, which, considering their length and the material of construction, are strong enough to carry the weight of the cylinders and the same load as there is on the piston rod. This only provides for direct strains. The lateral strain due to the angularity of the connecting rod will generally be resisted by the more or less clumsy supporting frame, but if the supporting columns are made light, braces must be put in to take care of the lateral component directly.

I once had occasion to reduce the necessary material to its lowest terms in the construction of a yacht compound engine of about 300 h. p. The foundation plate was well spread, but every detail carefully figured so as to make the thicknesses as small as would give the proper factor of safety. The frames were simply four wrought iron rods 3 ins. in diameter with tee ends bolted to the cylinders at one end and across the slots for the mains journals at the lower end, the brasses in the latter being set up with keys. In proper positions, the vertical rods were squared to form guides, and outside the center of the guides were forged lugs containing diagonal crossed holes. Simple rod braces only ⅞ in. in diameter, as I recollect them, where turned down between the threads, were run from the outside of the frames through the lugs at the center of the guides to lugs on opposite sides of the cylinders, there being also nuts each side of the lugs at the guides. Two braces equally light, on one side of the engine only, provided longitudinal stiffness. The speed being high, the cylinders were not large, so that the same, together with the frame,

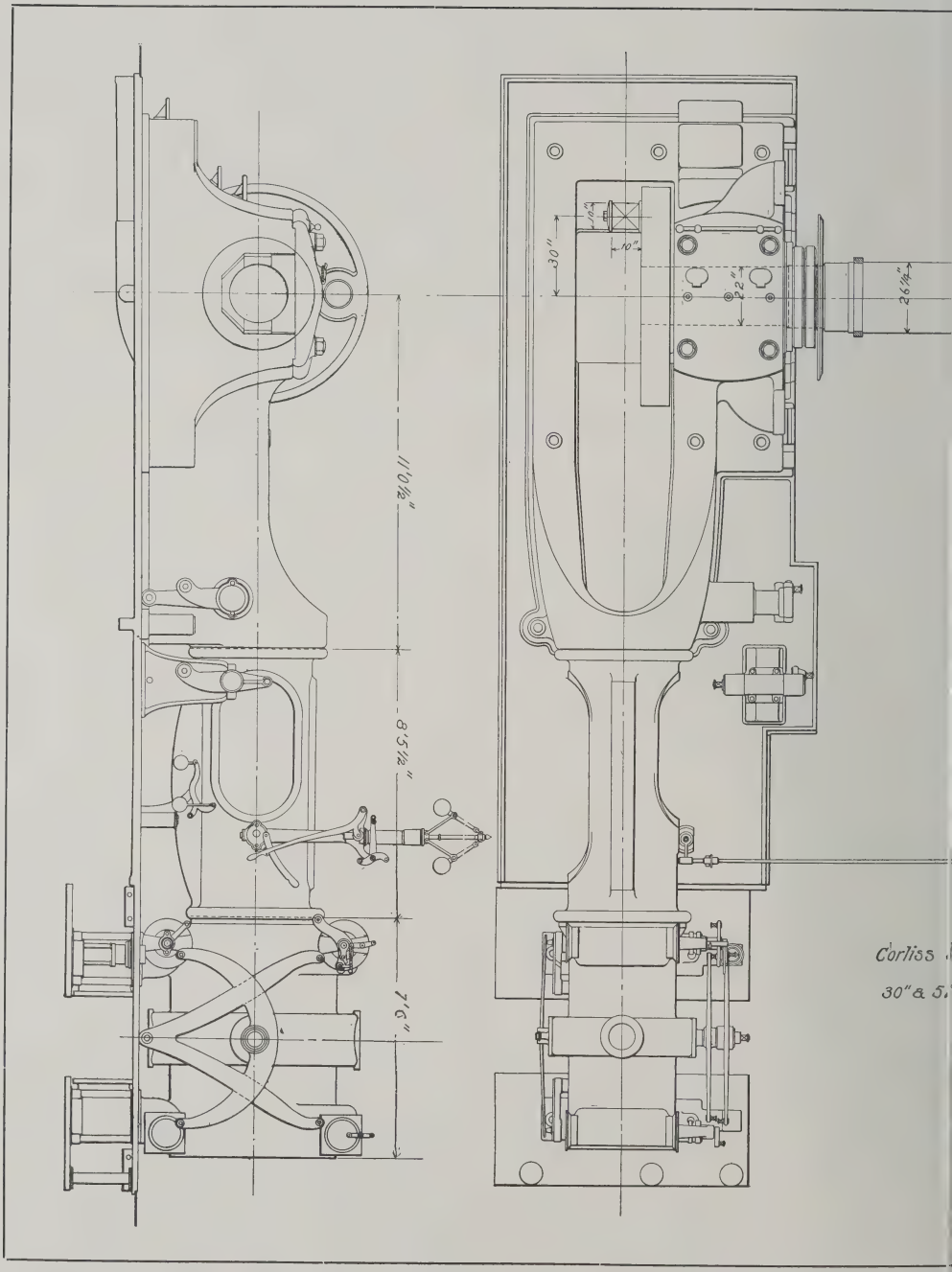
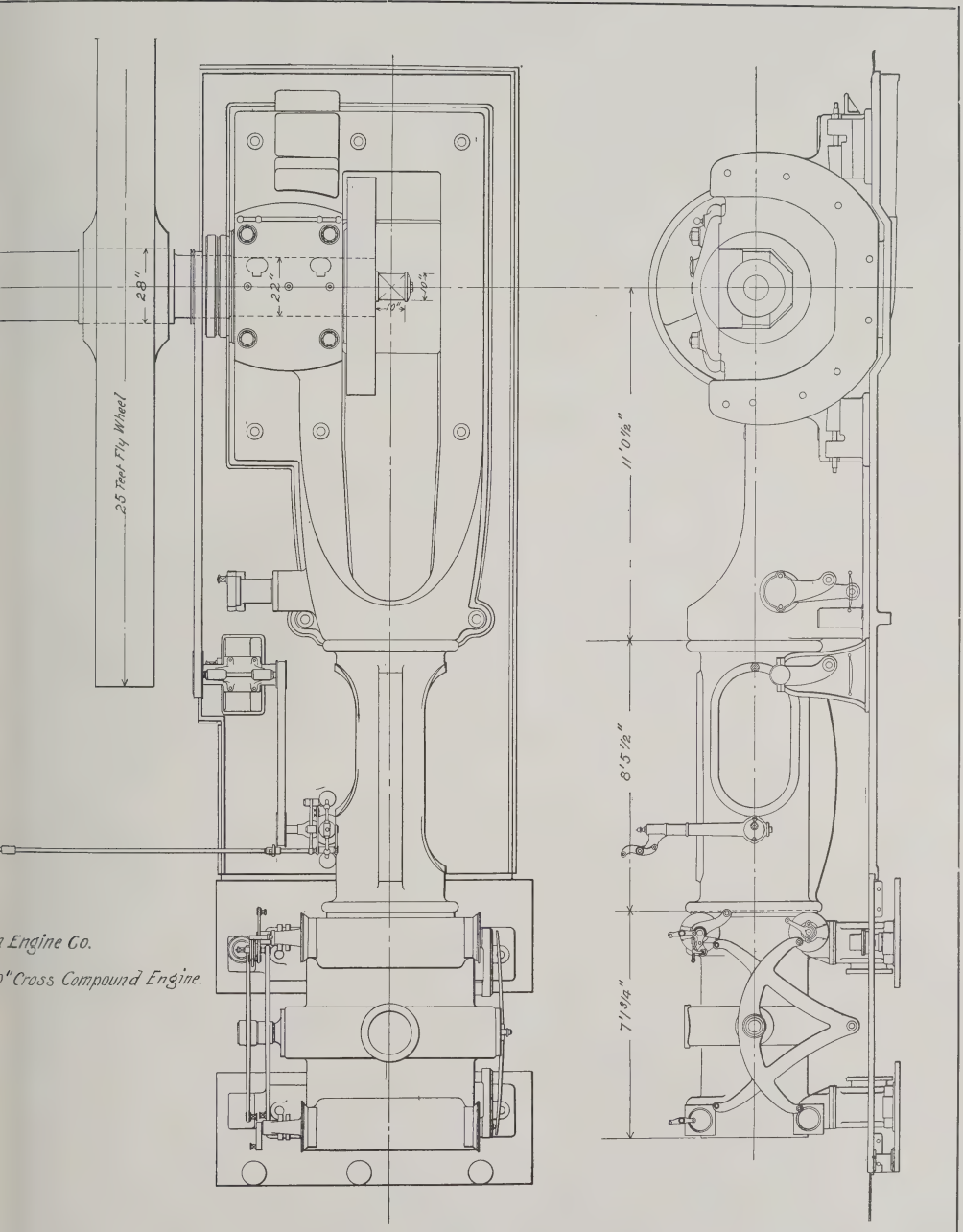


FIG. 11.—PLAN AND ELEVATION OF THE



Engine Co.

"Cross Compound Engine.

GE H. CORLISS CROSS COMPOUND ENGINE.

could be readily lifted off with a ship's tackle in case it became necessary to lift out the shaft. At a little distance the frame of the engine looked like a spider's web and the makers did not conceal from the owner their solicitude as to its success, predicting that the engine would all go down in a heap. Instead of that it was one of the few engines we have seen which was absolutely rigid, and finally the builders, evidently considering they must get a job out of the matter some way, with marked inconsistency, got permission of the owner to put on the spider web frame larger and much heavier cylinders, thereby, by the way, pleasing the owner in making more speed for a short spurt, but on a competitive trial reducing the average speed of the vessel one knot per hour for a long run. It will be observed that this engine was constructed precisely on the principles above stated. The projectile strains and the alignment of the bearings were provided for in the bedplate; the simple vertical columns took the direct strains. The very small diagonal braces provided for the lateral strain introduced through the angularity of the connecting rod, at the very point where this was a maximum, viz., the center of the guides. The vertical columns could have been smaller, except for the fact that in the rolling of the ship the weight of the cylinders would tend to flex the columns at the narrowest point of the whole structure, viz., the center of the guides. This spider web system of construction is, of course, not recommended for engines for electric railway power stations, but it shows the direction in which improvements can be made, and we hope may have some influence in checking the tendency to pile up mountains of cast iron to transmit comparatively limited strains. First look at the piston rod, then at the provision for meeting the transverse strains, then at the framing, and then judge if material has been put in merely to make an impression.

SINGLE CRANKS

The discussion above has so often referred to the subject of single cranks that the question may be asked, Why not build all engines with double cranks? Simply because it is not convenient in all cases to do so, and the overhanging crank pin can be more reasonable in size, is more readily accessible with the hand when in operation to discover signs of heating, the lubricating apparatus is adapted more easily and the crank pin end of the connecting rod is more easily examined, adjusted and repaired. The jar due to overhanging cranks is practically overcome at the present time by increased weight of foundation and distributed fastenings, and with improvements sure to come, in view of suggestions herein made, the system can be adapted to engines of still larger size and for still more severe duty.

HORIZONTAL AND VERTICAL ENGINES COMPARED

Large vertical engines are necessarily of shorter stroke than horizontal engines, otherwise the cylinders would extend so high as to be difficult of access, if not insecure. Short stroke engines are more difficult to make run smoothly and, at the best, are so high that there is considerable labor in climbing up and down to watch and oil the journals. Such engines, however, take less floor space, and with care operate satisfactorily, which form sufficient reasons for adopting them in cities where land is valuable. Moreover, it must be acknowledged that pistons and rods, operating vertically, wear more smoothly than where the same are horizontal. If a practical engineer were asked which type of engine he preferred to take care of, the vertical engine or the horizontal, his choice would probably be the latter type in a majority of cases. All the parts are where they can be watched and every bearing touched readily by the hand. This is true with double cranks, but single cranks are still more convenient.

There is more wear on the pistons and rods of horizontal engines, and instances have been known where the piston in the large cylinder of a horizontal compound engine has scored the cylinder, making reboring necessary, but this is inexcusable with our present knowledge of the facts. Either such engines should be provided with large bearing saddles under the piston, in the cylinder itself, or the rod should be run through the rear head and carry a sliding shoe on a guide or at least be supported in a long sleeve. The second plan is the better one, and one of the early English manufacturers was accustomed to give the rear rod a set downwards in a press so that it would be straight when carrying the weight of the piston on the shoe at its end.

CLASSIFICATION OF ENGINES

Engines are classified in various familiar ways, such as "condensing" and "non-condensing," "simple engines," "compound engines" and "triple compound engines," and there may be "simple condensing engines," "compound condensing," etc. They are again classified by the position of the cylinder, as "horizontal engines," "vertical engines" "inclined engines," etc. There are other classifications which, however, are rarely used for stationary purposes, such as "horizontal direct acting," "horizontal back-acting," "trunk" and "oscillating" engines. For our present purpose, however, classifications based roughly on the speed and again on the type of valve gear are all that will be required. For instance, we speak: first, of "slow speed engines," of which the Corliss engines at a speed of less than 100 r. p. m. are a type, and may have disengaging or positive valve gear; second, of "high speed" engines, or those running at 250 r. p. m. or upwards, and in general provided with lap valves to give the necessary cushioning to permit smoothness of running at such speeds, and third, of "intermediate speed engines" or those in which the speed is between 100 r.p.m. and 250 r. p. m. generally and the valve gear either disengaging or positive according to the particular construction of the engine. The classification by the valve gear would be: first, "engines with detachable valve gear," of which the Corliss is an illustration, and second, "engines with positive valve gear."

It is understood that all these engines have adjustable cut-offs.

SLOW SPEED ENGINE DYNAMOS

There is certainly a tendency at present to use slow speed engines, and in general also slow speed dynamos direct connected; in other words, slow speed "engine dynamos." Since it has been possible to obtain this kind of apparatus in units of 1500 k. w., say, 2000 h. p., many of the larger new stations have been equipped with it. The result is conducive to economy, as the engines themselves are of an economical type, and their aggregation in

a few units reduces to a very material degree the operating expenses of the station.

The construction above referred to may be called the best that is now available; at the same time it is not the only apparatus adapted for the purpose, and there are important reasons why the system will not be adopted in all cases. In the first place, the method of operating dynamos by belts from a large engine is not a bad one. Properly constructed, the friction of these plants can be kept so low as not to be objectionable. The speed of the dynamos can readily be made greater than that of the engine, which reduces their size and cost, since the speed is one of the elements which influence the electromotive force. In some cases also this construction permits the selection of units better adapted for the varying loads.

HIGH SPEED ENGINES

The modern high speed engine has been brought to a remarkable state of perfection. All troubles with hot journals have as a rule disappeared since better tools have been employed to construct all parts of the crank shaft and other parts of the engine parallel or in line, and J. C. Hoadley's adaptation of the shaft governor to an eccentric traversed across the shaft, as in his 80 h. p., portable engine, exhibited at the Centennial Exhibition and carried out afterward by his former assistants, Armington & Sims, with variations of the same, involving generally the same principles, have, particularly in connection with recent improvements, made the regulation of these engines practically perfect and the economy the best that can be secured under the conditions.

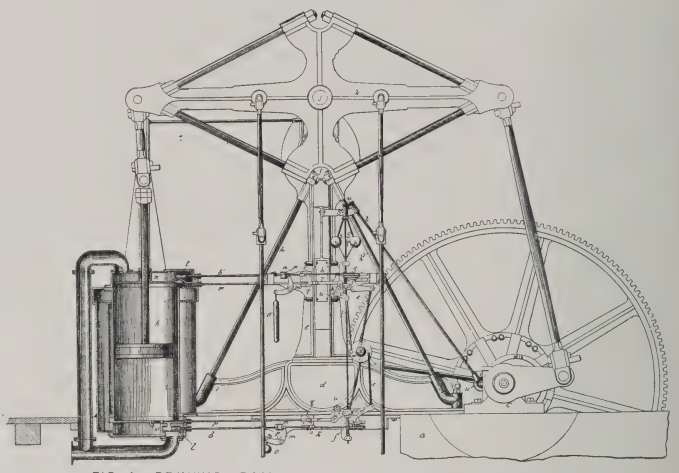


FIG. 1.—DRAWING FROM THE ORIGINAL CORLISS PATENT OF 1849.

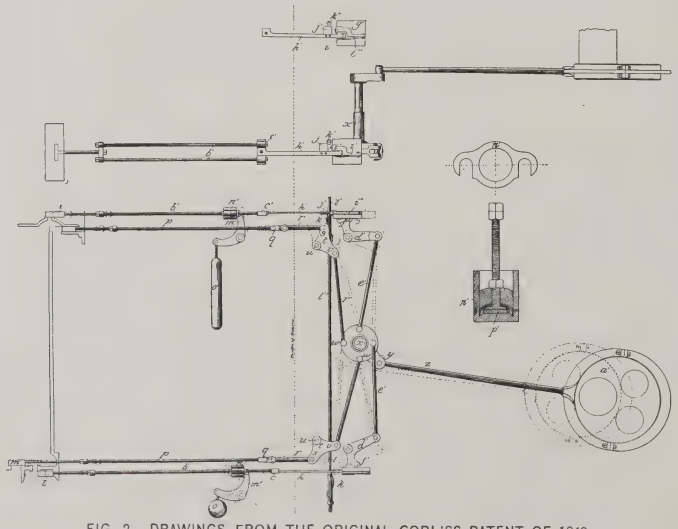


FIG. 2.—DRAWINGS FROM THE ORIGINAL CORLISS PATENT OF 1849.

Of course, if the lubrication of a high speed engine is neglected it grinds out its bearings very quickly, but automatic lubrication is being introduced to prevent such an occurrence. These engines, therefore, have a valuable field in small plants, particularly for electric lighting, but are also available for operating railroad generators. High speed engines, with single valves, and particularly those of non-condensing types, cannot be expected to compete directly in economy with compound engines designed especially to secure it, but there seems to be no reason why they should not be employed for the necessary duplicate or auxiliary plant to be operated, say, regularly during rush hours and as spare engines at other times. The small high speed engine and dynamo cost less, so the interest charges are less during the long periods of disuse, and the extra fuel used during rush hours is such a small percentage of the total costs as not to be appreciable. These remarks apply principally to what are known as high speed, single valve engines running over 200 r. p. m., and not to those of intermediate speed, which will be discussed separately.

INTERMEDIATE SPEED ENGINES

There is another class of engine available for railway power stations which has very many meritorious features, to wit: what we call intermediate speed engines; that is, those run at an intermediate speed between the well known slow speed engines and the so-called high speed engines. The class is a broad one, for in one sense it may include Corliss engines that are run at 100 to 105 r. p. m., but is more generally applied to engines with a positive valve gear running 150 to 200 r. p. m.

The writer had arranged to act as superintendent and take up the manufacture of steam engines at the Novelty Iron Works, New York, some twenty-nine years ago, and then prepared a series of tables of engine sizes, which included, first, the long stroke slow speed engines, then as now favorities, and also a corresponding series of higher speed engines with shorter stroke which would develop the same power when operated at a greater number of revolutions per minute. Even then the successful operation of propeller engines on steamships was so evident that he foresaw that the speeds of stationary engines must be modified correspondingly. The owners decided to close the works and nothing was done, but Professor Trowbridge had the circulars that had been printed rebound with additional matter and exposed for sale. The practice therein set forth has in special cases been adopted, the shorter strokes recommended being employed, for what we have called herein "intermediate speed engines," now run at speeds we did not dream of then; also for vertical engines. The moderately high speeds, even of long stroke engines, have not, however, become so general as I think they should.

GENERAL DISCUSSION ON THE SUBJECT OF ENGINE SPEED

Vertical compound engines in units of 10,000 h. p. and upward with 5 ft. stroke have been successfully operated at a speed of 85 r. p. m. for a number of years on the large ocean steamers, and in "racing" this speed is increased to over 100 r. p. m. Nothing is done on land anywhere approaching these figures and it is probably not desirable so to do. In general, station managers can afford to purchase engines which will require less care and attention at relatively greater cost. Still, the lesson is a good one and it is safe and expedient to operate engines faster than is now generally the rule. Corliss engines with disengaging valve gear are readily operated at 100 to 105 r. p. m. At this speed all parts can be carefully watched and taken care of whether the engine be large or small. The size and cost of the engines and dynamos are materially reduced and there is therefore no reason why this speed should not be universal, practically independent of size, though we realize that very high powers should not be undertaken on this basis until warranted by gradual approaches. The intermediate speed engines with positive valve gear can certainly be run faster than 100 r. p. m. with satisfaction. Vertical tandem compound engines of 1200 h. p. running 200 r. p. m. have been used to operate engine dynamos, but, in my opinion, the speed is greater than is warranted for engines of that class.

On this general subject of speed it may be said that engineers that "go down to sea in ships" like best to operate the old fashioned beam engines making generally less than 20 r. p. m. Every part may be seen and handled while it is in motion; the oilers nonchalantly walk across the top of the cylinders, under the beam or crosshead as they raise for the next down stroke, much as a boy dodges between the street cars, and with far less danger of injury. These engines are almost entirely replaced by vertical engines of three to five times the speed, operating screw propellers. Such engines do the work perfectly; they take less space in the ship, are not nearly so heavy, the method of propulsion is more efficient, so that ships thus provided earn more money. It is therefore useless for marine engineers to prefer the old fashioned engines; they *must* operate the more modern ones.

The conditions in relation to railway power stations are very nearly the same. Of course the engines of slower speed are more desirable in an operating sense, but the high speed and intermediate speed engines operate well; both, but particularly the latter, can be designed to secure economy; so, for financial reasons, if no other, all kinds will be sold. It is on the whole fortunate that nothing we can say will change the preconceived views of some purchasers or the conditions under which others enter the market. Some will have nothing but slow speed engines; with others it is high speed or nothing, for financial reasons, and others, after seeing the intermediate speed engines operate so perfectly, will select them. The progress in mechanical improvements has been so great in recent years that engines of all kinds operate well, and criticism of one as compared with another must be of the general nature above outlined. It is impossible to discuss these questions more definitely without apparently interfering with the business of established firms which have already made their engines successful under particular conditions, the advantages of which can best be described by the parties interested.

THE KIND OF ENGINE BEST ADAPTED FOR ELECTRIC RAILWAY POWER STATIONS

The above discussion shows clearly that it is improper to express a decided preference as to the kind of engine to be employed, classified on the basis of speed. The various questions relating to horizontal and vertical engines may also be considered as disposed of in the same way. It is safer, however, to express an opinion whether compound or non-compound engines should be employed. Simple engines cannot, for economical reasons, be used unless the exhaust steam can be utilized for other purposes. Exhaust steam contains fully 90 per cent of the units of heat originally derived from the boiler, and this allows a liberal percentage for radiation, although in many woolen establishments where high pressure steam is used for power and the exhaust for boiling water, dyeing, etc., the heating value of the exhaust steam is called 85 per cent of that of live steam direct from the boiler, merely to be on the safe side and allow for leakages and wastes that are incident to having plenty of steam. Exhaust steam is generally used at a lower pressure than live steam, so as not to make too much back pressure on the engine, and in such case merely requires that the distributing pipes be larger than where higher pressures are employed. Exhaust steam may be used for heating and for much of the dyeing in a woolen mill, though there are certain classes of goods which are injured by the grease which inevitably comes through from the engines and for such cases live steam must be employed, at least in the later operations. In some cases provision has been made to take the steam from power stations for distribution in the neighborhood for heating purposes during the winter. At an early date, when connected with the New York Steam Company, the author provided for heating water with exhaust steam and circulating the water with pumps for heating purposes, thereby reducing the back pressure and yet enlarging the area of distribution. He did nothing with it, however, except at the Patent Office, but others have been

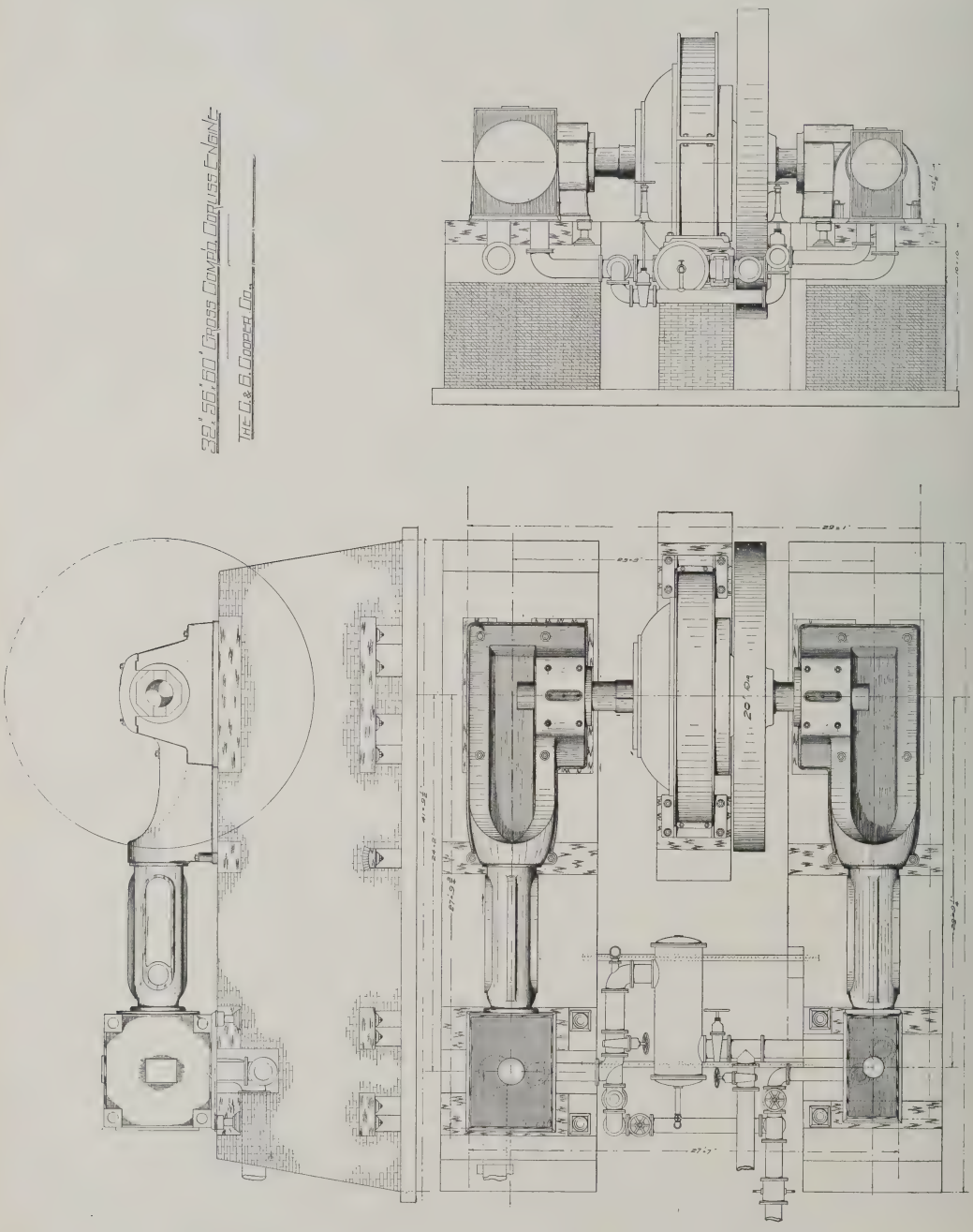
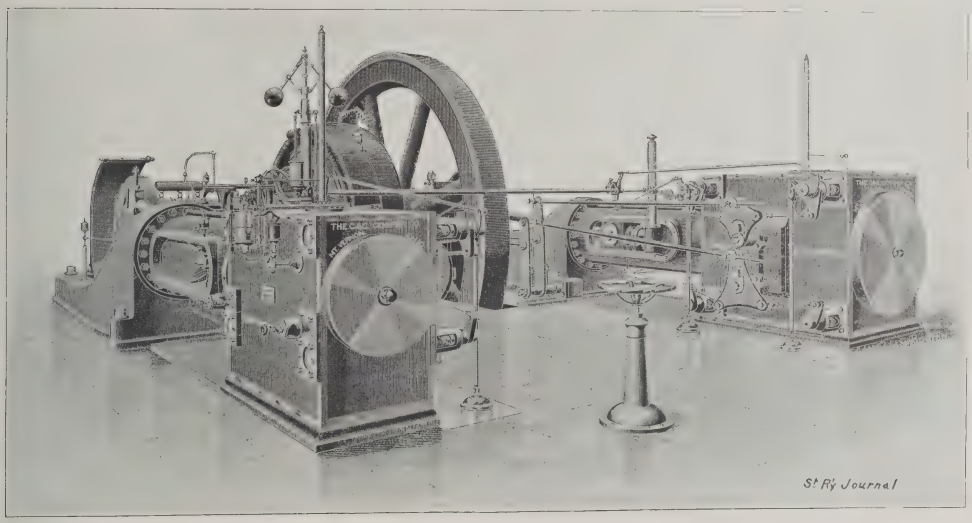


FIG. 3.—PLAN AND ELEVATIONS OF COOPER CROSS COMPOUND CORLISS ENGINE.

working on the subject recently. As steam for heating is only required in the winter, some combination must be made so that the engines will be operated compound if not compound condensing during other seasons.

When steam heating is not available the broad question under this heading is as to the kind of compound engines to be employed; for instance, whether compound or triple compound. This question is settled by the very simple fact that the loads are so variable in electric railway power stations that the triple compound engines cannot work to as great advantage as the compound engines. For similar reasons it is not desirable to attempt as great expansion for the maximum loads as would be employed if such loads were to be carried regularly as in mill practice. The engine will operate most economically if proportioned for about the average load, so long as the capacity of the engine is sufficient to take care of the maximum loads.

sudden shocks due to variation in e. m. f. and power. If the engine is slowed down during maximum demands, the current output is decreased compared to what it would have been if speed had been kept up, at least till the motormen change their regulators, so that the intensity of the demand partially regulates itself. The engine, moreover, acts in a sense to protect the dynamo. The advantages of this system were well proved on the Intramural Railway at the Chicago Exposition. The 750 k. w. G. E. generator with Williams compound engine would take care of the load at full voltage most of the time and only slow down as many cars pulled heavily at once. At present the idea is more interesting than practicable, as it is rarely the case that an engine dynamo will be found of just the right size for a road, and it is doubtful if any one is informed whether or not a number of generators could be operated, in parallel, satisfactorily on this basis.



THE COOPER CROSS COMPOUND CORLISS ENGINE.

The question is a simple one whether to use "cross compound engines"—those in which the two cylinders are connected to two cranks, forming a double engine—or to use a "tandem compound engine," in which the two cylinders are in line, with the piston rod continued from one to the other and then to the crosshead. There is some saving in price by using a single tandem, compared with a cross compound, and for belt driving with a slow speed engine or high speed engine dynamos, the former does very well in practice. For variable loads, at different seasons particularly, the double tandem enables part of the power to be thrown off in a way to leave a complete compound engine instead of a simple engine.

When the whole plant can be run by a single engine there is an element of safety in making the engine too small for the maximum loads, so that it will be slowed down when the demand for current considerably exceeds the rated power of the electric generator. With railroad work it is not absolutely essential to preserve a constant voltage, the energy stored in the motion of a train preventing any

The same question that makes the selection of a compound engine indispensable for electric railway work, and makes it desirable to keep down the expansion, affects the relation of the areas of the cylinders one to the other. One engine builder has especially discussed this subject, which may be referred to hereafter.

INTERMEDIATE CHAMBER OF COMPOUND ENGINES

We note that it is common in stationary compound engines to have a separate intermediate chamber between the two cylinders. This is necessary when intermediate heating is employed, which is of advantage in mill engines running at nearly constant power, but the receiver is considered a disadvantage for engines operating railroad dynamos. The system was given up years ago in marine practice, as it was found that the necessary pipes and passages gave ample capacity to prevent abrupt changes of pressure. A cross compound engine, with small cylinder four-tenths to three-tenths that of the larger, will work

satisfactorily with the intermediate chamber no larger than the small cylinder. This will not be practicable in all compound engines, and is extreme for any case, but a great reduction in capacity, compared with present stationary engine practice, is possible. The effect is simply to make the exhaust line of the high pressure diagram curved instead of straight. The admission line of the low

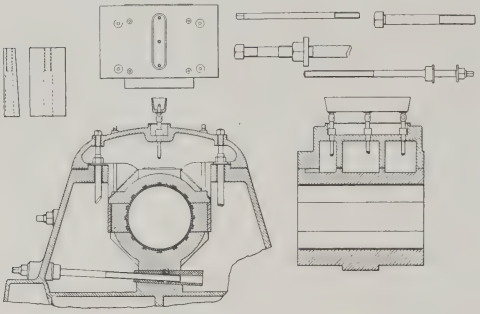


FIG. 4.—BASE FRAME—COOPER CORLISS ENGINE.

pressure cylinder correspondingly inclines downwards toward the center of the stroke, as if wire drawing, whereas the effect is simply produced by direct expansion from one cylinder to another. The lowered pressure in the chamber is restored by compression from the high pressure cylinder. This may not be quite as economical as to keep the admission line horizontal, but within certain limits the difference is trifling and the mechanical advantages great. For instance, the volume of much less steam is to be changed when the cut-off is suddenly changed for the purpose of regulation, so that the smaller intermediate chamber is conducive to more accurate regulation. Moreover, a system of pipe connections without a special chamber is much simpler in construction and appearance.

AUTOMATIC VALVE GEAR

It is believed that in all engines for electric railway purposes the cut-off is automatically adjusted by the governor to regulate the speed, but it must not be assumed that this is the only way to secure reduced steam consumption. With high steam pressure and high expansion, and particularly for work which is practically steady throughout the working day, quadruple, triple and even compound engines may be operated with a fixed cut-off adjustable at will by hand and the regulation performed by the governor, thus throttling the steam and reducing the initial pressure below the maximum. In the Willans engine, it was found in England that the economy was not appreciably affected by this kind of regulation, at least within the limits of power encountered in ordinary mill work. For low expansions the use of the throttle instead of cut-off must cause a loss, but it will be very small when high pressure steam is used. Further investigations to determine the limit can very properly be made in the technical schools now provided with very complete apparatus for the purpose, but the question is hardly practicable in relation to engines for railway purposes. The range of power is so great that the automatic cut-off *must* be used to secure regulation.

Practically only three principles are available in the design of an automatic cut-off: first, a detachable system in which the lead is fixed by an eccentric in opening the valve and the cut-off determined by automatically detaching the valve from the driving part with a governor; second, the riding valve system, in which the lead is fixed by one valve and the cut-off by another riding thereon and automatically adjusted by a governor; and third, the lost motion system in which both lead and cut-off are fixed by one eccentric automatically adjusted. With the first or detachable valve gear the valve is opened positively at such time as to give the requisite lead, which is constant. The valve is locked to the part moved by the eccentric through a pawl or catch which is tripped by the governor automatically, the valve being closed by a weight regulated by a dash pot in the Corliss gear, and by springs or steam pressure, with some form of cushioning, in other gears of the same type. In the riding valve gears, the lead is given regularly by a main valve which also generally regulates the exhaust, as if there were no cut-off. The cut-off valve usually rides over and regulates ports through the back of the main valve, though at times the cut-off valve is a piston valve, the cylinder being carried by the

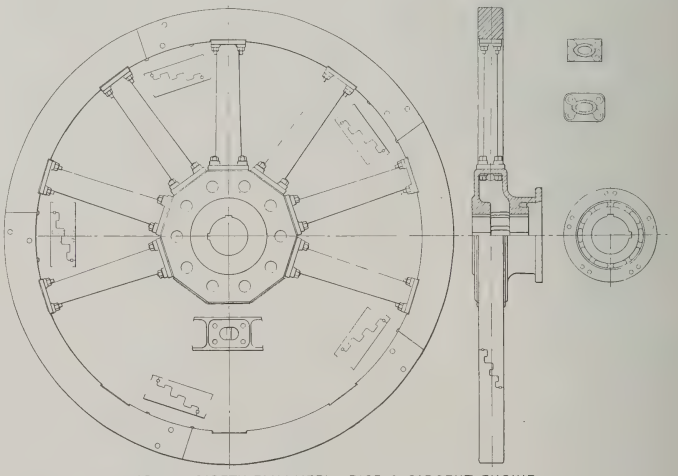


FIG. 5.—SAFETY FLYWHEEL—RICE & SARGENT ENGINE.

main valve. There are two ways to adjust the cut-off, one, in which the motion of the cut-off valve is opposite that of the piston and the time it approaches the ports to cut off steam is regulated by drawing together or separating of the cut-off plates. This is a very common system for riding valves regulated by hand, the distance apart of the cut-off plates being regulated by right and left hand screws. Some attempts have been made to form an automatic engine in this way, the two plates having separate or concentric valve stems operated through oppo-

site arms of a lever, a third arm normal to the first and parallel with the motion of the valve being operated by the governor directly or indirectly. The only form in which this particular arrangement is successful, so far as known, is the indirect one in which the valve is moved by hydraulic pressure admitted through "floating valve gear" by the governor.

In the Rider cut-off on this principle, the ports on the back of the main valve are made inclined in opposite directions and the cut-off valve being made the corresponding part of a V, need only be revolved partially to vary the time that its edges cut off the steam from the inclined ports. This partial revolution is made readily by the governor even when the valve is large, for the reason, that, longitudinal movement of the valve being positively secured by the eccentric, a very slight diverting force will cause the valve to move in a diagonal, thereby changing its angle and varying the cut-off. This system has perhaps not received the attention it deserves. The De Lamater works which first employed it have gone out of this business, but I note with pleasure the fact that the beautiful "Schichau" (German) engine, operating directly a Siemens & Halske dynamo at the Chicago Exposition, was provided with this kind of automatic valve gear.

In the other method of operating the riding valve the distance apart of the plates is not changed, but the angular movement is varied by an eccentric revolved partly around the shaft by a shaft governor. To make this plan practicable it is necessary to combine the movement derived from the governor eccentric with that derived from the valve, which is done by locating the fulcrum of the lever operating the cut-off in the arm of the lever operating the main valve. This construction is on the whole very simple and efficient.

The third system referred to in the design of an automatic cut-off is, as stated, the "lost motion" principle in which the lead and cut-off are fixed by one eccentric. The simplest form is the lap valve, or that in which the ends of a slide valve in mid position lap over the ports a certain distance at each end, called the "lap." If the lap be made equal to the width of one port and the throw of the valve be that required to open the ports, the half motion will be equal to the width of one port plus the lap, so that each port can be open only during one-fourth of the throw of the valve and must be closed—that is, the steam must be cut off—during the other fourth. This does not mean that the supply of steam to one end of the cylinder will be cut off during one-fourth of the stroke of piston, for the reason that the main crank and eccentric are at different angles. The proportions stated, however, insure, with customary lead, a cut-off at two-thirds of the stroke. The general principle is, however, that the steam must be cut off while the valve is moving back and forth a distance equal to the lap. To make such a valve operative the eccentric must be advanced with reference to the crank to give the lead; that is, so that steam will commence to enter the cylinder at or before the beginning of the stroke of the piston; then as the piston moves, the valve will open, but the valve will have reached the end of its stroke before the piston reaches half stroke, as would not have been the case if there were neither lap nor lead, and will have returned and cut off the steam before the end of the stroke of the main piston, which would not have been the case if the valve had neither lap nor lead. In order to adjust the cut-off with such a valve it must be operated by a gear which will keep the lead substantially uniform, when the point of cut-off will be changed by simply reducing the throw of the valve. This condition is secured by the use of a link motion, where one end of the link is driven by an eccentric on the proper side and properly advanced to give the desired lead in going ahead and the other is correspondingly set for going back. The motion at intermediate points will be a combination of the two, the lead remaining only approximately constant and the throw being reduced as the link moves toward its central position and then increased for the reverse motion after passing such center. When the link is suspended to permit only longitudinal motion, it is called a stationary link, and the reversal is accomplished by shifting a radius rod in such link, in which case the lead is constant. When longitudinal motion only of the block is permitted and the link is swung, the lead either increases or decreases as the link is moved toward mid position, the difference depending upon whether or not the rods cross on the side toward or opposite the valve, as can be arranged in the design. In locomotive practice the link is always arranged to increase the lead towards mid position of link so as to give as much width of port as possible as the cut-off is shortened. In automatic engine practice a different result must be obtained, for the reason that steam must be entirely shut off when the link is in mid position, or the engine cannot be controlled when running light. Ordinarily, with automatic engines, the link is dispensed with and it is arranged to shift the center of the eccentric across the shaft by a flywheel governor so as to give practically the same motion as the link; that is, the motion at one limit is that of the go-ahead eccentric in the former case, in the other limit that of the backing eccentric, and if the eccentric be shifted in a straight line between the two points the lead on the average is constant. If the eccentric, or an overhanging pin corresponding thereto, be hung from a pivoted arm, the pin may take the position for going ahead and backing at the two extremes, and still made either to approach or recede from the center of the shaft at mid position, according to the location at the pivot in arm, in the first place decreasing the lead, and in the second increasing it. The first arrangement is almost universally employed for automatic cut-off engines, so that the valve does not open the port in mid position of the shifting eccentric, and the eccentric is in practice only shifted from the go-ahead position to the center.

A lap valve necessarily reduces the steam opening, increases the cushioning and opens the exhaust earlier as the cut-off is shortened. In a locomotive these changes are advantageous. The size of cylinder required to start the train is too large for ordinary running; the throttling, cushioning and early exhaust reduce the effective size of the cylinder, and the cushioning to bring the reciprocating parts gradually to rest and the early exhaust to clear the cylinders before the beginning of the next stroke are exactly adapted for high speeds. Some of these advantages obtain in a single valve engine operating electric generators. The change in the effective size of the cylinder by the cushioning and early exhaust assist materially in the regulation and, with proper proportions, the gear prevents the expansion curve falling below the atmospheric line in non-condensing engines when the load is light. Moreover, the valve gear as a whole, including the

valve, is the simplest known and has such a degree of efficiency that the system is highly useful and important.

A flywheel governor has, on the same principle, been employed to operate independent steam valves, in which case a Corliss gear is frequently interposed between the eccentric and the valves, so that each valve is not required to move through the entire lap, but is simply thrown open and shut again, and the angularity of the connections, on the Corliss principle, reduces the throw of the valve during the angular movement of crank usually occupied by the lap, and the power required to move the valve on its seat when shut is materially reduced. In one engine a cam is attached to the stem of each steam valve, and the operating pin swinging on an arm runs in a concentric slot without moving the valve, until near the time to open such valve, when the pin enters a bend in the slot, opens and shuts the valve and again returns to the concentric portion of the slot where no motion is imparted to the valve.

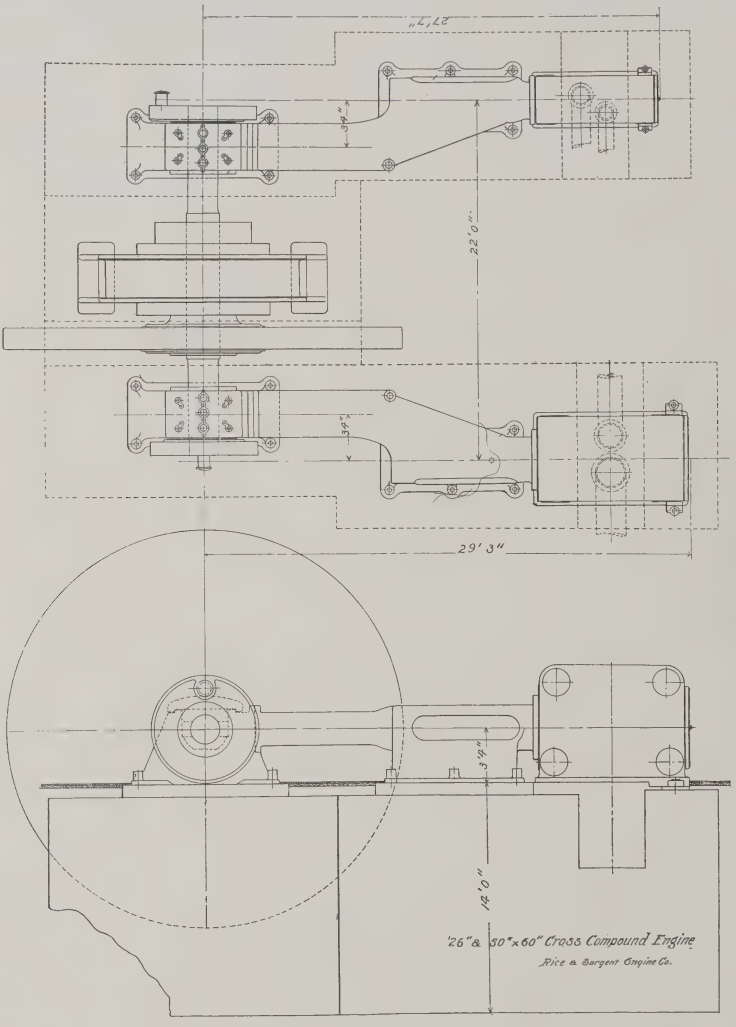


FIG. 6.—PLAN AND ELEVATION OF THE RICE & SARGENT CROSS COMPOUND CORLISS ENGINE.

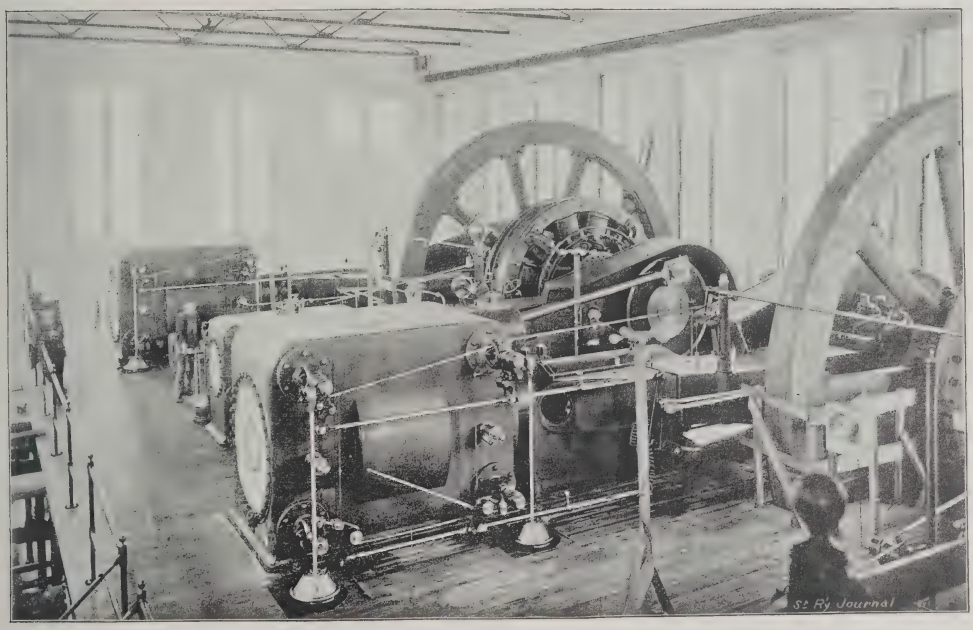
STEAM VALVES

As the pressure of steam is increased the selection of reliable steam valves becomes more and more difficult. The old fashioned D valve, with exhaust cavity under the same, involves so much friction that it is rarely used for high pressure steam without being balanced. For valves operated by a governor, balanced valves of some kind are always employed, as will be shown in connection with the details of the different engines. A box valve or a D valve with the top cut off running under a cover with blind recesses corresponding to those in the seat is quite common and gives opportunity in the construction for double ports. The valve is fitted in its place under the cover so that it is steamtight while moving freely. The piston valve is another equivalent of the ordinary D valve, steam being taken in at the ends and exhausted in the center in some cases, but more generally the steam is taken in the center and exhausted at the ends. Sometimes these valves are fitted so as to be tight and yet move freely, in which case it is absolutely essential that the valve seats be enclosed by a steam jacket so that they will be heated as rapidly as the steam valve to avoid jamming. Valves fitted so as to be steamtight and yet move freely may run a long time without material leakage, or may become scratched and leaky at any time without notice. Manufacturers using such valves, therefore, provide ready means for their repair or renewal. In some cases split rings are used in piston valves to secure tightness on the same principle as in an ordinary steam piston.

It is particularly desirable to select a valve, if practicable, which is held to its seat by the pressure of the steam and not balanced. For a valve governing a single port, the work due to friction is proportioned to the size of the port and the extent of movement. It follows, therefore, that a gridiron valve, in which there are a large number of narrow ports having in the aggregate the area

of a single port, but a very short movement, is the best adapted for the purpose, because the product of the area into the motion is less than for any other form of valve. There is some difficulty in making the design so that the valve chest and the valve operating gear will be simple and effective, but satisfactory success has been attained in this direction, as will appear in connection with the description of engines provided with these valves.

The Corliss or rocking valve is used to a larger extent than any other on account of simplicity of its construction and operation. With a long, narrow port, the pressure upon the valve is not prohibitory, the steam chest is fitted up directly by boring, the valve by turning and the connection of valve gear to an arm on the end of each valve stem is quite simple mechanically, involving only the multiplication of details necessary in any four valve engine. The rocking motion lends itself favorably to the use of Corliss valve gear, whereby the valve is opened and closed promptly, but has very little movement after it is closed, thus reducing the friction by reducing the motion of the valve when shut and exposed to the steam pressure.



THE RICE & SARGENT CROSS COMPOUND CORLISS ENGINE.

THE CORLISS ENGINE

George H. Corliss, of Providence, R. I., by the design and practical introduction of the various distinguishing features of the Corliss engine, built for himself a monument more enduring than bronze or stone, and his work has been an important factor in the great advances of modern civilization due to the promotion of the useful arts by the universal adoption of steam power. His principal invention, patented in 1849, was the automatic adjustment of the cut-off of a steam engine by a governor, thereby regulating the speed. It is true that his efforts were confined to the disengaging type of valve gear, but this was carried out in detail with such perfection that much the larger proportion of the slow and moderate speed engines now built embody not only his principles, but generally the details of his designs. His engine was not only successful in the United States, but was heartily received abroad, resulting in the presentation of the much prized Grand Medal of the French Academy at a time when such an acknowledgement was of great value and duly appreciated. All who visited the Centennial Exhibition recollect the central feature in Machinery Hall, the great double Corliss beam engine, remarkable, as engineers remember, more for its imposing appearance and marvelous workmanship than as the forerunner of the transition period which so quickly followed it. It was then demonstrated that it was possible to make both spur and beveled gears run practically noiseless under a floor carrying delicate watch and other machinery.

There has been such a large number of engines of the Corliss type furnished for illustration in these articles that it has been thought desirable to present some historical features of the early developments of the Corliss engine by Mr. Corliss. It has, however, been impossible to get all the desired material ready in time. I present, however, in Figs. 1 and 2, views taken from the original Corliss patent dated Mar. 10, 1849. They show the disengaging valve gear as it was originally applied to a large beam engine. Four independent sliding plate valves were employed in this engine, instead of the rocking valves which later became identified as a special feature of the Corliss engine. As shown in Fig. 2, the wrist plate and the connections therefrom were practically identical with the same features in more modern engines. The valves

move horizontally and were operated through bell cranks, the motion of the exhaust valves being positive in both directions. The motion of the steam valve was positive in opening, and when disengaged by the governor was closed by a weight operating through a bell crank, the shock being controlled by a dash pot of a form shown in one of the smaller figures. The exact details are unimportant, but it will be seen that all the distinguishing features of the modern Corliss gear are embodied. I am indebted for these views to Thomas D. Stetson, patent solicitor, who informs me that the patent was reissued and divided twice, the first time in 1851 when the only change was to remove the word "centrifugal" so as to make the invention applicable to all kinds of governors. Afterward, however, the patent was reissued in six parts and the six patents all extended in 1863.

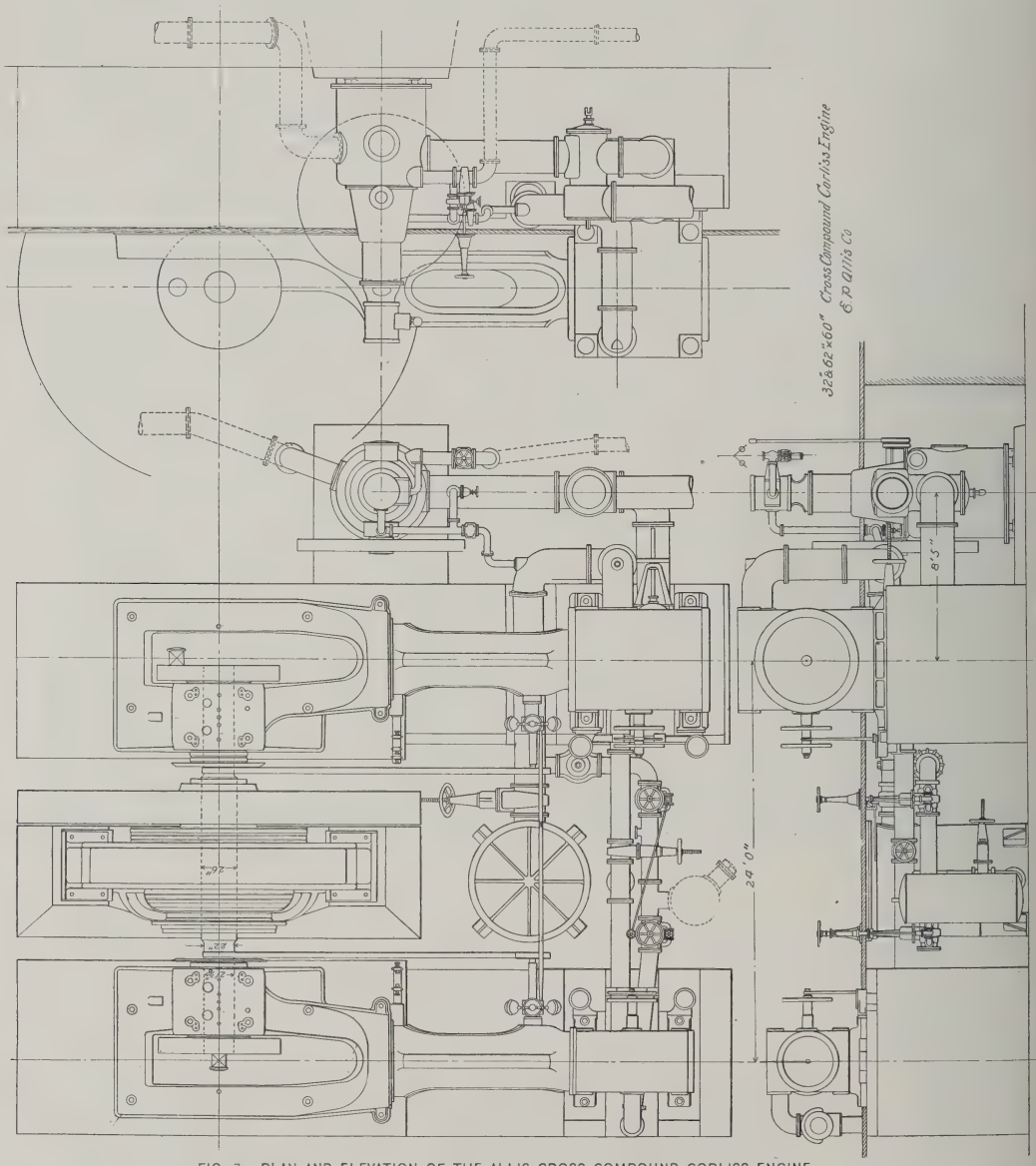
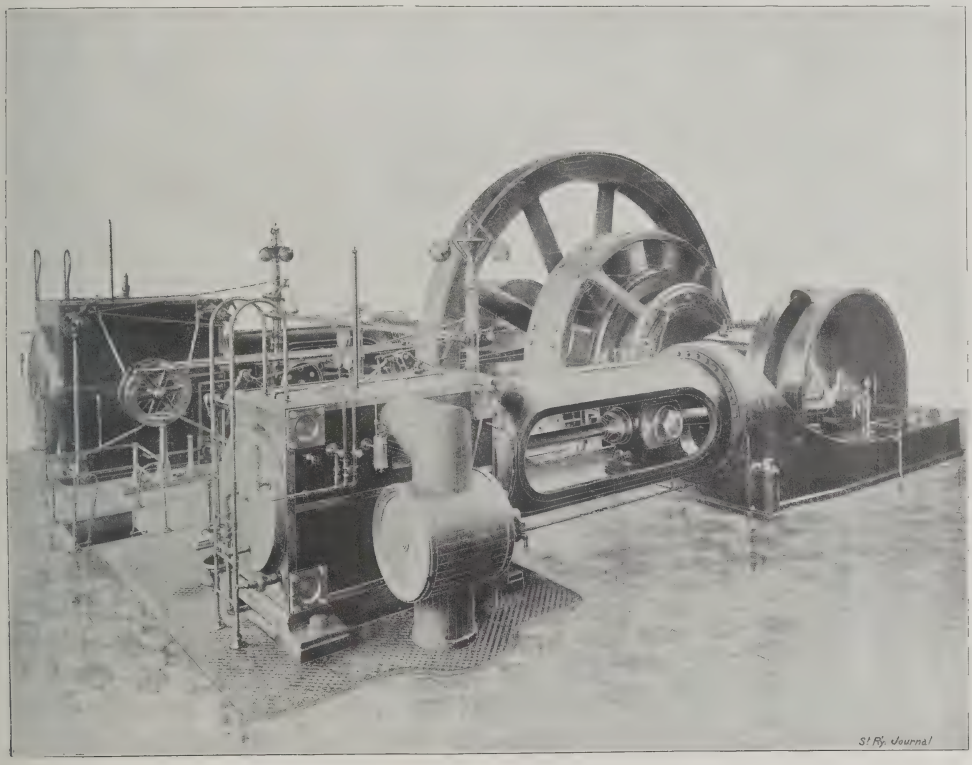


FIG. 7.—PLAN AND ELEVATION OF THE ALLIS CROSS COMPOUND CORLISS ENGINE.

A few of the original Corliss and Nightingale horizontal engines are still found in operation in different parts of the country, particularly in the East. In one early type the frame was simply a straight ribbed strut bolted

at one end to the pillow block and at the other to a projection on the side of the cylinder of the same size as the frame and looking like a continuation of it. The projection was, however, an open box, the steam valve stems, if we recollect aright, passing through sleeves cast in the box with external stuffing boxes so that the operating arms were outside the line of the frame. The exhaust valve stuffing boxes were, however, underneath the box on the cylinder in the customary location.

Fig. 10 (page 631) from a tracing of the Corliss Steam Engine Company, shows the form of the frame during one of the early transitions of which I have not learned the date. The cylinder was apparently about 17 ins. diameter with 48 in. stroke of piston. The frame was a ribbed casting, with horizontal web; the flanges were of uniform depth vertically with the cylinder and guides bolted to one of the same. The width of the girder horizontally was the same as that of the main bearing at one end, but the back curved outward to a greater width at the guides and gradually reduced to the thickness of metal at the end of the cylinder. This construction was known as the "whaleback" frame. The cylinder, the guide casting and the pillow block were supported on legs, the rock shaft had bearings under the guides and transferred the motion of the eccentric from the rear of the frame to the front so that the wrist plate, cut-off and exhaust gear were on the front or crank side of the engine instead of the rear as in later practice. We see in the legs of this engine the beginning of the curved forms and rounded edges which added so much to the attractive appearance of the later Corliss engines. As will be seen, the slides support the crosshead at a point between the cross head pin and piston, an arrangement conducive to simple construction, which was continued for a long period afterwards, but, as engines of larger size and greater power were built, was found to introduce vertical bending strains in the piston rod, so that the system was finally abandoned for one in which the guides are supported practically above and below the cross head pin. As is well known, the typical form of Corliss frame, succeeding the whaleback type illustrated, was one in which the cylinder end of the girder was brought into a circular form to connect directly with the end of the cylinder, and guides in partial continuation of the cylindrical portion were carried toward the crank in the form of curved ribs attached to the flange of the frame. For many years these frames were supported entirely by the legs on the cylinder at one end and those on the pillow block at the other, but later a stud was carried down to the foundation near the middle of the frame or practically under the governor spindle. Some of the Corliss engines hereinafter illustrated show a modification of this form of frame, the origin of which is unknown to me, in which the principal weight and spread is concentrated in the vicinity of the main bearing.



THE ALLIS CROSS COMPOUND ENGINE.

GENERAL FEATURES OF THE SEVERAL LARGE CORLISS ENGINES ILLUSTRATED

From the large number of plans of engines sent to the STREET RAILWAY JOURNAL for presentation in this series of articles, the plans of six cross compound Corliss engines, each adapted for direct connection to an electric generator, have been selected for illustration in this number. The engine constructed by the Corliss Steam Engine Company, of Providence, R. I., has been represented on a larger scale than the others and the plans given in inset form in recognition of the fact that this company has succeeded to the business founded by George H. Corliss, the original inventor of the system, and the further fact that the engine appears to represent present practice. The other engines have been reduced to the same scale so that the relative sizes and proportions will appear at a glance. A general inspection shows that these engines are in many respects very nearly alike in appearance and in details of construction.

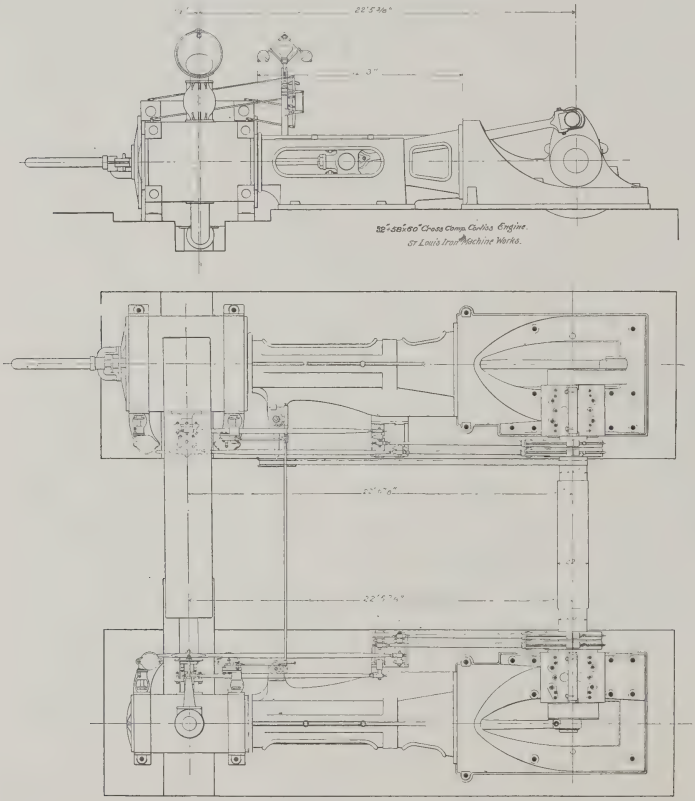


FIG. 8.—PLAN AND ELEVATION OF THE ST. LOUIS CROSS COMPOUND CORLISS ENGINE.

THE GEORGE H. CORLISS ENGINE

The engine illustrated in the inset (between pages 616-617) represents a cross compound non-condensing engine built by the Corliss Steam Engine Company and installed in the Western Avenue station of the West Chicago Street Railway Company. The steam cylinders are respectively 30 ins. and 52 ins. in diameter with 60 in. stroke of pistons. Three similar engines, except that they are condensing and that the large cylinders are 60 ins. in diameter, have been built by the same firm for the loop system of the West Chicago Railway Company, but have not yet been installed on account of delays in Chicago. In all these engines the armature of an electric generator is attached directly to the main shaft so that the engines are "direct connected," or in other words, each engine and generator forms what we have termed an "engine dynamo." Flanges for directly securing the frame of the smaller engine to the dynamo are shown in plan and elevation. Each main pillow block forms part of a large pillow block bed plate which is extended longitudinally and laterally around a sunken portion or crank pit in which runs the crank wheel, crank pin and end of connecting rod. This casting toward the cylinder is moulded to a circular form to connect directly to a spool shaped casting forming the guides, the other end of which casting connects directly to the cylinder. The cylinders are supported on legs, and the whole bottom surface of the pillow block bedplate is supported on the foundation and firmly bolted thereto. Independent steam and exhaust eccentrics are provided for each engine. The wrist plate of this engine as well as of all recent Corliss engines is considerably changed from the original form. In effect there are five arms, a pendent one receiving motion from the eccentric through an intermediate rock shaft and connection and two lateral ones at either end approaching quite closely the centers of the valves with pins in the lateral arms operating the arms on the valve stems through very short connections. The effect of this is to emphasize in the highest degree the peculiar Corliss change of angle, by which each valve is opened and closed promptly, but moves very little after closing. A novel feature of the more recent Corliss engines are the relief valves located in the exhaust valve chambers and pressed to their seats by a flat spring shown in the plans of the two cylinders. Most of these engines contain a provision for tripping the main steam valves and stopping the engine in case of the breakage of the governor belt, the details of which will be shown separately if presented for the purpose.

One feature always observable in the Corliss engine is the tendency to give most of the parts a curved outline, thereby avoiding the rugged and unfinished effect of intersecting straight lines. This is seen in the contours of the frames, in the shape of some of the smaller levers and par-

ticularly in the peculiar shape of the wrist plate. Mathematically, the effect of the wrist plate is the same as of five straight arms previously referred to, but the result is obtained by one drooping curve intersecting the two branches of a V with curved sides, giving to the whole construction a novel and not unpleasant appearance, sufficiently distinctive to attract attention.

THE ALLIS CORLISS ENGINE

Fig. 7 (page 626) shows various views of a 2000 h. p., horizontal cross compound engine manufactured by the Edward P. Allis Company, of Milwaukee, Wis., the engine being directly coupled to a 1500 k. w. railroad generator, one of the largest sized electric units thus far constructed. The steam cylinders are respectively 32 ins. and 62 ins. in diameter with 60 in. stroke of pistons. There are a considerable number of these engines in use, notably four in the Kent Avenue station, Brooklyn, N. Y.; one at the Consolidated Traction Company's power house, at Newark, and two in the Albany Street power house, Boston. Vertical cross compound engines manufactured by this firm, operating similar generators, will be illustrated hereafter. It will be observed that the engine illustrated resembles in all general details the Corliss engine of approximately the same size shown in the inset. The pillow block bed plate, the guides and the connections of the same to cylinder are practically identical. The wrist plates and valve gear, however, more nearly resemble the customary type of Corliss engine than the special one previously illustrated. There is one eccentric and wrist plate for the high pressure engine and independent eccentrics and wrist plates for operating the steam and exhaust valves of the low pressure engine. Two governors are provided, necessarily connected to operate together through a rock shaft. A condenser and independent air pump are shown in connection with the main engines. The main steam and exhaust connections are so arranged that the two engines will operate together as a compound engine, or may at will be operated jointly or independently as condensing or non-condensing engines. Steam is at first admitted to a steam separator from which it passes to the high pressure cylinder, a branch being provided to the low pressure engine. The exhaust from the high pressure cylinder passes ordinarily to an intermediate chamber, but by opening a branch may be turned direct into the main exhaust pipe and condenser. The steam from the intermediate chamber passes to the steam valves of the low pressure cylinder and from thence is exhausted to the condenser, a back pressure valve being provided in this pipe whereby the steam from either or both engines may be diverted, if desired, to a pipe leading outdoors, so that the engine or engines connected therewith will operate non-condensing. The air pump is vertical, operated by an independent steam cylinder, both being supported upon a jet condenser of which the injection pipe and the discharge pipe from the condenser are clearly shown.

This firm has made a specialty of large pumping, blowing and electric engines and has so extended its business that the various details of the engines are manufactured in separate departments where no other work is carried on. In building several engines of one kind, special tools set for one frame or principal casting can remain in place already adjusted for the next similar casting and the cost thereby be reduced to a remarkable extent. The operations of the company are carried on on a large scale, and engines manufactured in this interior city of America are sold in all parts of the world in competition with those manufactured in other countries.

THE COOPER CORLISS ENGINE

The illustrations (Fig. 3, page 620) represent a cross compound Corliss engine built by the Cooper's, with direct connected generator, practically as installed for the Lowell & Suburban Street Railway Company, Lowell, Mass. This engine is one of many of the same general type by this firm for heavy street railway work, among which may be mentioned seven, installed in the power station of the Nassau Street Railway located at pier foot of Thirty-ninth Street, South Brooklyn, N. Y. The cylinders are respectively 32 ins. and 56 ins. in diameter with 60 in. stroke of pistons. Pipes are shown whereby live steam may be admitted to either cylinder, and either cylinder exhausted independently, or the steam may be passed from the small cylinder to an intermediate chamber and from thence to the large cylinder, forming a compound engine. The details of the valve gear are not illustrated, but the half tone shows that it resembles the customary type of Corliss gear.

A large number of the detail drawings of this engine have been furnished, from which are selected plans illustrating, in cross section, the details of one of the main bearings for a journal 22 ins. in diameter and 44 ins. long. The shell forming the lower part of the bearing is provided on its back with a bearing surface 15 ins. broad and 12½ ins. long (parallel with the shaft), which rests on a key adjustable by a screw extending outside. The upper shell or top of the bearing has a bearing surface 15 ins. wide for 2½ ins. at each end and opposite two 2 in. intermediate ribs in the cap. The upper shell is hung to the cap, so that it can be removed with it by four 1 in. bolts. The side bearings or gibs are 10 ins. deep, provided with backing plates and set up at one side by three large set screws. Two of the cap bolts, 1⅝ ins. in diameter, are formed on the tops of two of the foundation bolts, 2 ins. in diameter, the latter having separate nuts concealed under the caps. (See Fig. 4, page 622.)

ST. LOUIS CORLISS ENGINE

The illustration (Fig 8, page 628) represents a cross compound, condensing, heavy duty engine, adapted for direct connection to electric generators, manufactured by the St. Louis Iron & Machine Works, St. Louis, Mo. The cylinders are respectively 32 ins. and 58 ins. in diameter by 60 in. stroke. Independent eccentrics and wrist plates are provided for the steam and exhaust valves of both the high and low pressure engines. The framing is of the same general type as that of the Corliss and Allis-Corliss engines previously described, but the main bearing bed plate is somewhat shortened and the length made up in the intermediate casting forming the guides, which has openings on one side only and a heavy rib on the other, and is moreover provided with a flanged extension carried down to the same depth as the main bearing bed plate and securely bolted to the foundation, thereby practically extending the length of such bed plate

and the length of the attachment to the foundation. The intermediate receiver in this case is above the engine. The governor is weighted so as to run at higher speed than those of some other designs, otherwise the details of the valve gear appear to be very much the same as in other Corliss engines.

The piston rod of the large cylinder is extended through a stuffing box in the rear head and supported in a stationary sleeve, thereby relieving the cylinder from a large portion of the wear due to the weight of the piston.

THE PHILADELPHIA CORLISS ENGINE

The illustration (Fig. 9) shows an engine designed by the Philadelphia Engineering Works, Ltd., Philadelphia, Pa. The manufacturers write: "This engine was intended for the South Side Railway Company in Chicago, and this preliminary drawing was made to accompany our proposal. The cylinders were 22 ins. and

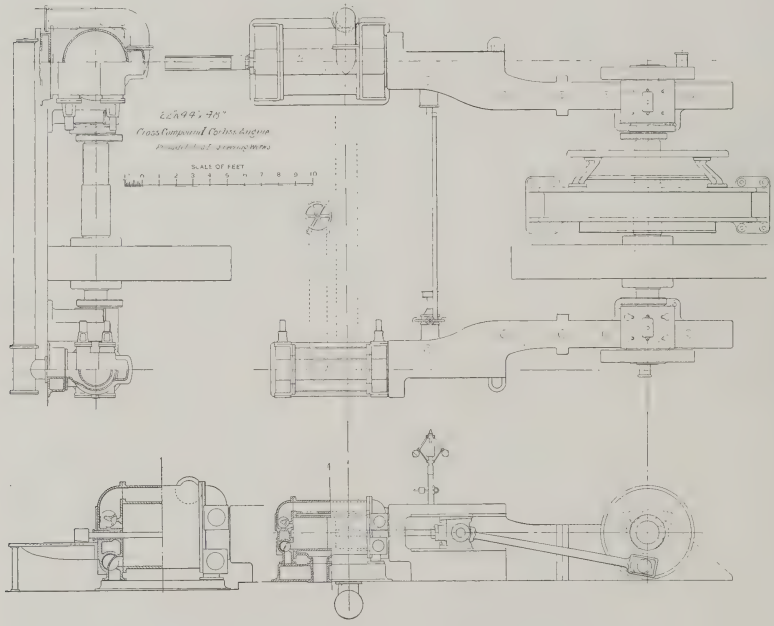


FIG. 9.—PLAN AND ELEVATIONS OF THE PHILADELPHIA CROSS COMPOUND CORLISS ENGINE.

44 ins., stroke, 48 ins., and for 100 r. p. m. To attain 800 ft. piston speed in an effective way, the valves were made extra large and the inlet valves were double ported and all valves placed in the heads to reduce the clearance as much as practicable for the excessively large portage provided. The high pressure cylinder only was steam jacketed. The steam passing in from the bottom entirely surrounded the cylinder and from thence passed into it. The exhaust valves are so situated that they entirely drain the cylinder and escape into a hollow bed plate, which forms part of the receiver, and from thence into a reheating pipe (another portion of the receiver) into the low pressure cylinder. The low pressure cylinder is not steam jacketed."

An inspection of the plans shows that the frame in plan very closely resembles the old type of Corliss engine, the joint between the frame proper and pillow block being moved away from the latter sufficiently to give good length of flange for bolts. In vertical elevation, however, the frame is extended entirely down to the foundation, so that its bottom is continuous with the pillow block, thus securing the width of base and facility for attachment to the foundation attained with other forms of frame. The piston rod is run through the head of the large cylinder, and carries a shoe running on a guide to relieve the pressure of the main piston in the bottom of the cylinder. The governor is weighted to secure the greater power due to high speed. Other details of the valve gear are not shown.

THE RICE & SARGENT CORLISS ENGINE

The illustrations (Fig. 6, page 624) shows several views of a cross compound engine, built by the Rice & Sargent Company, of Providence, R. I., of which two have been erected in the power station of the West End Street Railway Company, Dorchester, Mass. The cylinders are respectively 26 ins. and 50 ins. in diameter with 60 in. stroke of pistons. The frame is of the original Corliss type, except that there is a support for the same under the guides, provided with means for strongly bolting it to the foundation. The Rice & Sargent Company has introduced into these engines a safety flywheel, shown in Fig. 5, page 622, and constructed with a forged iron rim, 16 ins. thick and 20 ins. radial width, formed in five segments, scarfed together in steps provided with three sets of jaws consisting of projections and grooves, all accurately fitted by machine and bolted together, with side movement prevented by keys. Each wheel is provided with ten arms of oval shape, consisting of hollow steel castings. The hub is of cast iron in one piece forced on the shaft. The entire rim is tool finished, except the interior, which is smooth forged. The wheel is 24 ft. in diameter. The total weight is 120,000 lbs., of which 75,000 lbs. are in the rim.

The builders make the following statement in regard to the manner of fitting the parts of the wheel together:

"In the edge view you will note the outline drawing of the joint and the faces, *a a*, are the only ones which require to be fitted. These are planed up and finished with a tool which makes all three faces exactly the same

distance apart in all the joints. The seats for the arms in the rim are then slotted out, and the rim is erected on the floor, and the faces, *a a*, are tested with red lead and the outer cylindrical surface and two sides of the rim accurately turned.

The accompanying table has been prepared to show the comparative dimensions and weights of the engines illustrated in this paper.

TABLE OF DIMENSIONS OF SIX LARGE CROSS-COMPOUND CORLISS ENGINES.

Maker.	11 The Corliss Steam Engine Company.	7 The Edward P. Allis Company.	14 The C. & G. Cooper Company.	13 St. Louis Iron & Machine Company.	9 The Philadelphia Engineering Works, Limited.	18 Rice & Sargent Engine Company.
Diameter of small cylinder, ins.	30	32	32	32	22	26
" " large " "	52 or 60	62	56	58	44	50
Stroke of pistons, ins.	60	60	60	60	48	60
Revolutions per minute.	75	75	76	80	100	80
Steam pressure, lbs.	. . . .	. . . .	. . . .	125	. . .	150
Economical H. P. reported.	. . . .	2,000	. . . .	1,950	. . . .	1,350
H. P. for 33 lbs. M. P., referred to large cylind.r.	for 60" 2121	2,264	1,872	2,114	1,216	1,571
Weight of engine, lbs.	520,000	520,000	460,000	380,000	239,000	390,000
Diameter of flywheel, ft	25	24	20	24	16	24
Weight of flywheel, lbs.	160,000	160,000	150,000	150,000	100,000	120,000
Floor space required, indep. of piping and auxiliaries, ft.	32 × 40	32.8 × 41	29 × 37½	27.5 × 44½	22 × 36	26½ × 39½
Diameter of main journal, ins.	22	21⅞	22	19¼	16	20½
Length " " " "	42	48	44	36	30	37½
Diameter of main shaft between bearings, ins.	28	26	25	22	20	24½
Diameter of crank pin, ins.	10	10	10	9¾	7½	8½
Length " " " "	10	10	10	8	9	8
Diameter crosshead pin, ins.	. . . .	. . . .	9	. . . .	6½	. . . .
Length " " "	. . . .	. . . .	10	. . . .	. . .	. . . .
Diameter steam pipe to small cylinder, ins	. . . .	10	10	10	10	. . . .
" " " " intermediate chamber, ins.	. . . .	12	14	12	12	. . . .
" " " " large cylinder, ins.	. . . .	20	14	17	12	. . . .
" exhaust pipe, ins.	. . . .	22	18	18	16	. . . .

and scraped if necessary to bring them to a perfect bearing. After this the hub is placed centrally in the rim and the length of the arms calipered. When the wheel is erected in place the keys shown are driven in, which prevents the joints from opening at all, and the rivets are afterwards driven in, binding the whole into a perfect wheel. The segments are bought bent to shape and rough machined. No lead or other foreign substance is used." Finally the completed wheel is swung in a lathe

In another article, I will take up and discuss further principles of engine design as illustrated by a number of other engines of which full plans and data have been received through the kindness of the manufacturers.*

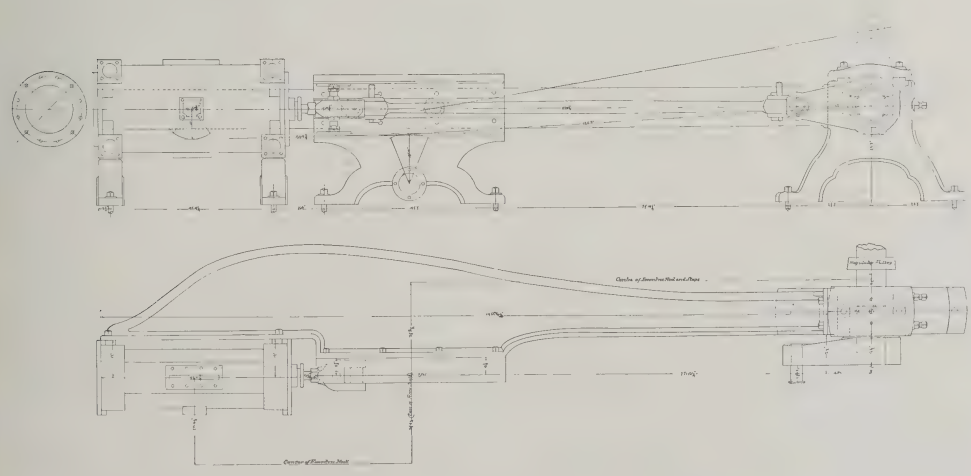
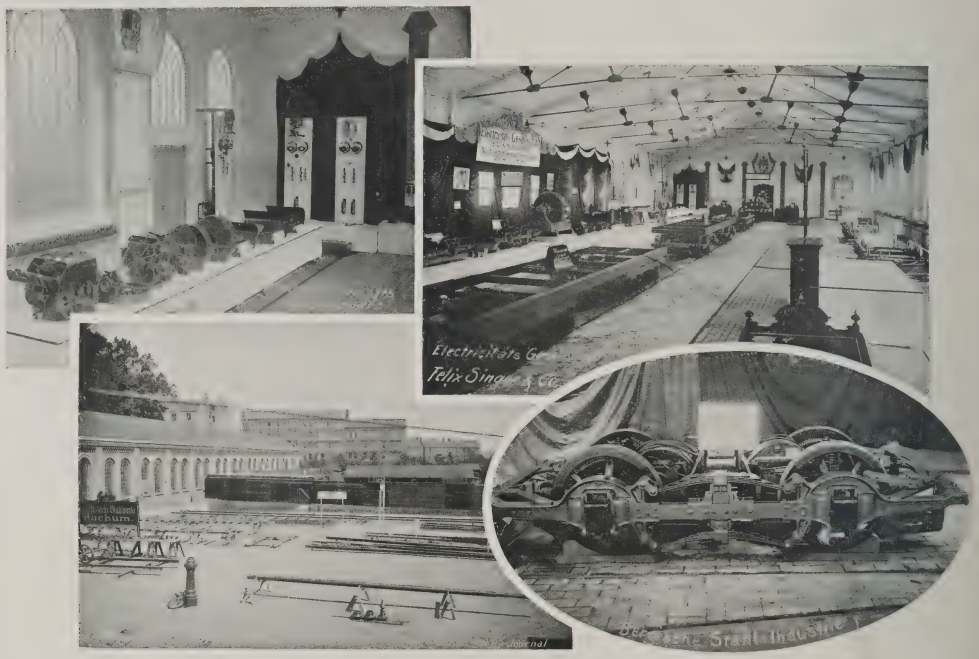


FIG. 10.—OLD CORLISS ENGINE WITH WHALEBACK FRAME.

*[The second article in the series by Dr. Emery will appear in the STREET RAILWAY JOURNAL for January, 1898.—EDS.]

NOTES FROM THE CONVENTION OF THE STREET RAILWAY MEN OF GERMANY.

The directors of the various street railway companies in Germany, held their first annual convention in the city of Hamburg. The proceedings were informally opened on Aug. 5, and the delegates spent that day and the 6th, 7th and 8th in this progressive city. There was remarkable interest shown in the proceedings and a number of valuable papers were read, dealing with several important questions in which all progressive railway men are interested. The sessions were mainly held in a beautiful pavilion at the Dammthorbahnhof on the banks of the Alster, and it was noticeable that the delegates remained in attendance during the entire proceedings, doing their sight-seeing after the convention was over. The weather was beautiful, and not the least pleasant feature was the trip on the inner and outer Alster, in a steamboat specially provided through the courtesy of the Hamburg Street Railway officials.



EXHIBITS AT THE TRAMWAY CONVENTION AT HAMBURG, GERMANY.

What attracted the delegates as much as anything was the display of machinery in one of the buildings at Falkenreid, which had been generously lent for the purpose by the Hamburg Street Railway. Hamburg has the largest electric railway system in Europe, and great credit is due to Managing Director Röhl for his laborious efforts which helped to make the convention a conspicuous success. He was untiring in his efforts.

One of the most noticeable displays in the exhibition building was that of the Bergische Stahl-Industrie. This enterprising concern showed several of its well known types of car trucks, noticeably the narrow gage truck, built for the Oberschlesischen Dampfstrassenbahn. This truck was greatly admired, and on it were mounted four Walker motors. The truck is fitted with the Standard Air-Brake Company's system which has been adopted for the protection of the entire road. Another type of truck shown was the one built for the Grosse Berliner Pferdebahn. This system is destined to work a beneficial change in the German capital. It is expected that over one thousand cars will be running before many months. The Bergische concern has supplied the Pferdebahn with trucks for horse cars, and it is expected it will be equally fortunate in securing the contract for the electric car trucks. A fine display was made by this same concern of special car wheels fitted with steel tires. The fine finish of this company's apparatus caused much favorable comment.

Another interesting display was made by the Electricitäts-Gesellschaft, Felix Singer & Company. This concern represented the Walker Company. It showed a fine generator and Walker motors of different sizes; also the current controllers and trolley devices. On the wall hung excellent photographs of different installations of Walker apparatus in America, and a number of efficiency curves, which excited interest.

The well known Union Elektricitäts-Gesellschaft did not make a large exhibit, but its representatives were in attendance and referred delegates to the large number of U. E. G. motors in service on the Hamburg road. This concern is one of the most progressive in Europe, and has furnished practically all of the apparatus for the Hamburg installation.

The well known firm of Felton & Guilleume, of Mulhein-on-Rhine, through their agent, made a fine display of cables of various sorts for lighting and power purposes. Another very attractive exhibit was that of the Harburger Rubber Comb Company, which displayed different varieties of its product. This company showed some remarkably fine specimens of statuary made entirely of rubber. An interesting display of wheels was made by the Wheel & Steel Works of van der Zypen Brothers, of Köln-Deutz. This company showed a lot of wheels and examples of fractures, with statis-

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The Hamburg Street Railway Company showed a double truck which was built at its shops. After the session, delegates visited the company's shops, and saw different cars in process of building. For car building and repairs the company has a special department that turns out exceedingly good work.

The Westfälische Stahlwerke, of Bochum had a display outside of the building of different kinds of rails and a specimen trolley mast. The Phönix Actien-Gesellschaft, of Ruhrort, also had an excellent display of special work and tram rails. These exhibits were most carefully inspected.

C. W. J. Martens made a good display of headlights and a conductor's fare box. A good exhibition of springs was made by Dittman & Newhaus. Smith of New York, also displayed a number of lamps.

The exhibits were all arranged in good shape. There was ample space and excellent light. It took no prophet to foresee that not only were conventions for Germany an assured success, but that the next one would be on a much greater scale. Some interesting souvenirs were given out, after the American fashion.

Among the prominent individuals in attendance were Directors Hille, of Leipzig; Hippe, of Munich; Kreuger, of Hanover; Rotalman, of Essen, and many others of equal prominence in German railway circles.

THE STATE ASSOCIATIONS

THE NEW YORK STATE STREET RAILWAY ASSOCIATION.

The fifteenth annual meeting of the Street Railway Association of the State of New York was held at the International Hotel, Niagara Falls, N. Y., Sept. 14, 15 and 16, 1897.

President G. Tracy Rogers, of Binghamton, called the meeting to order on Tuesday morning at 10:45 o'clock.

The roll was called and it was found that there was the largest attendance in the history of the association.

The president then read his address, which was received with great applause. An abstract follows.

ADDRESS OF THE PRESIDENT.

Gentlemen of the Convention: In behalf of the Street Railway Association of the State of New York, it is my privilege to extend to you all a cordial welcome to this, our fifteenth annual convention. It seems most fitting that we should meet here at Niagara, if for nothing more than to observe the object lesson which nature unfolds before us. The power exhibited here in nature's workshop is awe-inspiring and could it be utilized would propel every street car in our state.

The past year will long be remembered by those connected with street railroads, in many cases, as one of the most discouraging since the adoption of rapid transit. Trade and commerce have, we hope, reached their lowest ebb. The bicycle is now our too successful competitor. It operates without franchise of track, and pays no taxes. On the contrary, cinder paths are constructed, pavements laid down and in many cases pavements changed for its benefit. As a means of locomotion the bicycle has come to stay, but as a novelty it is being overdone and will share the fate of other novelties, and I believe has reached its zenith.

Notable improvements have been made recently in motors and car construction, especially for the suburban and interurban roads. Cars with all the comforts and conveniences of a steam passenger coach, are now in operation on some lines.

The Legislature and New York City officials have been dawdling with the question of rapid transit for a number of years, but whatever results have been accomplished in this direction may be attributed to the enterprise of the railroad companies. They have recently obtained the consent of the State Board of Railroad Commissioners to adopt electricity, instead of horse power, over a distance covering 110 miles of track. This change involves an expenditure of $12,000,000 and I am informed that contracts have already been made for a large portion of the work. Contracts also have recently been closed between the Brooklyn Bridge trustees and the Brooklyn surface roads by which the trolley roads of Brooklyn will extend their lines across the bridge. This great improvement will cost the Brooklyn roads $500,000.

Nothing has been done within the past ten years which has inured more to the benefit of the people of our state than the adoption of rapid transit and the consolidation of street railroads in cities, both large and small. Consolidation, which was at one time regarded as a menace to public welfare, is now universally recognized as redounding to its advantage.

It is far within the bounds of truth to say that for every dollar invested in a street railway, another dollar has been given to the people through the resulting increase in property values alone. The street railways have handsomely repaid the public for their franchises. The populistic element, with its plans for obtaining cheap fares and its ideas of municipal ownership, together with high taxation of railroads, if allowed to be successful, will materially cripple street railways. The free transfer system has been so liberally adopted in this state and the margin of profit is already so small that any legal reduction in fares, however little, would compel a complete abandonment of the far-sighted policy which is building up the cities of our state. Vested right is the last remedy we should seek in order to protect our franchise rights, but in many instances such measures must be resorted to in order to protect us against the clamor of the socialistic element. A number of decisions have been made of late which should be very gratifying to us.

More bills affecting street railroads were introduced in the Legislature last year than ever before; no doubt, a majority of them at the request of constituents. Had they become laws and been put in operation, the public, as well as ourselves would have suffered. We found the members ready to listen to our arguments and anxious to enact such laws as would be of service to the public good.

During the past year there has been organized an Association of Street Railroad Accountants. This association should have a cordial and hearty support. Next to the manager of a road, I consider the accountant the most important official, in fact, the successful manager must rely upon him largely as a guide in managing the road.

An important advance made by the street railroads since the adoption of rapid transit is the improvement in the character of employes. Better discipline is now maintained and more courtesy shown in catering to the public. As our business grows in technical and scientific requirements, it naturally attracts a class of men to whom there was formerly no call or inducement to enter its service. Nearly every road has a mutual benefit society or employes' club connected with it. Each has a plan agreeable to the ideas of the employes, and in nearly all instances the management has not only endorsed, but become a part of these societies. A number of roads have furnished club rooms and other substantial assistance for them. We cannot take too much interest in the men connected with the operation of our roads.

The organization of mutual indemnity insurance companies for electric railways has been suggested as a protective measure against the prohibitive rates we are now charged. For years, insurance companies have been experimenting with insurance upon street railroads. From the results obtained I should judge the business was not satisfactory. The insurance companies have either refused to write this class of risks, or have established, in many instances, prohibitive rates. In a measure, this may be the fault of the street railroad manager, who, feeling the responsibility in part removed, may have been more careless in the handling of his road. A number of roads still have low rate policies, but they are based upon the record of the roads' casualties. Not long since, the rate for fire insurance was almost prohibitive, but I am pleased to state that we are now being insured at a fair rate, as compared with other business risks. Owing to the insurance regulations we are now debarred from the sale of power, which, in many cases, would be a large source of revenue, and under the present restrictions commercial lighting from the electric railway circuit will have to be confined to out of doors.

The rapid increase in the number and size of parks and pleasure resorts owned by street railway companies and operated by them as traffic promoters has been one of the striking developments which have accompanied the introduction of electricity as a motive power on street railroads. The general opinion of street railroad managers, who have had experience in this direction, is that such pleasure resorts properly conducted, with a judicious selection of amusements and entertainments, tend to increase the ordinary traffic of a road. An amusement league for the interior cities of the state has been suggested. The idea is worthy of consideration and, if properly handled, should be a saving and convenience to the roads in such cities.

The experiment of carrying United States Mails has proved a success and the postal car service on our roads is appreciated by the public and accepted by the Government. New freight and express routes are being established, which operate not only as a convenience to the people, but as feeders to the steam roads.

The application of electricity to the existing steam roads is, today, a question of great importance to the practical railroad man. We have, no doubt, made inroads into their local passenger receipts and probably will continue to do so. Our roads are so situated that in most instances we are at an advantage. We can operate at a much less cost than they and our depots are at our patrons' doorsteps. The convenience and cheapness of our transportation recommend themselves. I believe there is room for us both, and, in a measure, the electric roads are a feeder to the steam roads, and the more closely they are allied, the better for both.

It is still a question as to whether the storage battery is becoming a practical factor in the operation of our roads, and whether at the present cost we can use it to advantage in our central stations and at the ends of our feeders, thereby assisting in maintaining the potential on the trolley lines. Compressed air and the many other powers now being tried may have some surprises in store for us. The results of these experiments and inventions may be the beginning of a new era in the street railway world.

I congratulate you upon the financial and physical conditions of your roads, for notwithstanding that the past year has been the most depressing in our history, it is the first year for some time during which a receiver has not been asked to take charge of some road of our state.

Many of the improvements I have referred to have been very materially promoted by the intelligent discussions they have had at the meetings of our association. I am a believer in the importance and good results that can be accomplished by united action. I know from personal experience for the past two years that this association has been a tower of strength in protecting the legitimate rights of the street railway interests of this state and I hope that the same earnest and energetic support it received during that time will continue to be given it by all persons charged with the duty of looking after such properties. The growth of our association and the interest taken in it by nearly all of the roads are subjects of congratulation.

It is the desire of the management that the active men connected with our roads take more interest in the association and

especially in the convention work. I sincerely believe in the future of the association, but it will become what we make it.

Secretary Robinson then read the report of the Executive Committee.

NIAGARA FALLS, N. Y., Sept. 14, 1897.

GENTLEMEN: Your Executive Committee respectfully submits the following report:

MEMBERSHIP.

Notwithstanding prevalent consolidation, lease and purchase, thereby decreasing the number of street railroads throughout the state, and the comparatively few new companies organized and new roads constructed during the past year, owing to the stringency of the money market, we are pleased to state that the growth and development of our association has been steady and satisfactory. Our membership at present consists of forty-eight companies, representing a large percentage of the street railway organizations and the bulk of capital invested in street railway enterprises in this state. All of the large roads are active members and closely identified with association work. There are still a number of companies which are not members, which should be, and we recommend that persistent and determined effort be made, the coming year, to induce every road in the state to unite with this association. We believe this result can be best accomplished by placing before them the importance of united effort on the part of street railroads in advancing our interests and protecting our rights, the incalculable benefit derived from the annual meeting, and the general interchange of ideas upon practical questions of construction, operation and maintenance. While our association, to-day, ranks first among the various state street railway organizations, we believe that it can be still further developed and its scope of usefulness enlarged.

LEGISLATION.

The usual array of bills affecting street railway interests were introduced in both branches of the legislature at Albany during the past year. The large number of special hearings before the various committees and the unusual activity of the promoters of the several bills introduced, required the almost constant attention and presence of the president and attorney of this association at Albany during the entire session. Upwards of 170 bills and amendments directly affecting the organization, construction and operation of street railroads were introduced, and the general importance and character of the respective measures demanded the closest attention and most careful consideration on the part of the representatives of this association.

Of the large number of bills and amendments introduced only the following new law and amendments were enacted:

The general grade crossing law. The portion of this law affecting street railroads is as follows:

"No. 68. All street surface railroads hereafter constructed across a steam railroad shall be above, below or at grade of such steam railroad as the Board of Railroad Commissioners shall determine, and such board shall in such determination fix the proportion of expense of such cross to be paid by the street surface railroad."

An amendment to the Penal Code, providing that a person who willfully does an act, by which (among other things) an electric car is wrecked, causing death, is guilty of murder in the first degree. Also an amendment to the Penal Code, which applies section 635, relative to malicious injury to railroad property, to electric railroads.

An amendment to the general law relative to liens on railroads. Section 5 of the Labor Law which provides that:

"Ten consecutive hours' labor, including one half hour for dinner shall constitute a day's labor in the operation of all street surface and elevated railroads, of whatever motive power, owned or operated by corporations in this state, whose main line of travel or whose routes lie principally within the corporate limits of cities or more than 100,000 inhabitants. No employee of any such corporation shall be permitted or allowed to work more than ten consecutive hours, including one half-hour for dinner, in any one day of twenty-four hours."

An amendment to the Tax Law, providing that a railroad corporation "hereafter incorporated" need not pay the organization tax (one-eighth of one per cent of its capital) until it receives a certificate from the Railroad Commissioners that public convenience and necessity require the building of its railroad.

An amendment to subdivision 10 of section 4 of the Railroad Law, relative to the issue of bonds by railroad companies.

An amendment to section 101 of the Railroad Law, which allows street railroads in cities of the third class, and incorporated villages, overcoming certain elevations to charge ten cents fare.

This result bespeaks the effective work done by this association, its officers and counsel.

We consider it fitting to incorporate in this report an expression of our appreciation and thanks to the members of both branches of our Legislature for the courtesy and attention shown the street railroads of this state at the several hearings and during the session, and for the fair and equitable treatment accorded us in their consideration of the many street railroad bills introduced.

SPECIAL WORK.

We wish to express our approval of the activity, close attention and effectual work accomplished at Albany in behalf of this association by our attorney, Hon. Edmund O'Connor. We are confident that his sound argument, good judgment and always conscientious work have redounded largely to the advantage of this association and the business which we represent.

Much special work has been accomplished the past year in the way of mailing circulars and letters to the street railroads of the state, pertaining to legislation and other matters of importance and this has done much toward stimulating the necessary work and keeping alive the interest in our organization.

FINANCES.

Our finances are in excellent condition, the association being entirely free from debt, with a snug balance in the treasury, as will be shown by the treasurer's report.

We forcibly renew our recommendation of last year that a sufficient amount, in keeping with the magnitude and importance of the business interests we represent, should be kept in the treasury at all times to meet any emergency that may arise, the amount to be maintained as a reserve fund. This fund could be provided for without imposing any serious burden upon the individual members of this association.

EXECUTIVE COMMITTEE.

We quote from last year' report: "We recommend that the Executive Committee be given sufficient latitude in administering the affairs of the association to enable them to act quickly and decisively upon all important questions that may arise requiring immediate attention, as a meeting of the Executive Committee can be called with much less trouble and delay than a meeting of the association."

We heartily endorse this recommendation and believe that the best interests of the association will be subserved by the policy recommended.

THE ANNUAL MEETING.

We believe that the annual meeting has clearly demonstrated its value to the association, and that the work accomplished and social privileges enjoyed thereat serve as a stimulant and invigorator to the practical physical operation of the various street railway systems represented. The annually increasing attendance, the general interest displayed, the entertaining and instructive papers read and the general interchange of ideas relative to construction, operation and maintenance cannot but prove valuable to every attentive and interested person in attendance.

We believe that with each succeeding year the value of the annual meeting will be increased and more thoroughly appreciated. We bespeak for it a useful and prosperous future, and recommend that each individual member of this association do all possible to increase the interest in and enhance the value of the annual meeting.

OUR FUTURE.

That an important and busy future confronts this association, none who are familiar with the work accomplished the past few years will gainsay. As our already large interests continue to develop and enlarge, the necessity of the association work will become more apparent.

The functions of the association are extensive and varied, demanding close attention and careful consideration. Its officers and Executive Committee should be selected from representative street railroad men, who will devote the energy, time and attention necessary to properly guard and protect our just rights and to improve and enhance the general street railroad interests of the state.

The report of the treasurer was then read and showed the financial transactions of the year to be as follows:

Receipts	$7,687.63
Expenses	6,326.24
Balance	$1,361.38

THE PRESIDENT: The next order of business is the reading and discussion of papers. I will state that a delegation of prominent tramway men is here from abroad and in behalf of the association I extend to them a hearty welcome, and also invite them to enter into our discussions, and perhaps we can get some light from the other side. The first paper is on the subject "How Can We Increase the Efficiency of Employes," by W. W. Wheatley, of Brooklyn, N. Y.

This paper is given herewith.

HOW CAN WE INCREASE THE EFFICIENCY OF OUR EMPLOYES?

The term "efficiency" implies the existence of a standard of excellence. To speak of increasing the efficiency is only another way of speaking of a nearer approach to that standard. Briefly outlined, a high standard of railway service may be described as safe, regular, frequent, rapid, clean and comfortable. Any near approach to that standard will be found to depend largely upon the human element in the service.

In order to divest the subject of any uncertainty and to confine its consideration within definite limits, the writer assumes that it refers principally to those employes who operate cars, in other words, to conductors, motormen or gripmen. They are the employes who come into direct daily contact with the public, and whose bearing and conduct, in the public eye is, to a great extent, the embodiment of the efficiency or inefficiency of the service rendered by the company. Our problem therefore is, how can we manage to secure in the personnel and in the conduct of our employes, the nearest possible approach to a higher standard of service, public or private.

For the safe, economical and efficient operation of a railway, there are three essential conditions:

First. A good track and motive power.

Second. An attractive and comfortable car equipment.

Third. Faithful, capable and well trained employes.

The first and second requisites may be obtained by a reasonable expenditure of money assisted by a high degree of mechanical skill, Money alone cannot buy the third requisite, because character and faithfulness upon which alone conscientious, capable and trained service depends, must be cultivated and developed. Of course, it pays to give a good price for brains, but brains alone will not make faithful, capable and well trained employes. Good materials bring a high price and intelligent men are worth more, because they are more likely to become competent than ignorant ones.

A simple and direct solution of our problem may be indicated under two headings.

First. Improve the personnel by the selection of better men.

Second. Improve their conduct and increase their faithfulness by a better system of discipline and training.

Let us consider first how we are to obtain better men. The man becomes the employe, not entirely upon his own volition, but through the process of selection by one of the company's officials. Whatever official is charged with the duty of selecting conductors, motormen or gripmen, bears a heavy weight of responsibility. To a large extent he is responsible for efficient service on the road, for upon him depends the selection of men who, in their habits, education and tendencies are fitted for the work. Unfit men once in the service may become very grave factors in the attainment or non-attainment of good results. The very best mechanical and engineering talent is engaged at great expense for the purpose of selecting and testing the material used in the construction, repairs and maintenance of roadway, power plants and equipment, and watching the results obtained from them. The utmost care is exercised before any device or material is selected for temporary or permanent use, but what methods do we pursue, and how do we assure ourselves of the fitness of the men in whose hands are to be placed expensive property and human lives? Are they not often hurriedly selected to meet some pressing temporary requirement, or what is worse, are they not often permitted (without regard to their fitness) to enter the service at the behest of some politician whose friendship may become useful?

The officer who is to select the men, should himself be selected with great care, and he should be protected from any influence likely to prevent him from selecting the best material. His field of choice will be limited largely by the wages paid to employes. If only such wages are paid as will suffice to command the service of inferior and therefore incompetent men, he should not be blamed for his frequent failure to select good men. No definite rules can be laid down for the selection of better men except to say that good character and fitness for the work should be the sole requirement for entry into the service. An ignorant, talkative blackguard should under no circumstances be permitted to enter, because he is not built right for the business, and by no system of discipline or training can a man of this character be fashioned into a gentlemanly, courteous employe. The writer believes it is best, as a rule, in selecting new and inexperienced men to take those who have had more or less of mechanical training either on the farm or in the workshop, provided, of course, they are suitable in other respects; and preferences should be given to married men beyond the age of twenty-five, because as a rule they are more steady, reliable and more amenable to discipline. Professional floaters who go from place to place, often under assumed names, are always to be avoided. This branch of the subject is too large to be compassed in a few paragraphs. Suffice it to say that success in selecting good men is largely a question of being a good judge of human nature, aided by careful methods of looking up the antecedents of applicants.

To improve the conduct and increase the faithfulness of our employes, a better system of discipline and training is demanded. It is the policy of railroad managers to bring their equipment, track and power up to the highest state of efficiency, but do they know that their men have a clear and practical knowledge of their rules and of the proper operation of their equipment? Do they know that their rules are habitually observed, and that their equipment is operated in the manner prescribed?

Experience has taught the leaders of military organizations that it is one thing to make a rule or give an order, but quite another thing to know that it is enforced. They have learned that efficiency of discipline can be obtained only by close inspection, and it is so in railway service. Inspection should be made not by secret service detectives, but by trained inspectors as is done in military organizations. In discipline, as in some other things, an ounce of prevention is worth a pound of cure.

Discipline consists not merely in administering punishment for offenses, but in a broader sense it consists in educating and training the men, so that it will not often be necessary to administer punishment. We may have the best roadway and equipment, but unless we are able to properly control and guide the intelligent human machines through whose agency results are to be accomplished, we may never have a high standard of efficiency.

GROUP OF ATTENDANTS—NEW YORK STATE STREET RAILWAY ASSOCIATION, NIAGARA FALLS.

Efficiency of service comes only as the result of long and persistent training, education and experience, and is therefore incompatible with short tenure of position. Is it not a conspicuous fact in street railway operation, that there is a comparatively short tenure of service of conductors, motormen or gripmen? Are we not continually discharging one set of men and employing new and inexperienced men to take their places, and if so what is the underlying cause and what the remedy? Passing hurriedly over these very suggestive and interesting questions regarding tenure of position, it may be profitable to briefly review our present methods and opportunities of training new and inexperienced men.

In steam railroad practice, before a man is permitted to act as conductor or engineer in charge of a train with valuable property and human lives, he is subject to several years of education and training in one or more subordinate positions. Opportunity is thus afforded to study his character and temperament, observe his methods and measure his fitness for promotion, but in street railway practice there are, as a rule, no subordinate positions in which men are required to serve before being placed in charge of a car. New and inexperienced men are inducted into the service in large numbers and after being schooled for a few days are given exclusive, absolute and independent control of a car running through crowded city thoroughfares and populous suburbs. Is it to be wondered at that costly accidents are the result?

It will be generally conceded that the position of motorman or gripman is a vastly more important and responsible position than that of conductor, as it concerns safety in operation. Why then should not all motormen or gripmen be required to serve an apprenticeship of three to six months in the shops or as conductors, during which time they could become perfectly familiar with the roadway, equipment and the rules and regulations, and during which time the

officers could become better acquainted with them? After having served such an apprenticeship would they not naturally be better qualified for the more responsible position?

But after all has been said about obtaining better men and training them to become more proficient in their duties, it still remains to make them faithful and attach them to the service. This point needs no emphasis when we remember the exactions of the service and the influences that are continually at work to degrade and mislead them, and prevent the proper and faithful discharge of their duties. There is no other calling which makes heavier demands upon the mental and physical endurance of men, and they should not be surrounded by demoralizing conditions which unfit them for the best service. Every company should take some interest in the social surroundings of its employes. They should be given some opportunities of enjoyment as well as self improvement. We must remember that the chief end of their existence is not work, and when their work for the day is done we should offer them some counter attraction to the street corner, the saloon or the gambling den. We should try to lead the men to feel that the company takes an interest in their welfare and wishes to improve their social condition. By so doing we shall more surely attach them to the service and make them more faithful and efficient.

Minor mistakes and blunders there will always be, but men do not as a rule make serious blunders with deliberate intent. In order to avoid blunders some incentive should be held out to make the men more careful. It is indeed questionable whether the fear of punishment is always the best incentive to offer, and yet how many of us offer anything else? The disgrace of suspension and loss of wages may often be a deterrent, but what kind of an impression does it leave on the man's mind after it has been inflicted, especially so when it comes after a long term of faithful service? Well may we raise the question whether our system of discipline is not wrong, when we hold out no other incentive to faithful service than the fear of punishment.

Many of the principal steam railroads throughout the country are making a distinct advance in their system of discipline, which is more in keeping with the progressive, enlightened spirit of the age. They are trying to abandon the "master and man" idea, and are seeking to attach men to their service by treating them "like men," and by giving some recognition and credit for varying terms of faithful, efficient service. Instead of fines and suspensions, which often beget a sullen, revengeful spirit, many roads are adopting what is widely known as the "Brown system of discipline, without suspension," which consists in keeping a debit and credit account with each man, and advising him personally as the entries are made. Suspensions are made only nominally, that is, they are entered against the man's record, but are not actually enforced. Geo. R. Brown, general superintendent of the Fall Brook Railway, who first inaugurated this system, says concerning it in substance as follows:

"Penalties are imposed for two purposes: first, to uphold the law and prevent its further violation; and second, to reform the violator. Punishment inflicted indirectly benefits many who do not violate the law, as well as the one who does. It often occurs that the disgrace and injury occasioned by a strict enforcement of a sentence does more to ruin the guilty than anything else, and a wise provision has been made allowing courts to use their judgment as to carrying out punishments; this is known as 'suspending sentence.' If the sometime offender does better, and is not guilty of the same or other offenses, the judge conveniently forgets the indictment hanging over him, but should he go on committing one misdemeanor after another, his 'record' rises up to condemn him. I believe in the practice of suspending sentence with railroad employes."

Under this system a man's position depends on his "record," and a long term of faithful service entered to his credit counts for something every time the account is balanced. That is undoubtedly the correct principle which teaches the employe that he will as surely receive credit for his good work as that he will be charged with his errors and faults, and he will certainly become a better man when he learns that his final success depends solely upon the "record" that he makes. The writer suggests that it may be possible to embody into practical methods adapted to street railway service the principle herein briefly outlined, but it should be undertaken only by those who are in sympathy with it, and whose experience in dealing with men has duly convinced them that harshness is less powerful than kindness, and that just, humane treatment of men will bring about a closer relationship and more perfect confidence between employer and employe.

MR. J. B. CAHOON: I agree most heartily with all that Mr. Wheatley has said, but I do not think he has carried the matter far enough, not as far as we have carried it on our road in Elmira. We not only go into the subject of a thorough examination of the man as to his personal character and habits, etc., but as far as possible have conformed to the law of the state and placed him in the power house and given him a thorough training there. We have followed that up with a course in the machine shop and car house, and endeavor in that way and thorough careful training on the cars to put him in a position to understand what his duties are. Of course, we have a small road, but we have the good fortune to retain our employes for longer terms of service than is usual. A man starting in goes on as an extra man and remains an extra man, as we find by experience, for about a year and a half. He only runs on the lines of smallest travel. In this way by the time he gets a regular run he is pretty thoroughly educated in his duties, and we can see whether our judgment has been right in regard to the man and whether he is a competent employe or not. We have also taken up the social side of the life of the conductors and motormen and established a club room for them with the daily papers, electrical papers, prominent magazines and various games and things to amuse them when off duty. This is located at a very convenient point where all our cars meet, and we hire a room for that purpose solely, on one of the principal streets of the city. In addition to that we have taken the men into our confidence, so to speak, and when there has been a falling off in the earnings we have talked with the men in a general way and explained to them how our daily receipts depend upon them; how if they are not polite to ladies and do not help them on and off the cars and answer inquiries politely and promptly they are hurting the road, and not only the road, but themselves; because if our earnings decrease it means we have to decrease our operating expenses and be compelled to economize, taking off and putting the men back on the extra list where they will get less pay. We have also adopted the service stripe system. We give a man for each five years of service a gold stripe on his sleeve, with an increase in pay of five cents a day, which is not much, but it serves as an incentive to the men and shows that they are considered, and that we are trying to do what is right by them. I have told them that if our earnings pick up so that we can do better than that, we will be glad to do it. We have now some fourteen men who wear the five years' service stripe and four or five who wear two stripes on their sleeves, indicating ten years of service and who get an increase of ten cents a day. We have found that by taking this personal supervision of each man and looking after his comfort, etc., that our earnings are picking up, that the men are more attentive to their duties and more careful of the property of the company and work with the management of the road in operating it on an economic basis.

THE PRESIDENT: Can we not hear from some other roads, giving their experience? Will Mr. Anderson or one of our friends across the water tell us what they do there?

MR. ANDERSON: Mr. President and gentlemen, I thank you for the opp rtunity given to me of saying a few words. As a tramway manager for twenty years I have had some experience in this line and fully approve of the sentiments expressed in the paper which has been read, in fact, it is quite in accordance with my own views. We have rather a different class of people in Dublin from what you have in this country; the men are apt to keep their positions longer. We have many men in our company who have been with us a great many years and a service stripe for ten or fifteen years would be quite common. We look after the comfort of the men as far as we possibly can and increase our efforts each year. We have a road 43 miles long, with 1600 horses. We have on part of our road adopted the electric system and are about to extend it, and it is with that object in view that the committee has come over here consisting of two directors and myself.

THE PRESIDENT: The next paper will be "A Decade of Electric Railroad Development" by W. J. Clark, of New York. Mr. Clark read the following paper:

A DECADE OF ELECTRIC RAILWAY DEVELOPMENT.

Going back to the commencement of the present decade, there was in your state but one electric line, some 3 miles in length, and this particular road—that in Binghamton—although it enjoys the distinction of being the nucleus of an extensive and model electric railway system, was experimental in its character, so that electric traction could not be said to have existed in the Empire State ten years ago; yet, at the present moment there are slightly over 6000 motor cars in daily use within the territory covered by your association.

(Mr. Clark, speaking: And, Mr. President, noticing that the Board of Railroad Commissioners is represented at this meeting, I trust that I may be pardoned for interjecting a few remarks concerning them personally. During many years of experience with railway statistics, covering both the United States and foreign countries, I have never seen figures which meant so much as those which are published by the railroad commissioners of this state. Neither have I, in my experience, met public officials who were so willing to furnish information to those who desired it for a legitimate purpose as these gentlemen. Applause.)

Statistics of electric railways in this country show, not only a tremendous increase in percentage of electric traction to the total, approximately 15,000 per cent, but also the fact that the street railway mileage of the United States has increased over 156 per cent during the period given. During the same interval, the mileage of American steam railways has increased but 31 per cent. This fact in itself would seem to demonstrate that the American street railway men have grasped the possibilities of building up transportation in a more thorough manner than have their brethren of the steam railway fraternity, as well as demonstrating the theory which we have advanced. But for a more immediate illustration of the comparative growth, as well as some other startling facts, let us come nearer home and introduce a comparative statement compiled from the reports of the Railroad Commissioners of the State of New York for the years 1887 and 1896, covering street railways, surface steam railways and steam elevated systems.

It may be said that all of the wonderful progress above shown by the street railway interests cannot be directly attributable to electricity, as the introduction of the cable in New York City is, to a certain extent, responsible for such progress, yet as the effect of the cable traction on our general proposition is so similar to that of electricity, and as New York is so fast becoming an electric traction

COMPARATIVE GENERAL STATISTICS ON ALL OPERATING RAILWAY COMPANIES, NEW YORK STATE, 1887–1896.

	Surface Steam Roads.				Elevated Steam Roads.				Street Railways			
	1887	1896	Inc. or Dec.	Per Cent Inc. or Dec.	1887	1896	Inc. or Dec.	Per Cent Inc. or Dec.	1887	1896	Inc. or Dec.	Per Cent Inc. or Dec.
Gross earnings, freight and passenger traffic	$143,724,490 67	210,089,592 75	$66 365,102 13	46.09	$8,691,439 49	$11,896,461 45	$3,205,021 96	36.87	$17,966,518 31	$28,868,898 84	$10,842,380 53	60.38
Operating expense, freight and passenger traffic	92,439,974 60	146,063,417 17	53,523,442 57	57.98	4,962,148 96	7,154,581 22	2,192,332 26	44.20	13,291,855 32	17,846,759 27	4,555,903 95	34.31
Net earnings from operation	51,284,516 02	64,026,174 58	12,741,658 56	24.87	3,729,290 53	4,741,880 23	1,012,589 70	27.18	4,674,662 99	11,022,139 57	6,347,476 58	135.76
Income from other sources	5,453,167 31	7,158,385 86	1,705,218 55	31.27	86,148 49	232,089 00	145,940 51	169.39	1,616,705 38	3,391,768 43	1,775,063 05	109.78
Gross income from all sources	56,737,683 33	71,184,560 44	14,446,877 11	25.00	3,815,439 02	4,973,969 23	1,158,530 21	30.36	6,291,368 37	14,413,908 00	8,122,539 63	129.08
Interest	17,469,522 21	23,052,019 30	5,582,497 09	32.00	1,781,443 29	3,104,125 36	1,322,682 07	74.24	4,996,593 37	12,388,312 43	7,391,719 06	148.14
Rentals of leased lines	14,704,117 28	20,710,892 89	6,006,775 61	40.86	20,000 00	68,225 00	48,225 00	241.1	1,565,711 62	3,351,770 31	1,786,058 69	114.15
Taxes	5,018,907 21	7,781,360 32	2,762,452 11	55.01	478,594 83	965,830 31	487,235 48	87.40	342,318 00	1,033,211 91	690,893 91	202.0
Miscellaneous deductions from gross income	3,939,744 19	5,934,561 89	1,994,817 70	50.62					859,197 49	1,194,824 40	335,627 91	39.4
Total deductions from gross income	41,132,291 49	57,478,834 60	16,346,543 11	39.74	2,279,537 12	4,068,180 67	1,788,643 55	78.53	7,763,819 99	17,972,118 74	10,208,298 75	131.49
Net income from all sources	15,605,391 84	17,705,725 84	2,100,334 00	13.46	1,535,901 90	905,788 56	630,113 34	41.03	2,527,548 38	7,440,789 26	4,913,240 88	194.38
Percentage operating expenses to gross receipts	64.32	69.52	5.1	7.92	57.08	60.14	3.06	5.36	73.98	61.96	12.02	16.26 dec.
Percentage net income to capital stock	3.5	2.43	1.07	30.6 dec	4.79	1.91	2.88	60.13 dec.	6.89	3.61	3.28	47.65 dec.
Percentage dividends to capital stock	2.19	2.49	.3	13.7	4.9	3.73	1.17	23.90 dec.	4.5	5.08	.58	12.89
Percentage gross income to cost road and equipment	4.81	5.39	.58	12.05	5.04	5.04	2.046	39.53 dec.	5.83	7.51	1.68	28.81
Number passengers carried	94,272,116	179,315,249	85,043,133	90.27	174,356,088	235,504,148	62,972,066	36.13	361,543,939	672,498,769	310,954,830	86.01
Passenger earnings per mile traveled*	2.22 cts.	2.16 cts.	0.14 ct.	5.94 dec.	5.54 cts.	4.05 cts.	0.01 ct.	2	4.97 cts.	4.28 cts.	0.69 ct.	13.90 dec.
Passenger expense per mile traveled*	1.46 ct.	1.64 ct.	0.13 ct.	8.61	2.88 cts.	3.04 cts.	0.16 ct.	5.56	3.68 cts.	2.65 cts.	1.03 ct.	28.00 dec.
Passenger profits per mile traveled*	0.85 ct.	0.58 ct.	0.27 ct.	31.73 dec.	2.16 cts.	2.01 cts.	0.15 ct.	6.94 dec.	1.29 cts.	1.63 cts.	0.34 ct.	26.35
Miles of track in New York State	13 248.44	14,401.82	1,153.38	11.07	155.67	182.41	26.74	17.18	5,578.38	10,487.26	4,908.88	88.00
Gross earnings per mile of road operated	$ 10,847.83	$ 14,587.93	$3,740.10	34.47	$55,840 69	$65,218 73	$9,378 04	16.79	$3,220	$1,816,591 25	$1,813,371 25	56,324.87
Operating expense per mile of road operated	7,776 00	9,585 47	1,809 47	23.32	45,103 60	42,652 80	2,450 80	5.45 dec.	2,382	10,975 60	8,593 60	360.73
Net earnings from operation per mile of road operated	4,314 03	4,301 74	112 29	2.61 dec	34,937 09	28,268 93	5,768 16	16.94 dec.	1,440	5,144 63	3,704 63	257.27
Average number of employes for year	102,634	146,987	44,353	43.22	5,136	7,120	1,984	38.66	13,573	23,932	10,359	76.33
Combined net income of operating companies and divi-												
dends declared by companies controlling entire in-												
come of all roads, companies, &c	$ 22,122,931 74	$ 24,337,604 59	$214,662 85	.97	$1,537,212 47	$920,819 43	$616,393 04	40.1 dec.	$2,226,974 29	$5,774,229 72	$3,547,255 43	159 3

* On street and elevated railways these figures are given "per passenger."

city, it is considered unnecessary to go into the refinement of subdivision of mechanical traction methods in their effect, for both tend to demonstrate the theory which we have advanced, and show that as great benefits have been conferred upon the community served as can be done consistently with the financial investments in the corporations, and unquestionably, to a certain extent, show also that in development which discounts the future, resulting in the public benefit referred to, the interests of stockholders may not have been as thoroughly promoted as if a less liberal policy had been pursued. Yet some of the figures, unless further explained, might be grasped by those who advocate municipal ownership, reduced rates of fare and additional burdens upon street railway corporations as demonstrating the theories of increased earnings, reduced operating expenses and other things which they consider sufficient reasons for advocating the practical confiscation of vested rights of the greatest benefactors, in a corporate way, communities have ever had. True, street railway earnings have increased and operating expenses have decreased, and many other advantages have come to the street railway companies through the introduction of electricity, but for every dollar of actual net return which the investor in street railway securities has received in the Empire State, we do not hesitate to say that the municipalities and the general public have received at least $10 direct benefit, and that the general public has thus profited far more greatly from the advantages of rapid transit than have the investors who produced it.

Let us consider some of the figures quoted : in 1896 the operating street railways of New York State paid $1,164,820.40 in direct taxes—a good sized percentage in itself on gross receipts, as will be noted. This, let it be remembered, does not include certain additional amounts paid by the holders of securities of lessor and other companies or certain percentage contributions, which, if calculated together, would compare favorably in amount with the demands for percentage payments made by some of the loudest advocates of such theories. A little calculation will also show that the street railway companies maintain about 9,000,000 sq. yds. of street surface or paving, the practical equivalent of maintaining a street 250 miles long, yet, as is well known, with the now rare exception of horse railways, the street railways of New York State do not wear the surface of the street at all, but their tracks unquestionably save much wear from vehicle travel, as compared to the ordinary roadway, which must be maintained by the municipality. Remember these burdens are imposed for the privilege of running the "poor man's carriage."

From a calculation based upon the census returns of 1890, the average tax rates of the various cities in New York State, the owner of an ordinary carriage or vehicle pays, proportionately, only about one-sixth as much for his privilege of going where he will with the same and wearing out the pavements at pleasure.

One of the results, for which I presume electricity must be to a certain extent held responsible, owing to the expectation of greater returns and other excuses made by municipal officials for unreasonable assessment, is inequality of taxation. To illustrate this point I have interjected a somewhat surprising calculation, compiled from the Railroad Commissioners' Report for 1896, which would seem to demonstrate that valuation of property, earnings, passengers carried, car miles run or no other intelligent basis of assessment of taxation on street railways in this state has been followed, and that certain hardships have resulted, is, we think, clearly apparent.

But to return to our analysis of the general statistics given, it is to be regretted that the data are not attainable which would show the exact increases in valuations of real estate, caused directly by the extensions of street railway lines during the past ten years. We believe, however, that such increases in New York State amount to $300,000,000, a direct gain to the holders of abutting and adjacent property and a direct benefit to the state and municipalities by increasing the amount of taxable property. This, it will be noted, is more than the entire investment in street railway properties.

Let as make another calculation. It is certainly reasonable to suppose that the extensions of street railway lines, and faster service obtained during the past ten years, saves to each passenger at least ten minutes of time. This means annually to the citizens of New York State a saving of 112,083,127 hours. Consider such time to be worth only an average of as low as ten cents per hour, and we have a saving of $11,208,312, or nearly double the net earnings from the operation on all the street railways of the state.

Looking over our figures, we might be met with that oft repeated statement that street railways have been overcapitalized. To this charge we cannot but reply that the promoters of some of the street railways have not been entirely guiltless of the sin of overcapitalization to a certain extent, yet far less than is ordinarily supposed. We believe, however, that the aggregate amount of all such illegitimate financiering in connection with the street railways of New York State, since the advent of mechanical traction is not so great as the unintelligent and wasteful expenditure of public funds in one or two large cities of the United States for a fraction of this period, and we cheerfully invite the advocates of municipal ownership to devote some study to this feature. Where the money represented by the present investments has gone is in the legitimate purchase of underlying companies or companies antedating mechanical traction and in expensive construction and equipment, which could be duplicated to-day at a much smaller figure. Some illustrations of this feature. In the early days of electric traction, when most of the construction and equipment was done in this state, girder rails cost more than double their present figure; electric car equipments from 250 to 400 per cent more; car bodies from 25 to 35 per cent more; power station equipment from 100 to 300 per cent more. That

prices have depreciated is not the fault of the railway investors and managers, and surely does not affect the legitimacy of their investments. The public should feel grateful for the additional incentive which the present low prices now give the railway corporations for offering them still better transportation facilities. Somewhat on the same lines, we should refer to the mistaken impression generally prevailing, even among those who are supposed to have some knowledge of the subject, as regards the entire cost of thorough electric railway construction and equipment. As illustrating this, a few months since, I was called upon to prepare a careful estimate on the cost of duplicating an extensive street railway system in the West, where the city engineer had stated that approximately $3,500,000 would rebuild the system in accordance with the most approved ideas. The engineer referred to was requested to answer a long list of questions, which practically constituted specifications as to his ideas on construction and equipment, and a most careful calculation was made by myself and others in accordance with his ideas, the result being that at least $7,500,000 was found to be necessary to duplicate such a system in accordance with the specifications of such engineer. The opponents of the present methods of street railway ownership and operation would probably state that the rapid extension of street railway lines would not have been made had not additional returns been expected by the investors, and that, to a certain extent at least, the results which we have quoted would verify this statement. Yet, far more apparent than this is the fact that with the extensions of lines have come the transfer system and lengthened routes, so that the average nickel will now carry a passenger three times as far on the street railways of New York than it would have done ten years ago; another illustration of the benefits which the public has derived, and it is safe to say we would hear no comments on the fact that the rates per passenger had been reduced during the past ten years. Let us now for a moment consider what might have been the result had the street railway management of New York State, as a whole, been less progressive than it has. All of the large systems are practically the outgrowths of old horse car companies, which were generally laid out on the principal thoroughfares, affording a large short haulage travel, and which could now be handled in a most profitable way by mechanical traction methods at an average rate much less than upon systems which have extended their lines, so that a large proportion of their mileage is suburban, or through comparatively unprofitable territory. Let us cite a case from actual records, showing what the effect would have been. A certain street railway system in a large city, operating about 30 miles of track by horse traction in 1887 equipped its lines with mechanical traction, but has never extended the same. It is well managed and gives magnificent service, but cannot be said to have conferred the benefits upon the community which other systems have that have followed the general programme of extension. The following shows the approximate results from its operation in 1887 and 1896.

GENERAL COMPARATIVE STATEMENT OF STREET RAILWAYS IN THE UNITED STATES, JANUARY 1, 1888—JANUARY 1, 1897.

	1888		1897	
Total number of operating companies	615		806	
Number of st. ry. sys. operated by horses	566		167	
Number of st. ry. sys. operated by cable	18		38	
Number of st. ry. sys. operated by steam dummies, not including elevated	35		33	
Number of st. ry. sys. operated by electricity	21		698	
Mileage of horse car track	5,474		1,010	
Mileage of cable track	217		515	
Mileage of steam dummy track, not incl. elev	216		145	
Mileage of electric track	86		13,580	
Total mileage of street car track	5,993		15,250	
Number of horse cars	21,736		3,664	
Number of cable cars: grip 860, trail 1,917	2,777		5,957	
Number of steam dummies and cars: dummies 165, cars 258	423		318	
Number of electric motor cars 166, trail cars 6	172		37,097	
Total number of st. cars, all descriptions	25,108		47,036	
Percentage horse car track to total mileage	.914		.066	
Percentage cable track to total mileage	.036		.034	
Percentage dummy track to total mileage	.036		.009	
Percentage electric track to total mileage	.014		.891	
Percentage horse cars to total number	.866		.078	
Percentage cable cars to total number	.111		.127	
Percentage dummy cars to total number	.017		.007	
Percentage electric cars to total number	.006		.788	
Average length horse car systems	9.67	miles	6.05	miles
Average length cable systems	12.06	miles	13.55	miles
Average length dummy systems	6.17	miles	4.39	miles
Average length electric systems	4.09	miles	18.02	miles
Largest street railway system (West End Co. Boston) operated by horses	212	miles	430	miles
Largest cable system (that of Chicago City Railway Co)	26.25	miles		
Largest electric street railway system (Richmond Union Passenger Railway, 40 cars)	13	miles	Union Traction Co. Philadelphia	

	1887.	1896.
Gross receipts	$1,345,550	$2,680,448
Operating expenses	974,794	1,448,157
Per cent operating expenses to gross receipts.	72.5	54.2
Fixed charges	294,326	316,007
Net income	77,428	886,284
Dividends	60,000	800,000

We think no comment is necessary to illustrate this company's prosperity. Nor does it need any elaborate argument to show that in this particular case at least better results could not have been obtained had extensions been built.

We have heard it claimed that the employes of the street railway companies have not profited as they should through the advanced methods adopted by their companies. A glance at the statistics we have quoted illustrates how their number has increased and the following statement will, we think, demonstrate that the condition of the employes of no other large industry in this country has shown as comparatively great improvement in ten years as has that of the street railway employe in the Empire State.

We regret that time and space will not permit us to make an elaborate comparison of the wages paid street railway employes here with those prevailing abroad, or to demonstrate at length that electric traction increases the labor account, although it produces economy in other directions. We would note, however, that according to the last report of the Glasgow tramways, the model horse railway system of the world and the ideal of municipal ownership, that the total wages aggregate but 43 per cent of the operating expenses, while on that model of electric street railways, the Buffalo (N. Y.) system, as shown by its report for 1896, over 77 per cent of the entire operating expense is paid to labor, while this percentage holds practically good on all the street railways of the state operated by mechanical traction. This analyzed would mean that out of approximately $29,000,000 gross receipts received by the street railways of the state, $13,000,000 are paid directly to employes as wages, while, of course, a goodly share of the remainder of the operating expense goes indirectly to labor in the production of materials required in connection with operation and replacement. Against this, the stockholders of the operating companies get but, approximately, $3,400,000 annually in dividends for their large investment.

Now, as to the most serious of all offenses that have been charged to mechanical traction, viz, accidents, the daily press is constantly filled with references to the "deadly trolley," with occasional remarks concerning Mr. Vreeland's cars of "Juggernaut," but what are the real facts concerning this very serious matter, and what are the comparative results between the present and the past on street railways in this state, and how does the annual result compare on street and steam railways. According to the Railroad Commissioners' Report of 1896, there were killed on the street railways

TAXATION STATISTICS.

CERTAIN STREET RAILWAYS IN NEW YORK STATE, 1896.

	Taxes.	Per Mile Track.	Per Car Mile.	Per Passenger.
Case One	$17,205	$880.00	.....	.....
Case Two	1,381	283.00	$.00766	$.00228
Case Three	54,537	1,280.00	.01485	.00377
Case Four	1,082	102.50	.00283	.00110
Case Five	3,180	113.50	.00379	.00094
Case Six	22,055	1,175.00	.00947	.00164
Case Seven	289,723	1,442.00	.01347	.00272
Case Eight	24,336	540.00	.00717	.00157
Case Nine	80,525	1,197.00	.01285	.00235
Case Ten	1,189	79.50	.00564	.00025
Case Eleven	1,560	52.00	.00251	.00236
Case Twelve	157	52.50	.00210	.00185
Case Thirteen	648	199.50	.00304	.00083
Case Fourteen	170	39.80	.....	.00032
Case Fifteen	23,399	935.00	.01132	.00355
Case Sixteen	187	31.70	.00240	.00067
Case Seventeen	600	57.20	.00283	.00085
Case Eighteen	24,932	312.00	.00910	.00181
Case Nineteen	1,430	387.00	.01985	.00613
Case Twenty	2,505	224.00	.00495	.00184
Case Twenty-one	1,033	243.00	.00490	.00238
Case Twenty-two	1,475	83.20	.00354	.00119
Case Twenty-three	2,450	162.00	.....	.00139
Case Twenty-four	1,151	192.00	.....	.00131
Case Twenty-five	602	140.00	.00635	.00191
Case Twenty-six	600	118.50	.00339	.00227
Case Twenty-seven	1,257	525.00	.....	.00402
Case Twenty-eight	1,498	214.00	.00485	.00097
Case Twenty-nine	4,505	214.50	.00718	.00182
Case Thirty	1,640	577.00	.00875	.00195
Case Thirty-one	427,599	8,550.00	.01820	.00245
Case Thirty-two	1,365	103.00	.00335	.00112
Case Thirty-three	16,273	266.00	.00352	.00114
Case Thirty-four	3,271	593.00	.00779	.00189
Case Thirty-five	5,478	331.00	.01220	.00369
Case Thirty-six	1,736	272.00	.01480	.00426
Case Thirty-seven	860	147.50	.....	.00275
Case Thirty-eight	2,567	153.00	.00467	.00143
Case Thirty-nine	48,814	558.00	.00975	.00282
Case Forty	3,365	218.00	.02850	.00590
Case Forty-one	1,497	308.00	.02140	.00228
Case Forty-two	680	300.00	.....	.00412
Case Forty-three	329	74.30	.00624	.00306
Case Forty-four	778	104.00	.00316	.00312
Case Forty-five	6,777	214.00	.00590	.00172
Case Forty-six	93,519	3,300.00	.00740	.00149
Case Forty-seven	1,689	283.00	.01510	.01515
Case Forty-eight	148	54.00	.00274	.00132
Case Forty-nine	12,769	505.00	.00575	.00127
Case Fifty	18,964	557.00	.00764	.00195
Case Fifty-one	3,002	375.00	.00363	.00085
Case Fifty-two	688	222.00	.00337	.00122
Case Fifty-three	587	90.50	.00179	.00105
Case Fifty-four	3,911	236.00	.00518	.00157
Case Fifty-five	1,914	212.00	.00449	.00147
Case Fifty-six	2,651	295.00	.00665	.00215
Case Fifty-seven	814	74.00	.00590	.00140

of New York State, thirteen passengers, seven employes and fifty-one others, making a total of seventy-one. This represents one for each 1,807,316 car miles run, or one for each 9,383,258 passengers carried. Against this number the surface steam railways killed five passengers, 211 employes and 544 others, or a total of 760. This represents one for each 241,950 train miles run, or one for each 235,941 passengers carried. So it is safe to say on fatalities that our steam railway friends are producing the same in the proportion of about eight to one, as against the street railways. In the same year the street railways injured 197 passengers, 35 employes and 157 others, or a total of 389. This represents one for each 329,875 car miles run, or one for each 1,728,788 passengers carried. During the same period the steam railways injured 174 passengers, 2142 employes and 592 others, or a total of 2908, running for each 63,233 train miles, or carrying 61,663. The total killed and injured on street railways was 462, or one for each 277,752 car miles run, or one for each 1,442,016 passengers carried. The total killed and injured on the steam railways amounted to 3668, or one for each 50,131 train miles, or one for each 48,886 passengers carried. From this comparison it will be seen that if the daily press devoted as much space comparatively to steam railway accidents as to those on street railways they would have room for nothing else in their columns, and might require hourly Sunday editions. To listen to some of the comments on street railway accidents, it would be supposed that no such thing had ever been heard of until the introduction of mechanical traction, yet in 1887 the street railways of New York killed one person for each 9,983,646 passengers carried; almost the same average as the present, as shown above. They injured one person for each 1,398,487 passengers carried, or proportionately 25 per cent more than in 1896. This, we think, thoroughly demonstrates that mechanical traction is far safer than the horse car in every way. But another surprise; while, as shown, the percentage of accidents has been decreased, the natural inference would be that this improvement had occurred in connection with the passengers or employes, and that with increasing speed must come greater danger to those upon the streets. Strange to say, however, the proportion of accidents between 1887 and 1895 to this class is 33¼ per cent less. It should be remembered in this connection also that the average speed of cars on the street railways of New York State has more than doubled during the past ten years.

COMPARATIVE STATEMENT OF AVERAGE WAGES AND SERVICES REQUIRED STREET RAILWAY EMPLOYES OF NEW YORK STATE.

	1887		1896	
	Wages per hour.	Hours per day.	Wages per hour.	Hours per day.
Conductors	$.141	11.79	$.159	10.62
Drivers	.141	11.97	.183	10.40
Starters	.184	11.14	.182	10.90
Watchmen	.142	14.09	.145	11.22
Switchmen	.142	10.68	.143	10.44
Roadmen	.158	10.29	.153	10.20
Hostlers	.131	11.52	.145	10.57
Blacksmiths	.252	10.11	.....	.....
Carpenters	.248	10.14	.200	10.00
Painters	.241	10.22	.200	10.00
Harness makers	.225	10.00	.....	.....
Inspectors	.217	10.70	.235	9.50
Car cleaners	.148	10.50	.....	.....
Tow boys	.109	12.31	.....	.....
Trackmen	.172	10.50	.....	.....
Repair men	.264	10.00	.....	.....
Foremen	.215	11.50	.200	10.00
Engineers	.220	11.33	.243	10.37
Motormen	.095	14.00	.161	10.72
Machinists	.....	.....	.222	9.98
Mechanics	.....	.....	.219	9.55
Linemen	.....	.....	.193	10.19
Firemen	.....	.....	.159	10.81
Electricians	.....	.....	.227	10.15
Transfer agents	.....	.....	.200	10.00

On motion the meeting was adjourned until Tuesday afternoon when a paper was read by Caryl D. Haskins, of Boston, on the "Economical Influence of Accurate Electrical Measurements."

THE INFLUENCE OF ACCURATE MEASUREMENTS UPON ECONOMIC OPERATION.

In no branch of commerce, save perhaps in some of the industries dependent upon the generation of electrical energy, is it considered sufficient to know only what raw material is used and what revenue is received. Nor is this information actually regarded as sufficient even in these industries. Until very recently, however, there has been no satisfactory method of actually determining how much electrical energy has been produced during any given period.

Many generating stations in the early days followed a system of frequent readings of ammeters and voltmeters, basing their assumptions as to the actual output on the product of coincident readings multiplied, of course, by the time factor; thus obtaining an approximation of the kilowatt hours output per day and therefore the approximate cost of generation per kilowatt hour. Many, however, abandoned these frequent readings of instruments, feeling that the approximations of true output measurement were too unreliable to be of real value, because of the constant fluctuation of load between readings. The conditions just described are in reality those of yesterday rather than to-day, and they existed only up to that time when it became possible to obtain output meters of sufficient capacity to measure in an accurate and proper manner the true output. Such meters as those to which I refer are now readily obtainable and are being rapidly adopted not only by street railway companies, but by lighting companies also. Electrical engineering skill has responded to the needs of the industries to which it is tributary, and standard designs now exist up to capacities as high as 8000 amps. while special instruments have been designed large enough for 16,000 amps.

These total output meters are accurate to a high degree, not upon steady and normal loads, but upon rapidly fluctuating loads as well, giving a true account of all energy output through them on loads ranging from 5 per cent to 6 per cent of their rated capacity up to about 15 per cent above their rated capacity, the reliability of the record being unaffected with the rapidity of fluctuation of current between these points. Knowing the efficiency which is to be expected from the generator, engine and boiler equipments, it is a simple matter to determine just how much coal and water should have been expended for the run of any given day to generate the indicated kilowatt hours output. Thus it not only becomes possible to determine just what it is costing to generate a kilowatt hour, but it also becomes possible to check the inefficiency of the equipment and to locate trivial faults which might otherwise have escaped notice. For example, should the indicated output fall 10 per cent below what ought reasonably to be expected from the known input of coal and water, an effort would at once be made to determine where the trouble lies, whether in uneven firing of the boilers, ill set valves on the engine, or some minor fault in the generator. In no other way known to me can this positive means of check upon a generating system be maintained than by the use of total output meters.

Important as is the measurement of the total station output, there is yet another application of positive measurements which, while it has been long appreciated by many, has not been applied in practice at all up to the present time, simply because the necessary meter was not available. I refer to the measurement of the energy used daily to operate each car. Every street railway management realized that a quite large proportion of the total energy generated is wasted by the careless and improper use of the controller and the brake, and where the old rheostat method of control is used the opportunity for waste on the part of the motorman is yet greater. Almost every street railway superintendent makes a different estimate of the percentage of power wasted upon the system under his charge, for there can be no positive knowledge upon the subject nor can the conditions be regarded as at all stable. An average drawn from the opinions which have been expressed to me would, however, indicate that not less than 20 per cent of the total energy generated is wasted by improper manipulation of the handles upon the part of the motorman. This improper manipulation is due to some extent to ignorance, but more generally to carelessness. A meter has now been designed which will, I believe, change all of these wasteful conditions. This meter is intended for permanent installation upon the car and its indications show accurately the consumption of energy in kilowatt hours for any desired time.

Grave difficulties surrounded the designing of a satisfactory meter for this purpose, and the perfecting of the device has only been accomplished by sustained effort extending over a long period. It was necessary, not only that the meter should be accurate, under the extremely unfavorable conditions of heavy vibration and shock, to which it has to be exposed, but also that its construction should be of such a character as to endure these rough conditions for long periods without damage to the mechanism and without the impairment of accuracy. Such a meter as that which I have described is now obtainable, and has been successfully operated in actual service over an extremely rough piece of track for many months.

Assuming that the energy is actually 20 per cent of the total, as I believe it to be, it is, I think, fair to expect a saving of at least half the present waste, or 10 per cent of the whole amount of energy generated, as a result of the knowledge on the part of the motorman that the management has absolute means of ascertaining how much power he uses per run, or per passenger, or per mile. For under this system he cannot fail to realize that the management has in its possession adequate and reliable data upon which to base promotions or encouragement, reprimand or discharge. Many steam railroads have long made a practice of offering annual prizes to the engine crew doing the most work with the least coal and water, and I anticipate that a similar system of reward may be found advantageous and profitable in street railway practice.

MR. CAHOON: There is a factor in this question which interests us all, and that is, how much does the meter cost?

MR. HASKINS: The 35 amps., 500 volts, is $40; the 50 amps., 500 volts, is $50, with a discount of 50 per cent.

MR. CAHOON: That is the main thing we want to draw out. We do not know whether we can afford these luxuries or not.

MR. HASKINS: Excuse me, it is a necessity, not a luxury.

THE PRESIDENT: Where have those meters been adopted?

MR. HASKINS: The meter has not yet been adopted by any road. It has not yet been offered on the market. It has just gone through its final test in our hands. It has been running on the Lynn & Boston road over the roughest section of its line.

THE PRESIDENT: The next paper is on "The Advantages of a Car Mileage Record," by T. J. Nicholl, of Rochester.

MR. NICHOLL: Mr. President and gentlemen of the convention: I have a paper here which was prepared by our mileage clerk, Charles J. Ingalls, and any credit which may attach to the paper is certainly due to him.

Mr. Nicholl then read the following paper:

STREET RAILWAY MILEAGE.

At one time the only records considered necessary were one of the total mileage made per day on the entire road, and this was kept in a rough way and was only used in figuring earnings and expenses per mile at the end of a certain period. During the horse car days an estimate, in many cases, sufficed, but the change to electric traction demands a most complete and accurate record, not only of the total daily mileage for the road, but of each route, individual car, the various systems of equipment and trucks, also for the different parts of an equipment viz., wheels, gears, pinions, armatures, brake shoes, trolley wheels, etc. In fact, the mileage is the chief, and in most cases, the best and only basis on which to figure statistics in reference to earnings, traffic, the various operating expenses, etc. In this way it brings every item down to a standard for comparison, and thus proves an almost indispensable guide to economy.

With the object in view of having, as near as possible, an absolutely correct system of computing its mileage, this company has spared no effort, with the result that the system now in force works to perfection, and answers our requirements in every detail.

We operate 78.73 miles of track in Rochester, covering an area of about 18 square miles. Some of our routes are quite intricate, and on part of them we have as many as six turning points where we can turn part of our cars, as the traffic on the balance of the line may not warrant the same service as nearer the city. In some instances our cars run on several different lines during one day. Our average daily mileage is between 13,000 and 14,000 miles, or about 5,000,000 miles annually.

In the first place, our engineers made a very careful survey of each line, and mapped same out to the scale of 400 ft. to one inch. These maps show all switches, crossovers, junctions, cross streets, etc., and the distances are given from commencement of the line to all points where it is possible to turn. From these maps we have figured tables for any specified number of trips or half trips in either direction on each route.

Each motorman makes report of the number of trips made by his car daily, on a card which answers a threefold purpose. In addition to giving the number of trips made, it answers as a time card and also as a trouble report. Any motorman taking out a car makes out one of these cards which he hands to his relief, and the man pulling the car into the barn drops this card into a box provided for the purpose. The night foreman has access to this box, and from the reports finds out all repairs necessary to be made, and anything he is unable to complete he reports to the day foreman. Every motorman is advised of the importance of having his trips, time, etc., correct, and is required to account for any trips lost and also to report any defect which he may notice about his car, and if he fails to do so is held strictly accountable.

The trip cards are checked with the starter's report, so that no cards can be left out; also the time of leaving barn and pulling in must agree, and there is no chance of anyone getting more time than is actually put in, as the time a man leaves the car must agree with the time his relief takes it. From these trip cards the mileage is figured by routes, the mileage for each car being put down separately on the slip. The individual car mileage is then posted daily to the credit of each car in a book provided for the purpose, and the amounts are carried forward monthly, so that when we want the mileage of any article we have only to subtract the mileage at the time the same was put into service from the total mileage made by the car on which it is used, at time it comes out. The route mileage is posted up daily in a book provided for this purpose, and in this way we get the mileage of each for the month or year; the earnings are also shown on this book.

A daily report on another blank is made for the manager, which shows the mileage and earnings on each line, also weather, etc. It also gives the corresponding figures for the previous year. A monthly mileage, earnings and passenger report on another blank is also rendered. This furnishes a comparison between the current and previous year, for each line. It shows the mileage, total earnings, earnings per car mile, passengers and transfers. It also shows the increase or decrease, as the case may be, and affords an excellent guide in regard to service that should be provided for each line, and we can thus keep each individual route up to a standard. From the figures on this sheet many valuable statistics can be deduced, especially in reference to traffic, etc.

On our monthly mileage statement we figure all the various operating expenses per car mile, showing also the corresponding figures for the previous year, and thus we have a very good comparison of results. We also keep records of the cost of repairs per mile on the various equipments in use; also of the life of car wheels and other parts of an equipment. In short, from the mileage we obtain most interesting statistics in almost every branch of the business.

MR. COLE: My system is similar in detail to the one which Mr. Nicholl describes; the motorman turns in a report which is taken off by the starter, and in all its details it is similar to the Rochester system.

THE PRESIDENT: Is there any road which does not keep a mileage record?

There was no answer to this question.

THE PRESIDENT: The next paper is "Facts and Fancies of Railroads," by W. W. Cole, of Elmira.

MR. COLE: Mr. President and gentlemen: in the preparation of my paper I have been guided, to a great extent, by the nature of the articles which have appeared in the public press. The public is being educated in the belief that the nickels taken in by street railroads are by some miraculous process being turned to gold, and the gold is used in the corruption of public men. Such assertions are an obstruction to the liberal policy of a street railroad, and hinder its good service, and at the same time it is an insult to public men. I believe public officials and railroad men should educate the people as to the facts and dissolve the fancies.

Mr. Cole then read the paper, which is given in abstract below.

FACTS AND FANCIES OF STREET RAILROADS.

To-day, if you pick up the reviews, the leading magazines or daily papers, you are confronted by writings as significant as the "Writing on the Wall." Everywhere we read the articles on municipal ownership and state government of railroads, committees of investigation, and the introduction of restrictive laws. In the many discussions of the distributions and gifts of franchises it may be well to define that a franchise is the right bestowed upon some party or parties to do something; that something to be of benefit to the general public, and it is always understood that if the parties obtaining the franchise have made intelligent calculations, and conduct their enterprise with experience and economy, they are entitled to remuneration, first, for their services to the public, second, for the intelligent application of their services and money. The municipality is a public business corporation, the railroad a private business corporation, but both are in the service of the public, with this distinction—if the municipality make mistakes in its management, the public must pay; if the railroad company be mismanaged, the individuals pay, and the public is still carried for the same price.

I will now quote from a current number of a magazine:

"Every legislator who, during the past winter, voted to give the enormously valuable street franchises of the cities of Chicago and Boston to private syndicates and corporations committed a crime against the living and oncoming generations. Massachusetts gave the special privileges of the city of Boston away for a quarter of a century, and the State of Illinois gave to a millionaire street car magnate the privileges of the city of Chicago for half a century. The city of Glasgow, Scotland, gives street car service for less than half the amount our citizens have to pay, and yet last year that city netted over $400,000 above her expenses. The street franchises belong to the citizens, to the society which makes the life of the city, and the giving of those franchises to private individuals is plundering the people of their own to enrich a few multi-millionaires. Our prisons are thronged with people who have been incarcerated for deeds essentially less criminal in nature and essence than those of many men who are now placing 'Honorable' before their names."

It hardly seems possible that such an article can be written in good faith, for if such conditions really exist, what benefit would really accrue from municipal ownership of street railroads, when these city officials whom we are led to believe are more criminal than the inmates of our state prisons, would be the very men to guide and manage the public corporation. Under such specious argument it is not surprising that it is further asserted "that corruption can be removed by doing away with franchises, or that when no valuable privileges are to be had, there will be no powerful organizations to corrupt the city, and that no good reason exists why the railroad should not be as well managed under public as private ownership of railroads."

If such statements are the facts and not fancies, is it possible, that in spite of inefficiency and corruption, that the net financial result would be more favorable than any which could be obtained from franchises? I would suggest to writers of such articles that they reform the cities first, and the railroads next, as corruption is a disease that cannot be cured by scattering it or driving it in.

The Citizens' Committee of Boston in its report states:

"Public ownership enjoys the benefits arising from the increased efficiency of contented, well paid labor, the economies of combination with other public departments, and the diminished cost per unit that accompanies the enlargement of business, consequent upon lower rates and the larger interest and patronage extended by the people to an undertaking of their own. Combination of the street railways with the gas and electric light plants would lead to large economies, and further co-ordination with highway, police and fire departments would increase the efficiency, safety and economy of all the services involved."

I believe this has been the experience of all trusts, whether formed by public or private business corporations, and like any other labor saving machine, a combination of effort well directed and guided must lead to success, whether conducted by a public or private corporation; but why should a railroad controlled by a municipality receive greater co-operation from police and fire departments more than the private corporation? As taxpayers we are entitled to all the protection and assistance to serve the public interests that could be rendered the public corporation. Again, this Committee states:

"The change of purpose from public ownership of a great monopoly means a change of purpose from dividends for a few to service for all. This change of purpose is the source of the improvement under public ownership in respect to cheaper transportation, a better paid and more contented ownership, a fairer diffusion of wealth and power, etc. This change of purpose will accompany the change to public ownership here as well as in Europe or Australia, and therefore public ownership of the railways here will cause a movement in the same direction as in Glasgow."

We will compare Glasgow with Boston. In Glasgow motormen and conductors are paid from $.85 to $1.12 for a day of ten hours;

in Boston they are paid $2.25 for a day of nine hours; and if Glasgow had brought the employes to the same state of contented citizenship, and made a fairer diffusion of wealth, as they already obtain in Boston, the vaunted $400,000 net would have been "nit."

The value of franchises, the possibility of lower fares or better service, the advisability of city ownership and all such problems can only be answered intelligently by the results already obtained. In Huddersfield, England, the financial statement does not indicate any great diffusion of wealth from municipal ownership of street railways. The operation of the lines for the year ending Mar. 31, 1895, resulted in a deficiency of £2473. Each year of the fourteen y ars of its history this tramway has run at a loss varying from £671 in 1882, to £16,626 in 1893, involving a total loss of £62,220. This has been met by transferring £20,982 from depreciation account, leaving only £340 to represent the depreciation of fourteen years. The remainder of the deficit has been made up by special taxes, ranging annually from ½d. to 5d. in the pound, and costing the ratepayers £41,238.

A factor which plays an important part in European schemes of municipal ownership is the low rate of interest which they would have to pay on the money spent in purchasing the railroads. This low rate of interest is the will-o-the-wisp, which will lead these advocates of municipal ownership into financial quagmires. The majority of persons urging the public ownership of railroads are moved by a desire to have the city receive large franchise returns, but these desires will not materialize from the facts. In the cost of labor as an index of the cost of city management, we find a situation that is, if possible, less promising in the matter of street railway operation than that of other managements. About 7 per cent of the operating expense of a street railroad company goes to pay labor; what would the city pay for the same wages? The general experience has been that policemen and firemen are better paid than the average railroad employe, and in many cities after twenty years of service, they can look forward to the retired list. Under municipal control, the railroad employe would not throw away votes, and as for the value of his services, he should certainly receive as much as a policeman. The management of street railroads requires qualities of the very brightest order, and a deficit in these qualities in generally followed by a deficit in the ledger. Most of our managers have grown up in the service, and have earned a long apprenticeship through the various departments before attaining their position, and if experience counts for anything, they are professionals. Our city officials are not professionals, as a rule, in matters pertaining to private corporations, and the committee of investigation is straining after an assumed standard of perfection, defective in theory and practice. The city official serves a composite personality which recognizes neither gains nor loss. On account of the short time of service of the various officers of a municipality, it is impossible for them to acquire more than a superficial knowledge of the intricate duties and methods of economical administration in serving the wants of the public.

The Englishmen secure poor service at low cost, and all Europe observes a policy which retards the rapid development that all America demands. In this country, the street railroad has made it possible for the working man to own a cheap, comfortable country home, and he can reach his work within the city in twenty or thirty minutes for five cents, with a ride of 7 or 8 miles. In Europe the workingman for two cents is transported perhaps a mile in ten or fifteen minutes, from a congested tenement house to his work in a thickly populated district, and with an inherited ox-like patience, he waits until a car comes along that has the prescribed amount of room.

There is an impression that railroads are generally overcapitalized, but when a real knowledge of facts is obtained, it is found that all roads constructed in the earlier days spent vast sums in the purchase of apparatus, and again, on the reconstruction which was necessary, to give the public the benefit of rapid improvements. This money was honestly expended, and to-day the public has the benefit of a liberal policy in the clean, well kept, up-to-date service generally rendered. And the men who have spent their money and time in perfecting this service are entitled to remuneration for both the service in actual operation and those benefits they have made possible throughout the land.

THE PRESIDENT: The next paper on the list is by H. S. Newton, of Syracuse—"Track Bonding: How Can We Obtain the Best Results?" Mr. Newton's paper is given in part below:

TRACK BONDING: HOW CAN WE OBTAIN THE BEST RESULTS?

The true importance of rail bonding, that is, the really significant factor it becomes in determining the cost of operation of the road is but indirectly realized, I am inclined to think, by the large majority of railroad men. There is an old formula in elementary electricity, for the energy developed in an electrical circuit. It is expressed in terms of the current and voltage of the circuit as CE, or in terms of the resistance and current as C^2R. Either of these expressions may be used to advantage in calculating the magnitude of leaks. An equipment consisting of a first class 600 volt voltmeter and a 250 amp. ammeter with a motor car and an accurate knowledge of the voltage carried at the station, are all the apparatus and data necessary to determine the quantities involved and to obtain with fair approximation the loss which is going on in the circuit outside of the motors and the generators at the station.

The first factor in the determination, viz., the loss in the trolley line, is, to some extent, a known quantity. You have already, or can figure easily the resistance of the trolley and the feed, and by assuming a certain volume of current, the amount of energy lost, varying, of course, with the power consumed, is at once arrived at. The second factor must be obtained by the subtraction of the determined factor from the total loss. For this total loss your instruments come in to play, and it is only by a series of readings on them with the car in motion on the road, and the determination thereby of the watts spent in running the motors, that a satisfactory result can be obtained. The difference between the voltage, as shown on the voltmeter, and the volts shown on the voltmeter at the station, multiplied by the current, gives us this result. The difference between this result and the loss obtained for the trolley and trolley feed lines by calculation should give us the loss in the track of the power employed for that individual car. The result is generally astonishing, especially if the traffic is heavy; and there are cities not a thousand miles from here where the sun of the horse car rail is not yet set, where readings will show a 50 and 60 per cent loss at certain times.

To obtain the best results a rail joint should have an equal—or better—a greater current carrying capacity than the body of the rail itself. We have all heard this theory advanced before, but we are all bound to acknowledge that we have never seen it put in practice except on a new piece of electrically welded track, on which the joints had not had time to break. Yet every city has portions of track through which a congestion of traffic and a consequent piling up of cars is forcing such a volume of current as to lead to serious power losses therein. The engineer will possibly remember of specifying a No. 0000 copper bond at the time the last piece of 9 in. girder was laid in the congested district, and of congratulating himself on thus getting what he thought was a first class job of bonding. And yet when he comes to consider that that rail has probably nine times the current carrying capacity of the bond itself, and the bond is only riveted or upset in some way in the hole in the rail, and instead of having six times its cross sectional area in contact with the steel of the rail, it has possibly two, he will perceive that there is some reason to doubt whether he has such a first class job after all.

A water works system which was so laid out that 10 per cent of the power at the station was spent in overcoming friction in the mains, would not be regarded with much favor. On the same principle, a street railway system on which a similar percentage of the power is lost in the rail should hardly be considered as a perfect example of electric railroad practice. Yet I will venture the assertion that there are not more than a score of roads in the United States to-day that can prove a more satisfactory condition of affairs. The trolley feeder systems are carefully calculated, but how the rail is bonded is usually regarded as immaterial, on the theory that the ground will take care of what slops over.

In Syracuse we use the soldered bond with no track feeders on the permanent way. The bonding is of No. 0000 capacity and double throughout. The congested district of the city, the common center, is not (as it should be) bonded to equal the capacity of the rail section. Our financial backing has not been educated to that extent as yet, and would regard such an outlay as extravagance. The whole track, however, is in such a condition, where the above named bond has been used, that a low reading voltmeter has failed at any time to detect a difference of potential between water pipes and rail, and the Western Union Telegraph Company, with its keen nose for electrolytic action, has been unable to locate a drop between its lead covered return and the iron of the rail, the attempt being made with an instrument reading to 0.01 volt.

The importance of a true metallic return cannot be overestimated. Where the chance for corrosion between bond and rail is allowed to remain the certainty of an interrupted contact one day is assured. The jar produced at the joint by the impact of the car wheels results in vibration enough to loosen fishplate bolts, and in the natural course of events must loosen rivets as well. The rail should be one mass of continuous metal throughout to give permanency of electrical contact. It must therefore be homogeneous. To make it so some process of brazing or soldering must be adopted. The former process has been found impracticable except in cases where it is possible to take advantage of welding currents, or return currents of immense volume. These can be obtained ordinarily only at the power station, or by a large expenditure for special welding apparatus. With these considerations in view the conclusion is forced upon us that the really practicable process is to solder the bond to the rail. Experience has proven it economical in first cost, and most desirable in the character of the results obtained.

The current carrying capacity, or the number and sectional area of the bond conductors, should depend upon the location of the track, many and large for the crowded districts and at the points where the great volume of return current flows before entering the return feeders to the power house, of smaller number and capacity in the outlying districts. With these provisions for perfecting the ground comes, as a matter of course, freedom from electrolysis and water and gas pipe corrosion, and a saving in overhead negative feed lines, which should be of immense importance in the design of the permanent system.

MR. MCNAMARA; I wish to ask the writer of the paper the method he uses of placing the bonds in position, whether an attempt could be made to get six times the conductivity of the area of the bond wire.

MR. NEWTON: We get nearly ten times. The contact between the bonds and the rail is made through a plate at the terminal at

each end of the bond which is so designed as to have about ten times the surface of the cross section of the wire itself.

MR. MCNAMARA: How do you distribute it from the wire?

MR. NEWTON: The bond has six times the area of the cross section of the copper conductor and comes in contact with an equal surface of the rail.

MR. MCNAMARA: How do you secure that, with No. 0000 wire?

MR. NEWTON: It has contact terminals cast on the ends of the wire which are soldered to the web of the rail.

MR. MCNAMARA: Do you do that by increasing the diameter of the terminal or spreading out the copper in some way?

MR. NEWTON: There is a bond terminal about 2¼ ins. diameter cast on the copper.

MR. MCNAMARA: I am much interested in this paper as in anything that Mr. Newtown undertakes to discuss. I am sure there is no one thing that street railroad men give more attention to at this time, than the perfect bonding of the tracks. Not only for economy and operation, that is, to utilize all the power generated at the station, but to get rid of what I feel is coming one of these days—large claims for damages by reason of electrolytic action. I am sure if no other paper had been read to day than the paper read by Mr. Newton I would feel repaid for coming here. While I am up I want to speak of Mr. Cole's paper. This bugaboo of municipal ownership is something which alarms us unnecessarily. If a majority of the people of the state of New York decide they are going to own the street railroads of the state, what are you going to do about it? Are you going to revolt? There are not enough of us. A large number of the people of the state of New York are determined that it is economy and good for the people to own all the street railroads, telephones and telegraph companies. What are you going to do about it? Nothing except to surrender your property and get value for it. I think that one way to bring about that result is to continually try to demonstrate that municipalities cannot run railroads. You should not do anything of the kind. We should stop it, because the radical result of the thing would be that the people would determine to own the railroads. They will appoint commissions and take them, and we will have to take the money and get out and do something else, and the municipalities will run the railroads. The way to hasten that day is to get on the hilltops and mountain tops, and in railroad cars, and say that municipalities do not know how to run railroads and never can run them with economy. What do the people care about running things economically? What does Greater New York care about economy? Are they going to run that city with economy? No. They are going to have a good city run in tip-top shape no matter what it costs. I am sorry that this matter of municipal ownership has not been more thoroughly discussed. I want to call attention to a paper in this month's STREET RAILWAY JOURNAL by Edward E. Higgins, a very thoughtful paper on this subject of municipal ownership. I understand he is discussing the subject with Mr. Warner, of New York, who takes a stand in favor of municipal ownership. I commend this paper to every member of this association as a thoughtful and able paper on the subject, and while I differ entirely from the conclusions and the remedies which Mr. Higgins suggests I am very much indebted to him and I am sure every member of the association would be if he read the paper. Mr. Higgins has adduced some valuable facts and has stated them in a very plausible manner in comparing the service to Glasgow with that given in Brooklyn and Boston, two cities of equal population, but of much greater area.

MR. COLE: I would say that I think the people should be educated by our public men to understand that every time a law is passed which is beneficial in a measure to a railway that it is also a benefit to the people, because the railway is enabled to give better service. The newspapers should not howl about bribery, because the laws sometimes give a benefit to the railroad. A railroad company does business on the same principle as a merchant. They have something to sell; they sell rides on their cars. The more attractive they can put the ride on the market the more rides they will sell. The mere fact that the public patronizes roads in such large numbers shows that they appreciate these efforts and they should be educated to appreciate that laws passed for the benefit of surface railroads are also for the benefit of the people at the same time.

THE PRESIDENT: The paper by C. L. Rossiter, of Brooklyn, "Advantages of Up-to-Date Street Railway Service; Why the Rate of Fares Should not Be Reduced," is next on the programme.

The secretary read Mr. Rossiter's paper, which is given in part below.

ADVANTAGES OF UP-TO-DATE STREET CAR SERVICE; WHY THE RATE OF FARE SHOULD NOT BE REDUCED.

One has only to recall the wretched transportation facilities of horse car days to appreciate the advantages of an up-to-date street railway. We remember the small, dimly lighted horse cars, so cold in winter that straw was placed in them to keep the feet warm, and so poorly lighted that it was impossible to read in them. Insufficient horse power frequently made it necessary for passengers to get out and assist the horses on the steep grades. To day over 80 per cent of the street railways in this country are operated by electricity, and millions of new capital have been expended in constructing the necessary new tracks, cars, electric equipment and expensive power houses, so that to ride in one of the modern cars of an electric railway to-day is a positive pleasure, and thousands of dollars of the income now received by the roads comes from this pleasure riding.

The electric street railway to-day is essential to every city, not less so than its department of sewers, water and street lighting and, in fact, the railroad in nearly every case is the pioneer in all the improvements and building up of the city. The railroad corporations are very frequently looked upon as being antagonistic to the city's interests and both the public and the city are oftentimes inclined to impose unjust burdens and hardships upon the roads, when, in fact, the capital to construct the railroads is furnished by banks, trust companies and organizations having in their trust the savings of the people.

It is only a few years since the western part of our country was almost unknown, its wonderful fertility and resources of no profit to mankind. It required only the railroads to make possible the populating of it, building up its vast area and bringing its enormous yields of grain to the Eastern market, thus adding untold wealth to our nation. In the same way, the up-to-date electric railway opens up the suburbs of our cities and makes it possible for those of moderate means to find pleasant and healthful homes, obtainable in no other way, and enriching the city by adding to its taxable value.

The purchase of a piece of farm land for building purposes in the suburbs of any of our cities is followed immediately by a request upon the local railway to extend its line, and without such extensions it will be found that the city itself will be very slow to make expenditures for the improvement of the streets and sewers, water mains, etc., and next to impossible to get the gas and other companies to extend. In support of this statement some figures in regard to Boston are very instructive, showing as they do in the case of Brookline, a suburb of Boston, that in thirty years from 1855 to 1885 the increase in value was from five and one-half millions to sixteen millions, while in the next five years, with the introduction of the street railway, the value increased to thirty millions. Another case that will illustrate this has occurred in Brooklyn. During the year 1896 one of the roads constructed an extension some 3 miles in length through an entirely new territory where the streets for blocks had not been cut through and no improvements whatever made to the adjoining property. To-day, less than a year, some 500 houses have been built, nearly all of them being occupied as soon as completed, on the line of this street and adjacent side streets. If it had not been for the railroad extension not one of these houses would have been built, and it can be readily seen that it is not the railroad company which will reap the first benefits, but the city, which will have increased its assessment roll not less than $3,000,000 in the present year and the opportunity given to hundreds of individuals of finding comfortable homes. If the city and the public treat the railroad companies justly and fairly there will be no trouble caused by the policy that the companies pursue, as nothing pays better to the owners of the railroad property or to the city itself than to have an up-to-date railway in its cars, equipment, tracks and facilities, and the roads can be trusted as they continue to be prosperous to give the greater part of every nickel that is taken in to the public in the shape of good wages to their employes, thus securing competent and reliable men, and also expending, as it can afford to do so, the necessary money for extensions as required, and for new cars and equipment properly maintained, and the companies will continue this policy so long as the public show appreciation of it by patronizing the cars. On the other hand if the earnings of the road are not sufficient to properly and well maintain the property, the spectacle of old cars and equipment and negligent employes will be seen, and while this means loss to those who have invested, it is no less a direct loss to the city and the public which has such a railroad. To secure the needed funds for extensions and improvements of our electric roads there must be a perfect understanding between the city and the owners of these properties. If the city places unnecessary burdens and taxes on the roads that cannot be met, then those who are called upon to furnish the capital will refuse to do so and the city will lose ten-fold more than it could possibly gain in any other way. If the railways to-day can maintain friendly relations with the city's representatives and give to them and to the public full information as to the financial and physical condition of the properties a much better understanding will be had and the final result will be to secure the good will of those on whom success of the railroads depend. An up-to-date street railway service pays the company itself, particularly if it has a competitor who is not up-to-date, and it pays the city and the public in the immediate benefits they receive in clean, attractive cars, good service, and freedom from accidents, and it pays the employes of such a company to be identified with it and to assist in bringing such a result about as well as in good wages promptly paid.

In regard to the matter of fares and why they should not be reduced, I want to say at the outset they have been reduced, and to-day the street railways of this country are carrying passengers a longer distance and at cheaper fares than in any other country in the world. The distances in the ten largest cities in this country where the public is carried for a single fare of five cents range from 9.9 miles to 18 miles—this latter in Brooklyn. In horse car days a ride of 5 miles for a single fare was a long one and the average was below this. The railways in Glasgow, Berlin and some other foreign cities are frequently referred to as furnishing lower rates of fare. This is not so. On the contrary, they are not only much higher, but have many disadvantages which would not be tolerated in this country. The average and usual rate in England is two cents for the first mile and one cent for each mile thereafter, and this works injury to the laborer and artisan classes. In this country the average rate is from one-fourth to one-half cent per mile, and in many

cases less than one-third cent per mile. Abroad five representative cities average 11,099 population per mile of track. Seven of the largest cities in this country average 2127 population per mile of track. This meaus that the laboring classes and artisans abroad are compelled, on account of the high rates of fare to the suburbs, to live in the crowded quarters of the city to the menace of their health, and this overcrowding and density of population are causing much concern to the cities. On the other hand, the railroads in this country with five times the tracks and facilities to the same population give to those who desire it the opportunity of finding comfortable homes in the suburbs where their families can be properly brought up. In the matter of wages, English conductors and drivers receive from 85 cents to $1.12 per day of ten hours. In this country the conductors and motormen receive from $1.75 to $2.25 per day of ten hours. Very many trips are run on all our roads for the accommodation of the public on which the revenue taken in does not equal the wages of the conductors and motormen, and the average street railway to-day with the luxurious and comfortable electric car well lighted and well heated in winter gives the cheapest transportation in the world.

It has been said that it would be an ideal condition to have the street railways all confined to some lonely field in the remote country, where they could be run on time, never crowded, and quite unobjectionable, but quite useless also; but as crowded thoroughfares are unavoidable in a large city and means of transit indispensable, the problem is, how best to accomplish it to the benefit of all concerned. Complaint is too often made without cause and without reason. The fact is that most of the roads are giving better service to the public than they can afford, the trouble being that the people expect too much for five cents.

J. P. E. Clark read the following paper by Robert Dunning, of Buffalo, on "The Repair Shop."

ELECTRIC STREET RAILWAY REPAIR SHOPS.

The repairs of the electric road which operates twelve or fifteen cars, are, generally speaking, as varied in character as those of a much larger road, but it would be impossible for the small road to maintain a repair equipment equal to that of the large road, so much of their repair work must of necessity be done outside. But it is of the larger road which I speak. The road which operates from 100 to 400 cars. In the lists of machinery and tools which I have prepared I have aimed to give only those which are most generally useful as the volume of work increases. Many little conveniences for its quick and easy handling will suggest themselves and can be added to the equipment.

The machine shop with its auxiliaries—the blacksmith shop, truck shop and armature room—naturally takes precedence in repair work. The value of a convenient arrangement of these departments and the proper location in each of work benches and machinery to give full working space cannot be overestimated. To find that you cannot operate your speed drill press at times on account of work in the shaper or planer being in the way is aggravating and unprofitable. In a factory where new work is being turned out, space may be economized, but in a repair shop you know not what a day may bring in to you. A good rule to observe in this matter is to take as much room as you think you will need and then double it.

A lathe equipment consisting of one 24 in., one 20 in. and one 10 in. speed lathe will meet all ordinary requirements of that class of work. The larger lathes should be provided with jib crane fitted with differential of air pressure lifts for the safe handling of heavy work.

Two large drill presses 22 ins. and 26 ins. and one speed drill press will do the work of that department.

The other machinery may be listed about as follows:

A good milling machine (not necessarily universal).
A shaper with 18 in. stroke.
A hydraulic wheel press.
A pinion press.
A vertical wheel boring machine.
An axle lathe.
A power shearing machine.
A power hack saw.
A power thread cutter, right and left.
A power punch.

And the necessary bending and shaping machines for sheet iron and tin work.

The grinding work can be done with one dry and one wet grinder, a fine and a coarse emery wheel, and there should also be a set of buffing wheels for finishing car and electric fittings.

A babbitting furnace and suitably arranged gas or charcoal stoves are a necessity. The air for blowing these fires may be provided by a tank and pump operated from a special pulley on the overhead shafting.

The necessary vises and hand tools must be according to the men and the work, but in the matter of wrenches I prefer the solid jaw fitted to standard nuts to the screw or set wrench. A good arrangement with regard to tools is to have a special tool room in charge of a competent tool maker and a check system for the purpose of making the workmen responsible for tools drawn.

In the armature room, besides the necessary work benches and armature stands, a binding machine, a field winding machine and bake oven are essential. A jib crane or overhead trolley with chain falls is necessary for the proper handling of armatures, and a full outfit for testing work completes this outfit.

Have system in the arrangement of work benches. Keeping the different kinds of work separate, you will thus avoid the delay and trouble of hunting for mislaid pieces.

The truck shop, besides the usual assembling tools, should have an overhead hand power crane, of from 4000 to 6000 lbs. capacity, for the safe handling of motors, etc.

The carpenter shop next claims our attention. The same rules which apply to space and arrangement in the machine shop apply here.

The following outfit of machinery will do for all ordinary work:

1 planer,
1 resurfacing machine,
1 jointer,
1 mortiser,
1 boring machine,
1 shaper,
1 woodturning machine,
1 band saw,
1 emery wheel,
1 good grindstone.

A first class man should be in charge of the machinery, who thoroughly understands the grinding and sharpening of tools, and it should be his work to see that, not only are the machines kept in order, but also that tools owned and used by workmen are in proper shape.

In the space devoted to work on car bodies see that there is plenty of room for necessary trestle benches and the convenient handling of work. Pit room for half a dozen cars is a necessity. As a means of moving cars and trucks between carpenter machine and truck shops, an electric transfer table will be found most convenient.

The paint shop should be constructed so that it will have good roof light, and the width between the tracks should be sufficient to allow the work to be performed on cars standing parallel and not to crowd the workmen; in other words, the gage lines of tracks should be between 7 ft. and 8 ft. and should be of such capacity so as to have the cars pass through regularly every nine or ten months.

The floor should be concrete with a smooth surface, so that it can be easily kept clean and free from dirt, and it should also be graded to be easily drained. The power for operating the machinery can generally be best furnished by motors in each shop conveniently located, and so set up as to permit of quick substitution in case of a burnout, or breakdown.

Many small repairs which can be done by hand, such as the replacing of trolley wheels, switches, bell or register cords, etc., can be as well done in the car house proper as in the shops, and result in a considerable saving of time, and I think it well to have tracks set aside for this work and have the conductors of cars instructed to run cars in need of certain repairs on to those tracks when coming into the barn, and to leave a note on file in the barn foreman's office stating repairs needed.

In the whole general scheme of repair work there are minor but yet important parts which go to round out and complete the whole. Among these is the pattern maker, a visit to whose den shows many minute reminders of the transitory state of affairs even in the street railway business, and the draughting room where a look through the drawers and pigeon holes reveals many ideas "born to blush unseen" by the outside world.

The management which has the interests of its road constantly in mind will keep ever closely in touch with the repair department. Do not be afraid of doing too much for it. The fault is generally the other way, for though it works in dirt, and as a rubbish producer is unequaled, it is but performing the vital work of renovation and removing that which is dead and is acting as a clog to the whole system.

I do not wish to create the impression that repair work is the one great and vital factor in street railroad economy, but I do wish to claim a high place for it. Look well to the repair department.

On motion, adjourned until Wednesday morning.

A brief meeting was held on Wednesday morning, at which no business was transacted, and the meeting adjourned so that the delegates might take a trip to Lewiston. At three o'clock in the afternoon the meeting reconvened.

PRESIDENT ROGERS: I appoint as the Nominating Committee, Messrs. Moffit, Robinson and McCormack.

The paper by H. H. Vreeland on "Municipal Ownership" was then read. It is given below.

MUNICIPAL OWNERSHIP AND OPERATION OF STREET RAILWAYS.

I wish first to clear this question of what may be called an expired claim, which agitators imagine has still some vitality. When originally broached, *municipal ownership* was coupled with the idea of *municipal operation*, but this claim has been formally and publicly abandoned by the most advanced spirits in this so-called reform.

It is not to be expected that an advocate of municipal ownership and operation will be influenced by the statements of a railroad president on the subject. I take it, however, that both those who have a "professional" and those who have only a sentimental interest in this debate will accept as final the statements of such men as Dr. Albert G. Shaw, of Johns Hopkins University, and author of "Municipal Government in Great Britain" and "Municipal Government in Continental Europe," Louis Windmüller, president of the Reform Club; J. Harsen Rhoades, Allen Ripley

Foote, author of "The Law of Incorporated Companies Operated under Municipal Franchises;" Frederick W. Wurster, mayor of Brooklyn; Charles A. Schieren, ex-mayor of the same city; John Joralemon, president of the Board of Aldermen of New York City, and a number of others equally distinguished, whom I will quote in support of the assertion that the idea of municipal operation has been abandoned as part of the doctrine.

Dr. Albert G. Shaw, in a sworn statement made to a committee of the Legislature in November, 1895, in answer to a question, said: "I have never dreamed of advocating municipal ownership in the city of New York. I have never thought of it as a remedy."

Louis Windmüller, in May last, said: "I am opposed to the municipal ownership of public franchises. I think we have already too much paternalism, and that the business would be better conducted in the hands of private individuals or companies. We had a discussion about that some time ago in the Reform Club, and I was very much opposed to it, as we already have enough of political patronage as it is. I think the business is better conducted by private enterprise; more honestly and economically than it would be under the municipal government's control."

At the same time, and in the same discussion, Robert B. Roosevelt said, "I am not in favor of government control of any more businesses."

Continuing the discussion, Charles A. Schieren, ex-mayor of Brooklyn, said: "I have no opinion to express as to the advisability of a city owning these franchises and itself operating them. When I was in Glasgow, the mayor of that city said that he was of the opinion that the city should not own its street railways."

John Harsen Rhoades, on the same occasion, said: "I am opposed to public franchises being run by municipal ownership, for the reason that, under our republican form of government, there is already too much power exercised by the political parties of the day toward controlling the votes of those who are directly or indirectly in their service. In my judgment, to add to this power, with all the opportunities for corruption and bad management which have heretofore characterized so many of the municipal governments, would be a very dangerous thing."

Frederick W. Wurster, the mayor of Brooklyn, discussing municipal ownership of gas works, took occasion to say: "I believe it advisable for the city to manufacture its own gas. Ownership of street railroads is something that should be carefully studied before it is adopted, from the fact that there are now in the employ of the different railroads of the city of Brooklyn 10,000, yes, I should say, nearly 15,000 men, and the question of so much patronage being given to any party is one that should be very carefully considered."

Speaking of the city railroads, John Joralemon, the president of the Board of Aldermen of New York City, in a voluntary contribution to the discussion, said: "I am of the opinion that private corporations can manage such large enterprises much more economically than would be practicable for a municipality."

John H. Inman, late Rapid Transit Commissioner, testified under oath before the Legislative Committee, whose findings conclude this array of authorities, when asked his opinion on the subject of municipal ownership of railroads in the various cities of the state: "I do not favor it at all, except for perhaps a large enterprise like the proposed subway road in the city of New York; generally speaking, I do not favor municipal ownership of property of that character."

The late William Steinway, in this same proceeding, in answer to an identical question, said: "I would be entirely opposed to it. I think it would be a huge political machine, a refuge for old political hacks, no good for anything, and would make no money; the operation of these things should always be left to private enterprise, when the city's interest is properly protected."

C. E. Curtis, in the *Yale Review* for May, 1897, thoughtfully discussing the relations of street railways to the public in Great Britain, Canada and the United States, says: "For American cities to undertake this experiment (the ownership and operation of street railways) would involve such grave objections, through political abuses, as to far outweigh the possible advantages, especially as it is yet to be shown that the working of the tramways by English municipalities has in itself wrought substantial benefit to the citizens."

If further authority than this is needed, it will be found in the quotation herein from a report made to the Legislature of New York, by a special committee appointed for the purpose of investigating the subject of the alleged public demand for municipal ownership and control. This report is contained in two bulky volumes, accompanied by the testimony taken by the committee and published by the state as a public document in 1896. That committee not only failed to find that the demand for municipal ownership was supported by public sentiment, but reported directly against it in unequivocal language.

With the testimony before them, the Committee of the Legislature reported back to that body: "We have attempted to give all classes an opportunity to be heard on the question of municipal ownership, and many have appeared before the Committee and expressed their views, giving their reasons for or against the various municipalities of the state embarking in this business. But few have advocated the ownership and operation of railroads by the cities. The preponderance of testimony taken and the majority of opinion expressed before this Committee are against the subject so commonly referred to as municipal ownership. It is obvious, under our present system of municipal government, the ownership and operation of railroads by the cities and municipalities would have a tendency to convert these enterprises into powerful political machines, the results of which would be detrimental to the public welfare. Under all the conditions and circumstances it would seem that the ownership and operation of street railways by the municipal authorities is quite impracticable at the present time. As an abstract proposition we believe that no government, national, state or municipal, should embark in a business that can be as well conducted by private enterprise. The reverse of this proposition carried out to a logical conclusion would put all business enterprises under governmental management and control, and leave to no citizen any hope, ambition or aspiration beyond that of seeking an official position that affords a meagre existence."

While the claim that municipalities should *operate* franchises may still have some pleaders, they are among the class of place makers whose motives are so apparently selfish that honest public sentiment gives them no support, since it sees behind the plan the danger of multiplication of offices and enlarged opportunity for political patronage and corruption. If, then, we consider the subject with this original menace of municipal operation removed, the doctrine, in its bearing on railroad properties at least, is divested of some objections that were common alike to the conservative public and to railroad owners.

So far as the city of New York is concerned, all that is left of the original claim in favor of municipal ownership has been conceded in the normal development of the law, for that municipality now owns such franchises as have not already been given or sold to the highest bidder at public auction. To-day, with us, no franchises can be legally given away; regulations are prescribed by statute under which they are sold, in open market, after long notice, to any one who offers the highest price for them. This highest price, by the way, is so fixed that it varies with the growth of the gross receipts earned from the franchise granted.

There remains, then, concerning the roads now in operation, the single question of municipalities purchasing back those franchises which they have already given and sold. Franchises that were given away in the early history of street railways in New York City were of little value at the time of granting, and the history of their development and the difficulties experienced in obtaining money to build and operate them would be interesting reading to those who insist on discussing them from the point of present value. The stock of some of the horse car lines in New York City was given away in payment for hay, oats and bedding, at 25 per cent of its face value, and was only accepted at that rate for the reason that there was nothing else with which to pay. The heated advocates of municipal ownership and operation are ignorant of facts like these, and insist on discussing the original grant from the point of present value—a value largely imparted to them by the enterprise and good management of their owners. It is unfortunate, too, that the case of railroad franchises has been complicated in this discussion with that of other quasi-public grants, because the merits of our position are distinct. The benefits which street railway development have contributed to cities in a variety of ways is beyond calculation. Through its agency the death rate has been reduced by relieving the congestion of population in certain crowded areas, and it has increased the taxable value of real estate enormously. The careful consideration of this last economical feature of the question might well form the subject of a separate paper. I have not the time here to do more than to suggest the subject as a topic for future discussion.

If, in the face of the deliberate utterances and warnings of those who have officially investigated the merits of the question, it should still be determined that the municipalities of the state should reacquire the street railway franchises, heretofore disposed of, two matters, so far as New York City is concerned, will come up for discussion and consideration in this form:

How is the city to take possession of the property and rights now owned by private corporations?

What improvement can the city make to relieve the public from the "wrongs" which demagogues have invented?

An intelligent answer to the first question requires that reference should be made to the character of the property of a street railway corporation. The property of such a corporation consists of its real estate, which includes land, buildings and track; its personal property, consisting of cars, horses and all movable chattels, and its franchise to construct, maintain and operate its road.

It is quite apparent that the franchise is the element which gives value to the corporate property. It is that upon which the earning power of the corporation depends, and it is that which gives value to the corporate stock. The character and nature of a franchise as property has frequently been the subject of consideration by the courts.

It has been uniformly decided to be a contract and entitled to protection against legislation which would destroy it, or which by some alteration of the charter would impair its obligations. Corporations are entitled to have the clause of the Federal Constitution liberally construed so as to secure their franchises every immunity in such respects.

In the case of The People *vs.* O'Brien, which arose out of the legislation which annulled the charter of the Broadway Surface Railroad Company, it was decided by the Court of Appeals that while the Legislature might annul and dissolve the corporate body, the franchise survived the dissolution of the corporation and was irrepealable and indestructible, and was property, the value of which could not be taken from the creditors and stockholders of the corporation either through the action of municipal officers or by the Legislature. That the grant of the right to construct a railroad in

the street was in perpetuity, and the title thereto was indefeasible, and that the track and the franchise to maintain and operate the road were inseparable. In another recent case before the Court of Appeals it was decided that the Legislature could not destroy or confiscate the property and franchise of a corporation, and that while such property was, like all other, held subject to the right of the state to appropriate it for necessary and reasonable public use, that could only be done upon just compensation being provided to be made therefor.

In the case of the Monongahela Company *vs.* The United States, decided by the Supreme Court of the United States in 1893, there was an express direction in the Act of Congress authorizing the acquisition of the plaintiff's property, that the franchise to collect tolls, which the corporation possessed on the Monongahela River, should not be estimated or considered by the commission appointed to appraise the value of the property. But the court held that the right to take tolls was as much a vested right of property as the ownership of tangible property, and that the National Government, under the power to take property for public use, could not deprive the corporation of its right to take tolls without just compensation being made therefor.

The power of eminent domain, which is the reserved right of the state to take and appropriate private property for public use, can be exercised only under the constitutional limitation, that compensation must be made for all property taken, and when not made by the state it must be ascertained by a jury or by commissioners appointed by the court.

Assuming that ownership of street railways would be decided by the courts to be a municipal power, under the Constitution the power of eminent domain can be delegated by the Legislature to municipalities, and it could be, through its exercise, in the absence of agreement with the corporation, that railroad property and franchises now in existence could be acquired by the cities of the state.

Municipal ownership of street railways has never been the policy of this state, and before there can be such ownership the municipalities must be empowered, by appropriate legislation, to acquire and hold such property. When such enabling statutes are passed and the power of eminent domain delegated to the cities, street railroad property now in existence may be either purchased by agreement with the corporation owning and operating it, or may be taken after the value is ascertained by the method I have pointed out. In ascertaining and fixing that value, the most important element will be the value of the franchise to maintain and operate the road, and in fixing that, due regard must be had and due effect given to the future growth of the locality in which the roads are operated, and the life or term of existence of the corporation owning them, and the reasonable and just expectation which those who have invested money in such property or its securities had in mind when so investing.

It is quite plain, therefore, that to acquire many of the existing roads in the state would impose upon the cities taking them a large burden of debt and taxation, which, in some instances, it is not improbable, would be entirely beyond the limit of indebtedness which the Constitution imposes upon the municipal corporations of the state.

The answer to the second question, in view of the suggestion made in the authorities I have already quoted, will be obvious when I have stated what private ownership and consolidation under the Metropolitan Street Railway system in the city of New York have done for the traveling public in that city.

Nowhere in the debate on this subject have I been able to find, even in the statements of the most heated advocate of municipal ownership and operation, any denial of the fact that the centralizing under single management of the various railroads that make up the Metropolitan Street Railway system has improved the public comfort and convenience. The extent and nature of the benefits which this centralizing has achieved is best shown by the statistics. The following table shows the expansion of its transfer system for the last ten years:

Year.*	Miles of Track.	Paying Passengers. Total Number.	Transfer Passengers. Total Number.	Transfer Passengers. Prop. to Paying.	Average Fare. (Cents.)
1896–97...	190	177,338,677	56,929,611	32⅛	3.78
1895–96...	172	145,965,251	28,450,996	19	4.18
1894–95...	140	109,6[illegible]6,472	9,671,697	9	4.59
1893–94...	131	107,036,524	5,306,654	5	4.76
1892–93...	80	63,011,785	3,203,832	5	4.76
1891–92...	61	45,239,670	2,643,800	6	4.72
1890–91...	37	39,971,929	2,766,080	7	4.68
1889–90...	36	39,571,464	2,523,239	6	4.70
1888–89...	36	37,386,809	2,206,866	6	4.72
1887–88...	36	37,318,730	1,996,871	5	4.75

*Years ending June 30, except 1887–88 and 1888 89, which ended Sept. 30.

From this table it will be noticed that in the first seven years about one passenger out of fifteen or twenty received a transfer; in the year 1894–95, one out of every eleven passengers received a transfer; in 1895–96, one out of every five; and in 1896–97 about one out of every three.

The phenomenal development by the company of this great privilege speaks for itself. By means of it, the general fare during the whole day has been reduced to 3.78 cents, and during the crowded, rush hours of morning and evening, when the working people are going to and coming from their work, the average rate of fare is only 2½ cents. This transfer system, like the lighting of cars and various other improvements, was done without legislative compulsion and in accordance with the settled policy of the company to increase public safety and cheapen transit.

While voluntarily developing this transfer system, the company has also made large contributions annually to the funds of the city and state. A resolution was recently passed by the Board of Aldermen of New York City, demanding that the Comptroller furnish the Board with a statement of the amount of taxes paid by the various street railroads in the city of New York, and the Comptroller furnished it with the following table, showing the amounts paid, during the year 1896, by the Metropolitan Street Railway Company and the Metropolitan Traction Company :

CITY TAXES.

Percentage of receipts	$ 43,101.93
Fixed rental	150,000.00
Car licenses	40,280.00
Personal tax	39,114.27
Tax on real estate	112,607.30
Track taxes	54,489.75

STATE TAXES.

Percentage of earnings	$90,000.00
On capital stock of Street Railway Company	20,000.00
On capital stock of Traction Company	42,000.00
Total	$591,593.25

In this statement no account was taken of the contributions of the company, amounting to over $100,000, in the shape of repaving and maintaining pavements.

The time is ripe, I think, for a clear understanding of what municipal ownership means, and if one could be assured that those who advocate it comprehended the question, there would, to my mind, be no cause for heated discussion. The trouble with the discussion thus far has been, that most of those who have taken part in it have either been ignorant of the truth, or have willfully ignored facts that were within easy reach. When people are informed that railroad franchises are no longer given away in New York City, but that they are sold by the municipality, after a long advertisement, to the highest bidder, for a percentage of the gross earnings, which secures to the municipality a participation in the yearly increase of the business developed by the company along the line in question, and by means that bring to it the contributing travel collected along and on about 200 miles of road elsewhere in the city, it seems to me that loose talk about franchise grabbing will not find attentive listeners.

The trouble is that the question is discussed, not in the light of existing conditions, but with continual reference to methods and practices long since obsolete. It would not be a greater anachronism to discuss transcontinental travel from a stage coach point of view than to refer to the present system of traffic in cities as most of the advocates of municipal ownership insist upon considering it. No later than fifteen years ago the only revenue the city received from these franchises was in the shape of car licenses; whereas, to-day, as I have shown in the figures given above, a single corporation contributes over half a million dollars to the public treasury.

I have nowhere seen any definite figures presented by the advocates of municipal ownership and operation, so far as it relates to street railway properties, and I think, that when these figures are arrayed, the gentlemen who advocate ownership and operation will hesitate. Roundly stated, the street railway properties in the city of New York, and they are only a small portion of the franchises proposed to be taken, can be purchased for about $295,000,000. I hardly think, that in the present state of the public sentiment, there is any likelihood that the city of New York will take upon itself, by purchase, so great a burden, especially when it is coupled with the danger of expensive management and political opportunity.

THE PRESIDENT : We could discuss this paper for the balance of the afternoon, and I wish we might have some discussion upon it; but as it seems to me to be the desire of the members to proceed with the reading o the papers we will proceed to the next.

H. S. Cooper then read a paper on "The Prevention of Accidents : The Best Method to Accomplish this End."

THE BEST METHOD OF PREVENTING ACCIDENTS.

If the cause—or causes—of the majority of accidents on street railways be thoroughly and critically examined and analyzed, it will be found that, directly or indirectly, in the personal element lies most of the danger from accidents, and also the means of their prevention, according as to how it is managed. I do not mean to say that the remedy lies entirely with the human element unassisted, for no matter how good the workman is, he must have tools —and good tools—before his work can be his best. We must supplement our human nature with the most perfect "safety appliances," moral, mental and material, if we wish to obtain anything approaching entire immunity from accidents, for which we are really responsible, or are held responsible. But we may equip our roads from the bottom of our substructure to the top of our poles with the most approved safety apparatus and still have our "holocausts" (as the lay press appropriately calls them), if we do not give full consideration to the personal element.

By the "personal element" I mean the personnel of the com-

pany; not only the motormen and conductors, not only the starters and switchmen, not only the inspectors and repairers, but everyone connected with the company—the foremen, superintendents, managers, clerks, counsel, executive officers, board of directors—and I do not know but what I would include the stock and bondholders.

That may seem far-fetched, but let us look at it. If a company inaugurates or perpetuates a policy by which it hires the "cheapest" kind of men regardless of the duties that they are to be made to perform; if it pays them only what it is compelled to by law, by trades unions or by the competition of other labor employers; if it works these men longer than human beings can endure and remain well balanced; if it works them in unnecessarily uncomfortable, exposed, or dangerous situations; if it gives them difficult or delicate duties to fulfill and inefficient means or apparatus to perform them with; if it shirks the use of improved safety appliances or methods, and only installs them when the loss from accidents, the force of public opinion, or the hand of legal authority forces it to; if it treats its employes merely as a minor and necessary adjunct of its machinery and apparatus; if it does any, or most of all these things, do you not suppose that the personal element will be a danger element?

On the other hand, let a company hire men of habits and intelligence suitable to the duties they will be required to perform, let it take care of them in such a manner that they will at all times be in condition to exercise their faculties of mind and bodies to the fullest advantage of their duties; let it give them the proper means and facilities for performing those duties in a perfect manner; let it give them every tried, so-called "safety appliance" before adverse circumstances force it to; and I will guarantee that the personal element will be a safety element. Why? Because the men are better men? Not all that. Because they are more comfortable in the performance of their duties? Not all that. Because they feel more secure in their position and the fulfillment of these duties? Not all that either. While all these points have a bearing (and a great one) on the safety element, the real reason, the soul of the whole of the matter, lies in the fact that one company does not seem to care for immunity from accidents if that immunity causes more trouble and expense, the other proves that it does not want accidents at any cost. The one shows that it does not care for accidents, the other proves that it does not want them. In the first the employes feel that the company does not "back them up" in any safety efforts; in the second one, they feel that the company is "right behind them" in any efforts that they may make for safety, and—conversely—that it is "right on top of them" for any neglect of safety.

That is the real "safety appliance;" the feeling that pervades the company from the highest officer to the lowest employe, that the spirit of the company as evinced by all its actions is for safety, first, last and all the time.

You all have rule books and bulletin boards. Now both of these are good when they are good, and when they are bad they are the very devil; and nothing will render them so quickly bad as to have dead rules or orders in them. See to it that the rules and orders are alive in every part of their being. Overhaul them, renew, repair, mend and amend them as you would any other part of your machinery or apparatus. Don't let them either wear or decay unnecessarily. Put up a big blackboard in every department—put one up in the directors' room and in the officers' offices—and when a safety rule is being slighted, when it is being overstrained, when it has been revamped, changed or repaired; put up a big "Notice" on the board and call attention to it. You can go farther than this; if you are about to have something extra in traffic or in operating; if your city is to have some event that will greatly increase your traffic; if the winter season is coming on with its attendant snow, sleet and ice; if the summer season is approaching with its increase in traffic; seize the opportunity to put a little blood into some of the anæmic rules, give them an outing on the blackboard, rub up the links with them; it will do them both good. In fact, it is wiser to go even farther than this. Make it a point to see that the safety rules and orders *all* get an airing once a season or so.

We instinctively allow a factor of safety to everything else; even to so homely a thing as a camel's back we give the margin of a "last straw" and yet we deny it to the personal element which needs it most! Is this done from thoughtlessness, or from carelessness, or because we honestly believe that this factor is so infinitely great that we may disregard it in our calculations? If the last is the true reason for our neglect how mistaken we are! For there is nothing so capricious, so sensitive as the personal element, nothing with which we deal has so small and changeable a factor, and the best results as regards safety will be to the company that carefully keeps it a maximum.

Dropping metaphor, the personal element is the danger element. Ninety-nine one-hundredths of the accidents come, not by some thing that failed, but by some one who caused it to fail by neglecting at some time his safety duty.

Mr. J. P. E. Clark: Owing to the lateness of the hour and the amount of business to be transacted, I move that the remaining papers be read by title, and I believe, under the circumstances, the gentlemen who prepared them will not be affronted.

The motion was carried. The papers referred to are "Low Joints: How to Prevent Them," by C. L. Allen, of Syracuse; "Street Car Wheels: Should They Be Made Heavier?" by F. D. Russell, of Rochester; "Construction and Maintenance of Car Bodies and Trucks," by Robert Dunning, of Buffalo.

LOW JOINTS: HOW TO PREVENT THEM.

Nearly every street railway company has a stretch of poor track, which for good reasons it is trying to use for a term of years or until such a time as it is possible to rebuild with what is now called "permanent construction," and the greatest of the track-man's troubles in keeping this track in a condition for the operation of cars is the joint. In the majority of cases if the joints that were placed on the rail at the time of the construction of this track remain in use the bolts will become loosened and at a great many joints shear off. The supporting ties may be tamped solid, yet the the joint will hold its proper place for only a short time.

In Syracuse, last fall, during our reconstruction, we had a street 4500 ft. long, in which were double tracks. The structure was a 47 lb. stringer rail upon 5 in. × 7 in. pine stringers, the ties supporting the stringers every 5 ft. It was our aim to save as much of this structure as possible and yet have a track structure in the street which would survive a period of five years' traffic. At the end of that time it is hoped that all the sewers, water, gas and conduits will be in the street so that permanent construction can be built without being ruined during the process of construction of these underground structures.

The paving was removed and the stringer rails consigned to the scrap heap, the stringers and ties lowered 2½ ins. below the original grade. Ties were introduced between those under the stringers so that the spacing under the stringers was 2½ ft. between centers. To the stringers were spiked the Johnson Company's 66 ½ lb. girder rail which had been removed from track by reason of failure at joint. This rail had been laid on chairs and had become so worn at the joints that it was doubtful whether it could be used; but, aside from the deflected ends the rail was in good condition and not worn out. The ends of a great many of these rails were tested for deflection previous to laying and in many cases $\frac{3}{16}$ in. deflection was found. What effect traffic would have upon the ends of the rail after placing upon them the Weber joint was a result that was awaited with much interest. This joint was purchased with the idea of benefiting the rails, bringing them up to grade and proper line. The rails were laid with broken joints with rail ends butted tight. No trouble was encountered in placing the joint, and the track structure was completed and paved in. It was our intention at the time of construction to operate on the track a day or two previous to replacing the pavement, and then to tighten the bolts once more firmly. The conditions of traffic would not allow this and the structure was paved in without this second tightening.

At first the cars which were operated upon this track pounded considerably at every joint. As the construction of this track was completed just before the final freeze-up last fall the pounding was made more prominent by reason of the frost holding the track structure firmly.

In the spring, after the frost had left the ground, the rails were examined, and although no metal was restored to the head of the rail the ends of the rail had been brought up to grade and line. The bolts of some of these joints had become loosened so the paving blocks were removed at the joint and the bolts thoroughly tightened. This track is not as good a track as our standard 9 in. construction, but we have saved from the scrap heap rails that, without the use of these joints, could not have been used as relaying rails. This construction, we believe, will do the work we expected of it, i.e., the carrying of traffic for a period of five years.

During the past four years girder rails 9 ins. in height, with brace plates and with joint plates of varying dimensions as to thickness and length, have been considered standard material for permanent construction, but the joint is still the weakest portion of the track structure.

Three things that are important in the solution of the joint question are as follows:

1st. Materials used in track construction.

2d. Manner of supporting the rails.

3d. The location of the joints in relation to each other.

In the purchase of track material for 9 in. construction, if the rails are all that are considered, and the selection of a suitable joint for the rail is passed upon lightly one would naturally buy that which would give to him track material at the lowest cost per foot of single track, i. e., the joint would be the cheapest joint purchasable. The other appurtenances aside from the rail would receive like treatment. But if, on the other hand, a good track structure throughout is desired with a minimum cost of maintenance after the track construction has been turned over for operation, due consideration will be given to all track appurtenances before final decision is made to purchase cheap material. Good material throughout is necessary to good construction and without it permanent construction cannot be had. The best material purchasable to-day will be poor enough after ten years of operation under electric traction.

Considering that good materials are economical, we will now turn our attention to the support of the rails. The support of the rails along the entire length is just as important as for the rail to be well supported at the joints. The greater the number of lineal inches of tie-bearing supporting the rails when the ties are well ballasted and tamped, the longer the life of the track structure. To give good support to the rails, ties should be placed as close together as it is possible to do so and yet give room to properly tamp with the tamping bars the ballast supporting the ties.

The manner of fastening the rails to the ties should be carefully considered. Spikes that will give good holding power and not split or cut the ties so as to injure them should be selected. The

joints in the rails upon either side of the track should not be opposite each other.

Rail ends of the same section very frequently show, upon being calipered, that there is a difference in their height, and when two ends like this are united by the joint a pound or blow will result at this joint causing a weakness upon that rail of the track. If another joint is laid immediately opposite upon the same ties supporting the poor joint, no matter with what care or in what condition the joint when laid may be, this pound or blow will have its effects upon the good joint and it will not be long before two weak spots will appear in the track where, if the joints had not been laid opposite each other, there would have been but one; on the other hand, if the joints be laid broken the pounding is transferred by the axle of the car not to the weakest spot on the opposite rail, i. e., the joint, but to the solid portion of the rail. The cost of maintaining to proper grade and line track laid with broken joints is not so great as track having joints laid opposite, as when once repairs are needed, the latter will require attention a greater number of times. In the construction of permanent track to-day, street railroads have the joint question to face only half as many times as they did three years ago. Sixty foot rails have cut the joint question in two.

We are laying in Syracuse the following construction at the joint, and from it have had no trouble: the joints are laid broken with rails butted tight. Corrugated joint plates, $\frac{3}{16}$ in. thick and 36 ins. in length, are bolted tight by means of twelve 1 in. bolts, the nuts of which are held in place by the Young gravity nut lock. The ties at the joint are laid to form what is known as the three tie joint; the center tie supports the rail ends equally, and the other ties are laid so that the ends of the joint plates are supported upon the center of the ties, thus giving three ties supporting the rail underneath the joint plate. The spacing under the rails, aside from the joint, is $1\frac{83}{100}$ ft. between centers of ties, giving thirty two ties to every 60 ft. of track. The ties used are Southern yellow pine, 6 ins. $\times$ 8 ins. $\times$ 8 ft., and they are supported by 8 ins. of broken stone ballast.

The question of low joints cannot be solved by simply considering the joint alone, nor by considering everything else and omitting the joint. The whole track structure must be considered. The subgrade upon which the ballast is placed must be made perfectly firm. The ballast must be of good thickness to give proper subdrainage and thoroughly rolled to give firm support. The ties should be the best obtainable, and as stated before, the closer spaced the better the track structure. The steel rails and their appurtenances used should be the best material that money can buy, and when this track material is properly assembled the question of low joints should not arise for some time.

STREET CAR WHEELS: SHALL THEY BE MADE HEAVIER?

It seems to me this subject might be better handled by some practical street railway man, the user of the wheels, than by the maker, for the one knows from actual experience what is needed, while the other can only get his knowledge second-hand, as it were, from observation, and by keeping in touch with what is going on. However, to see what can be done with the subject by the maker, suppose we first glance at the motors, beginning with the earliest, their weight and power, and then at the character of the service, and see what is now required of wheels.

Mr. Sprague's Richmond motor, of the summer of 1888, which I understand is the same as Edison No. 6, had 15 nominal h. p., and could work up to about 23, under favorable conditions. Its weight was about 1700 lbs., and it required a $3\frac{1}{4}$ in. axle. The F. 30, another double reduction motor of 1888, was rated at 20 h. p., could develop 30, and weighed 2200 lbs. The S. R. G. of 1891, and the W. Ps. 30 and 50 of 1892, as also the G. E. 800 and G. E. 1000, which bring us to the spring of 1896, together with the Westinghouse motors of corresponding period, are so well known to all of you that I will not go into detail regarding them further than to say that by the spring of 1896, we arrived at 35 to 50 h. p. motors, nominal capacity, and weight of 2100 lbs. to 2400 lbs., using $3\frac{3}{4}$ in. or 4 in. axles. I understand the Westinghouse Company has made a special $62\frac{1}{2}$ h. p. motor for Pittsburgh, using 4 in. axles, and that there is a G. E. 51 rated at 80 h. p., competent to work up to 120, and weighing nearly 4000 lbs. This uses a $4\frac{1}{4}$ in. axle. Of course, there are larger motors, but this is about the limit at the present time for street car service. I confine myself for purposes of illustration to these two lines of motors, and no neglect is intended toward any other makes.

Of course, motor wheels have been undergoing during the last nine years a somewhat similar development to that of the motors, trucks and cars, and may be said to have kept pace with what has been required of them. Our first 30 in. motor wheel weighed about 250 lbs. or 260 lbs., and our first 33 in. was a 300 lb. wheel, and, I may add, this is a good pattern yet, for moderate sized cars at not over 15 or 18 miles. Next we came to 280 lbs. for the 30 in., and 325 lbs. for the 33 in., and then, which was about four years ago, to 300 lbs. and 350 lbs. respectively, and remained at that for a couple of years or so, with the exception, of course, of special lots from time to time. About a year and a half ago we added about 20 lbs. to wheels for interurban service, which brought us to 370 lbs. or 380 lbs. We also brought out a 400 lb. wheel, having eight spokes or arms instead of the usual number of seven, for fast, long runs, also snow plow and snow sweeper and sprinkler service. These are all 33 in. wheels. On 30 in. we now run about 325 lbs., sometimes to 335 lbs. and 350 lbs., but 325 lbs. is probably heavy enough for a 30 in. wheel.

I do not wish to be understood that mere weight is in any sense desirable. The lighter the wheel, in fact, the lighter the whole equipment within limits, the better it is for the roadbed. The service is bad enough for the tracks as it is, without adding any more weight than is absolutely necessary. A comparison of the weights of the motors will show that the increase has been mainly in capacity. Take, for example, two Westinghouse motors, viz., the 15 h. p. of 1890, and the 50 h. p. of 1896. These both weighed 2400 lbs. And so it has been with us to an extent. There is a great deal in the manufacture of a wheel besides the mere question of weight. The question of the pattern, the careful proportionment of all parts to obviate strains in cooling, the mixture and treatment of the iron, as well as the annealing of the wheels, not to mention any number of minor things, which have to be watched carefully, all these must be combined to produce a thoroughly reliable wheel. To sum up briefly, and taking the 33 in. wheel for a standard, our conclusion is that 380 lbs. to 400 lbs. on $2\frac{1}{4}$ in. and $2\frac{1}{2}$ in. tread is not any too much for the present service.

There are two factors which try the very withers of cast iron wheels. One is the twist or tortional strain as the motor drives the wheel, and the other is the heating of the periphery of the wheel from the friction generated by high speed, or continued application of the brakes. This latter, I firmly believe, is the hardest part of the service required of a motor wheel, because it tends to expand the rim, and set up a severe strain where the arms, which remain cool, unite with the rim. All our patterns are designed to resist this strain.

Now a few words on the subject of standards—axle standards, I mean, for the wheels, in tread and flange, are gradually approaching as near to a standard as the varying conditions of service will admit. We lately purchased about 1000 bars of steel for axles, and it was nothing short of a Chinese puzzle to make up a list which would properly cover our needs. Taking the trucks in order of length of axle, we have:

Taylor	axle	6 ft.	3	ins.	long	
Peckham	"	6 "	$4\frac{3}{8}$	"	"	and 6 ft. $6\frac{3}{8}$ ins. long
Brill	"	6 "	5	"	"	
McGuire	"	6 "	5	"	"	and 6 ft. 6 ins. long
Bemis and Baltimore	"	6 "	$5\frac{1}{4}$	"	"	
Diamond	"	6 "	$5\frac{1}{2}$	"	"	

I have not at hand the lengths of the DuPont or Dorner & Dutton, or any other axles not mentioned in the above list, but you can depend upon it, they are different.

The foregoing lengths are on standard gage and usual tread, which means, not exceeding $2\frac{1}{2}$ ins. All, I believe, are subject to variation where wheels have treads wider than $2\frac{3}{4}$ ins., and, of course, for wider or narrower then standard gage.

My idea in speaking of these varying lengths of axles, is to suggest whether you cannot get together and establish a standard axle, and by amicable arrangement with the various truck makers, bring about the adoption of a standard length of axle, a standard journal, a standard brass and a standard box. The Master Car Builders of the steam railroads long ago took exactly such action, and it is nothing new which I suggest. They have a uniform standard. Their axle is 6 ft. $11\frac{1}{4}$ ins. long, and the journals and boxes and brasses are interchangeable the country over. If *they* could establish such a standard, why cannot street railways arrange for the same? Instead of interfering with the interests of any truck maker, it seems to me it would benefit, and it certainly would simplify matters enormously for everybody concerned.

REPAIR OF CAR BODIES.

As the life of a car body depends almost entirely upon the bottom framing, nothing but well seasoned and perfectly sound, straight grained timber should be used. Ordinary kiln dried lumber is not suitable for car framing, and even when timber has been in the drying shed for a long time it should be given a couple of weeks seasoning after its first working, for well dried timber will show a slight shrinkage after being worked. Too much care cannot be used in the cutting of mortises and tenons to see that they are tight all the way round and all the way through. The placing of cross sills will be influenced somewhat by the style of car, and motor equipment, and there is probably nothing better than strong diamond bracing to hold the frame square. Lead the mortises and tenons, and when the frame is driven together, put in the tie rods, draw up tight and put on corner angle plates and finally square and level up the whole work.

The end and side framing should be assembled with the same care and set up in solid sections on the bottom framing, and lastly put the roof framework in place. Avoid splicing and do not use two short pieces where one long one can be made to do the work. Secure all corners inside and out with light steel angles and where possible the inside and outside angles should be held in place by the same bolts.

The framing of the platforms should be well considered and made to meet any emergency. The size of timbers will in any case be proportioned to the carrying capacity of the car. The application of the outside covering, inside lining and trimming should be carefully studied as to its efficiency in the covering of joints and to keeping the frame dry, as well as to its appearance. The main principle to be observed in the whole framework, is to produce a combination truss that will offer the greatest resistance to any strain

that may be imposed upon it, and the avoidance of the introduction of useless material.

The present tendency in painting is toward simplicity as to colors and ornamentations and is certainly to be commended from a practical standpoint. The use of a few colors and those that do not fade quickly make retouching easy and satisfactory and reduce the cost of painting very materially. The neat effect of natural wood finishes in the inside of the car is also to be commended for beauty and long wearing qualities. As to the methods of applying paint, any one which embodies the principle of good materials well mixed, carefully applied and cut down, will produce good results. Nearly every boss painter has some little difference in the method of handling his work, but if he is intelligent and unprejudiced he will produce good results.

In truck construction we have nearly as many patterns as there are of life guards and each makes claims to embody some principle which no other truck has, and all other trucks are therefore fatally defective. With one the great principle of a perfect truck lies in the bearings, with another it is in the frame, another the springs, another the amount of traction, and so on, with additions, subtractions, multiplications and divisions, and the end is not yet. Taken collectively the truck builders have wrought a great work, and when the day comes that produces a truck in which each of the principles they claim is brought to the perfection they now claim in each instance, we can cease our looking for improvement in that direction and reflect complacently that Solomon was certainly mistaken when he said that there was no perfection under the sun. As it is we must be content with the knowledge that there is one *best* truck on the market and though each maker claims it is his, we still have the privilege of choice and can act accordingly, even to experimenting a little ourselves when we feel like exploiting a pet theory. The ideal truck is the one which gives the maximum amount of traction, rigidity of frame, flexibility of operation, ease of running and the minimum amount of oscillation and weight. These and many minor principles go to make the perfect truck. How to attain them is the study of every mechanical engineer in the street railway business and some outside. To enter into a discussion of the principles involved is impossible in this paper, as any one of them would require a long article which time forbids, so we will pass on to the maintenance of cars and trucks.

Perfect maintenance may be described as that which produces the greatest efficiency and best appearance extended over the longest period of time. The method of accomplishing this will differ in minor details under different conditions and service, but the main principles are the same. As to the car body, the words paint and varnish cover nearly the whole subject, and if the car be kept well varnished the question of painting, if well done in the first place, may be set aside for an indefinite time. A car in regular service should be revarnished once in nine months, or oftener if the locality in which it operates is subject to conditions which are specially injurious to varnished work, such as an excessive amount of smoke and coal gas in the atmosphere. Before retouching and varnishing have the joints of the car inspected and if any indication of shrinkage or working is shown see that it is put right.

In the truck, besides the painting and varnishing, other conditions are to be met, for here the wearing parts demand constant attention and should be gone over every time the car is run into the house. You cannot depend upon the driver or conductor to always report defects even though he is ordered to do so; his mechanical knowledge may be very limited, and as long as a thing works it is all right to him. In the matter of brake shoes see that the shoe sets true upon the wheel and is in perfect contact on the whole face; through carelessness in truck construction and the moulding of brake shoes we often see them worn through at one end and scarcely touching at the other and again worn in such a way as to show they were set diagonally to the face of the wheel. Test the brake, track cleaners, sanding apparatus and wheels, for you cannot tell what may have happened to them while in operation and it may mean the saving of life and thousands of dollars to the company, if these things are constantly and carefully looked after.

In the matter of flat or skidded wheels, we all know the causes; we also know many remedies for the trouble and have applied them, but the wheels continue perversely to skid, and will probably continue to do so as long as the braking power is applied to them and emergency stops are made. The regular sanding of the track has probably done as much good as anything that has been tried so far, but for the present there seems to be nothing better than to get as high a mileage contract as possible from the wheel maker with the necessary regrinding included.

To the electrical equipments, all the previous remarks relating to testing and careful inspection apply with double force. The power which is so quick and ready when properly conveyed and guarded will vanish upon the least relaxation of vigilance, and leave disaster in its wake. How to properly care for motors, switches and wiring is also a subject too broad for this paper to attempt to cover, and only a few general points can be mentioned, one of the most important of which is cleanliness. Care in this direction will save many a breakdown, and it is hardly possible to be too thorough. Dirt may be a good insulator at times, but it is scarcely safe to trust it.

Insulation is another point to be carefully scrutinized and the careful and solid connection and securing of the various parts is another. A loose wire if not attended to means damage sooner or later, and a poor connection loss of power and possible burning. Some roads advocate the taking apart and thorough overhauling of motors and controllers once a month. This would seem to be somewhat oftener than is actually necessary and it would be an extraordinarily severe service that would require it. The chance of doing damage to electrical apparatus while it is undergoing an overhauling is quite a factor and it would seem to be more reasonable to use judgment in this matter than to take the apparatus out and put it back at regular periods without regard to other conditions.

The question of maintenance naturally merges into the one of repairs and it is difficult to tell where one leaves off and the other begins. The work of correcting and replacing the thousand and one little things constantly requiring it can only be realized by one who is fully experienced, and fortunate is the road that has efficiency and ability and thoroughness in this department. To say that a street railway company is known by the cars it keeps may be an odd adaptation of an old saying, but it is true, and the road that is thorough in this respect will not stop here, but will keep its other departments up to the same high standard and its reward in nickels will be great.

Mr. J. P. E. Clark: I move that a committee of five be appointed to confer with the Railroad Commisioners of the state for the purpose of framing a set of standard or uniform rules to govern the operation of street railroads of our state. The committee should be selected from the larger and representative roads of the state, and be appointed after careful consideration, as I believe this is an important matter for the street railroads and the public of the state.

Mr. A. L. Johnson, of Brooklyn: I believe this is the most important matter which has come before the meeting. I believe that the framing of just such rules will do more to prevent accidents than anything else. The greatest preventative of accidents is that the men who run the railroads should do the thinking for the employes. We run 150 miles of road. At every bicycle street we have a "Stop" sign; that means stop, not slow up. At 140 different places we have "Slow" signs, where children congregate on the street; all cars must keep 200 ft. from the one ahead; there are five dangerous curves, and 200 ft. ahead of the curve there is a circuit breaker, and the lights instantly go down. It takes the action of both motorman and conductor to proceed over the curve, as the latter must change the trolley to the live wire and give the usual two bells. At all street railroad crossings we stop the cars. At the steam railroad crossings our men go across the track and signal the car, as we do not rely upon the flagman. I do not believe it is always desirable to educate your men and keep them for a long time. The most dangerous accidents we have are with old men and not new ones; it is the would-be expert who often gets into difficulties, especially in colliding with other vehicles, in taking too many risks. We accept no excuse for a car running into a vehicle ahead of it, if the brakes are in good order.

Mr. McNamara, Albany: I think the remarks of the last speaker demonstrate that this committee should be composed of men from the great cities, especially Greater New York. They have collision and other difficulties there which do not occur in other places. I think what would be safe for New York would be safe for Buffalo, Rochester and Albany.

Mr. Clark's motion was put and carried.

The President: I will appoint Messrs. H. H. Vreeland, of New York, C. L. Rossiter and A. L. Johnson, of Brooklyn, H. H. Littell, of Buffalo, and J. W. McNamara, of Albany, as the committee.

The report of the Nominating Committee was presented and the following officers elected: President, G. Tracy Rogers, Binghamton; first vice-president, W. Caryl Ely, Niagara Falls; second vice-president, T. J. Nicholl, Rochester; secretary and treasurer, Henry A. Robinson, New York City.

Executive committee: Herbert H. Vreeland, New York City; John W. McNamara, Albany; Henry M. Watson, Buffalo; Clinton L. Rossiter, Brooklyn.

A telegram from C. L. Rossiter, president of the Brooklyn Heights Railroad Company, Brooklyn, inviting the association to hold its next meeting in that city was read. Mr. Johnson, of Brooklyn, seconded the invitation, and assured the association of a hearty welcome. On motion, the invitation was accepted.

After a vote of thanks to the local committee and different organizations which had contributed to the entertainment of the attendants at the convention the meeting adjourned.

SOCIAL FEATURES.

The programme of entertainment arranged by the local committee of railway managers in Niagara Falls was most pleasant, and the attendants were unanimous in their expressions of appreciation of the hospitality extended. On Tuesday, during the business sessions of the convention, many of the ladies made the trip to Toronto and return. On the following day a number of excursions were made by the different delegates. One included a trip to the Canadian side, thence by special cars over the Canadian electric railway to Chippawa, and thence to Queenston, returning by the Gorge Route. Another excursion was made to the plant of the Niagara Falls Hydraulic Power & Manufacturing Company, and a third to that of the Niagara Falls Power Company.

The banquet was held at the International Hotel on Tuesday evening. W. Caryl Ely acted as toastmaster, and responses were made by Messrs. Hastings, O'Grady, Welch, Bangs, O'Connor, Cole,

Murphy, Concannon, McNamara, McGraw, Stedman, Clark and Brinker.

On Wednesday evening a ball was given at the International Hotel, and on Thursday the entire party was conveyed to Buffalo on special cars of the Buffalo & Niagara Falls Electric Railway Company.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION.

The sixth annual convention of the Pennsylvania Street Railway Association was held at Allentown, Pa., Sept. 1. The meeting was called to order in the parlors of the Hotel Allen at 11 A.M. by Robert E. Wright, second vice-president of the Association.

After an address of welcome to those in attendance by F. E. Lewis, to which a fitting response was made by Robert E. Wright, the following interesting papers were read: "Relationship between Claim and Operating Departments of Electric Railways; the Prevention of Accidents and Disposition of Claims," by Richard W. Day, general claim agent of the Wilkesbarre & Wyoming Valley Traction Company; "Trolley Service in the Future," by R. M. Douglass, of the Schuylkill Valley Traction Company, and "Street Railway Legislation in Pennsylvania," by Dallas Sanders, of the Schuylkill Traction Company.

Mr. Day recommended a close relationship between the management of the operating department and claim department as, where contention and bitter jealousy exist, the effect of any carelessness or misunderstanding in one department naturally falls upon the other.

Experience has taught him that special care should be given to the maintenance of overhead wires, as serious accidents have occurred from failure to keep these wires in proper condition. The success of the operation of the claim department largely depends upon the man or men employed, and the secret of their success is regulated to a large extent upon their past experience in this work, ability to correctly judge human nature and to maintain perfect control of temper. For a man to properly handle a claim department he should be placed in unrestricted charge. The practice of insuring in indemnity companies the author considers expensive, and that a railway in adjusting its own losses can get good satisfaction for a sum not exceeding 2 per cent of the gross receipts. He is a firm believer that passengers should be excluded from the front platforms; first, because the position of the motorman is such a responsible one that he should have sufficient room to operate his motor, brake and bell without interference of passengers crowding against him; and secondly, with the absence of individuals on the platform with him his sole attention is given to the streets before him and the crossings as he approaches them. The conductors and motormen should be carefully instructed regarding the furnishing to the company of an intelligent narrative of any accident which occurs to any person upon or by their car, and of furnishing the company with the names and addresses of all witnesses which they may be able to secure.

To prevent discharged employes from becoming valuable witnesses for the plaintiffs in damage cases, the writer has for years pursued the following, which has proven a bar against them from testifying against their employers. An affidavit has been taken, or in the case of a removal, the deposition of any employe who has been in any way connected with an accident on the road. This method has been adopted for the reason that the largest amounts ever recovered in damage cases have been awarded by juries who have listened to detrimental statements made by discharged employes against their former employers. Regarding the question of feigned injuries which have become so prevalent within the last few years, the writer has found it to his advantage to have associated with his company the most able physicians and surgeons in the locality, so that they may, by their learning, experience, and upright character, overshadow the shyster element in the medical fraternity, which usually follows up persons who have been injured, keeping them incapacitated so as to prolong their disability, thereby increasing their fees accordingly.

Mr. Douglas in an interesting paper on the "Trolley Service of the Future," contrasted the condition of horse railways with electric, and described the advantages to the public which the electric railway has brought.

Mr. Douglas believes in the importance to the community of an up-to-date trolley system. All classes use the electric cars. The wealthy patronize them freely from a sense of convenience and ease, the great middle class all use them, and to the poor the trolley car is a godsend. They could not hire carriages: this is beyond their means, but all can spare a nickel and go out into the country and get the much needed rest and change. The beauty of the trolley road is that the lines pass along the best roads or pikes, over the hills, through valleys, passing beautiful homes. With it the borough, village and city people go to the very doors of their relatives and friends. Trolley cars do more than this, however. They advance values of property of city, borough and country. It is a well known fact, he stated, that a street in town enjoying a good car line is most desirable for residence. Houses are all occupied on this street, rents are firm, just off this street houses are empty, though equally good. The trolley also brings into use and value outlying property along the country roads and pikes.

The status of the trolley railway companies in the future depends he believes, largely upon the railway companies themselves, and he recommended united action through the association for the advancement of the interests of the railway companies. If they stand together as an association they are a power, but if they shirk responsibility and do not respond with time, means and influence they will be weak. He especially recommended that each company institute and pursue the association's general line of policy within its city or borough, and especially its county, interest the people, join hands with the leaders, look to the primaries, and go into the next legislature with friends in the Assembly and ask for the enactment of laws that are just and favorable to their interests.

Mr. Sanders rehearsed the history of street railways in Pennsylvania from the first bus line started by James Boxall in 1831, and referred to a good many of the contests passed through by them. Among them he cited opposition to Sunday travel, which was finally authorized by the Supreme Court on a hearing from an injunction in 1867, and the admission of colored people to the cars which was permitted by legislative enactment the same year. Up to 1874 all street railway companies were incorporated by special acts of the legislature giving them the right to use certain streets, and some sixty-five received charters during that time. Electric power when introduced was regarded with considerable apprehension by the public, and bills of equity were filed in several cities to prevent the introduction of the trolley, but on appeal to the Supreme Court, the right to use such a new and novel mode of transportation was upheld. By the act of May 21, 1895, street railway companies were given the power to carry United States mails, and this has been extensively followed throughout the state. In the direction of accident suits the Supreme Court of Pennsylvania has applied to trolley roads, with however, certain limitations, the well known doctrine of steam roads of "Stop, look and listen." Although this doctrine was at first extensively criticized in some of the other states in the Union it is now being accepted as a correct exposition of the law of negligence in many of the other states. The history of accident cases shows a growing tendency on the part of juries, in the teeth of evidence, to take from him that hath and give to him that hath not, as shown by the following rapid increase in accident awards. In 1896, when 137,000,000 passengers were carried by the horse roads, the total damages paid were $16,150; in 1892, before there had been much change to electric power, there were twelve cases with aggregate damages of $30,608, an increase of nearly 100 per cent, while the passengers carried were 187,000,000, an increase of only about 40 per cent. In 1896 the passengers carried had increased to 261,000,000 or again 40 per cent, while the verdicts in negligence cases reached $345,410, or an increase of about 1000 per cent. The Legislature in 1893 passed an act limiting to two years the right of action for any alleged injury. The question of giving street railways the right of eminent domain, and also the right of carrying freight are questions still in abeyance in Pennsylvania and will be left for further consideration as the Legislature does not again meet until 1899.

In the evening a complimentary concert was tendered to the delegates and visitors at Central Park, by the Allentown & Lehigh Valley Traction Company, and on Thursday, Sept. 2, the attendants were given a trolley ride over the lines of the Allentown & Lehigh Valley Traction Company, and a lunch at the park.

The following officers were elected for the ensuing year: president, Robert E. Wright, of the Allentown & Lehigh Valley Traction Company, Allentown; first vice-president, Frank Silliman, Jr., of the Scranton Traction Company, Scranton; second vice-president, Dallas Sanders, of the Schuylkill Traction Campany, Girardville; secretary, S. P. Light, of the Lebanon & Annville Street Railway Company, Lebanon; treasurer, W. H. Lanius, of the York Street Railway Company, York. Executive Committee: Robert E. Wright, B. F. Meyers, S. P. Light, E. C. Felton, John A. Rigg. Scranton was selected as the place of meeting in 1898.

AT a recent meeting of the Stockton (England) Corporation, a committee consisting of the mayor and several councillors together with K. F. Campbell, the borough engineer, presented an important report on the new tramway system. The report reads in part: "Pursuant to your instructions, as per minute, dated July 20 last, we have visited Leeds and have made a thorough inspection of the system of overhead electric tramways recently constructed by the City Corporation. * * * On the Kirkstall road (which for a considerable distance is an important thoroughfare) tubular poles on one side only, with single bracket arms about 14 ft. in length, are used for carrying the trolley wires, the width of the road between the buildings on each side being about 45 ft. Along Boar Lane, which is a still more important thoroughfare, 60 ft. in width, with heavy traffic, similar poles with double brackets, each about 5 ft. in length, are fixed between the up and down lines in the center of the street. Your committee paid special attention to the appearance of the two classes of trolley poles, and also their positions, and the unanimous decision arrived at was that although the single bracket poles by no means disfigure the general appearance of the street, the double bracket poles placed in the center between the double lines far excel in appearance and usefulness the single bracket poles, and that they are a distinct improvement from an æsthetic point of view over the latter. In this view the committee are supported by the opinion of the Leeds Corporation, who have decided to fix center poles in all streets over 60 ft. in width. * * * After our investigations of the whole system of overhead electric tramways at Leeds, we are bound to say that what we have seen has quite removed from our minds any objections we may have had both to the overhead wires and trolley poles."

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Havemeyer Building, 26 Cortlandt St., New York.

The Battle of the Motive Powers.

The problem of motive power in transportation work the world over is a most interesting and absorbing one, and those who are responsible for the conduct of transportation enterprises, great and small, are studying it with almost painful anxiety. Questions of prime investment, questions of cost of changing present motive powers to those which may be considered "improved," questions of relative economies in operation, and questions regarding the attitude of the public towards each method under consideration—all these disturb the dreams of many an anxious street railway and steam railroad manager. Animal power for street railway service has almost entirely passed away in America, and its doom is unquestionably sealed abroad, though the time taken in the process of change is and will be longer than has been the case here. Steam railroad methods are so firmly established by decades of precedent and settled engineering principles that it is almost like a nightmare to think of the tremendous changes which a new motive power would entail; yet something must be done to win back the ground which has been lost of late to the busy electric railway lines which have proved such serious competitors in interurban work. In all the cities of the world, urban and suburban transportation problems are demanding the best thought of trained engineers and operators, and as it is sometimes wise to call a halt in the whirl of a busy life to take a measure of all the influences working in a large way throughout an entire industry, so we take this occasion to present a brief résumé of the relative advantages and disadvantages of different forms of motive power so far as developed in actual practice up to the present time.

The motive powers to be herein discussed may be classified in two groups as follows:

Class I.—Motive powers involving a distribution system and central sources of supply.
1. The cable system.
2. The electric system.
   a. The overhead conductor system.
   b. The open slot underground conduit system.
   c. The surface contact system.
   d. The third rail system.

Class II.—Independent motive powers.
1. The steam locomotive.
2. Compressed air motors.
3. Electric storage batteries.

There is no doubt that independent motors would be far more desirable *per se* than those which are dependent upon central sources of supply with complicated and expensive distribution systems, were it not for the difficulties which have so far imposed serious limitations upon their usefulness. There is undoubtedly a great demand for a successful self-propelled motor in street railway work relatively equal in power and efficiency to the steam locomotive in railroad work, but the very fact that the supremacy of the steam locomotive, with all the years of engineering development which have brought it to its present perfection, is seriously threatened in its own peculiar field by a motive power belonging to the first of these two classes, shows how difficult it is to fulfill all the exacting requirements of the transportation service with any self-contained motor.

The cable system has undoubtedly been an efficient and economical transportation agency in the peculiar class of street railway work for which it has been used. For handling a large volume of business along routes of great traffic density it yet has its advocates, particularly in Europe, and it is not impossible that a genuine advantage over electricity can in some cases be shown, though the difficulties of making true comparisons are almost insuperable. Notwithstanding these facts, it is, in America, being steadily displaced by electricity, in some cases because of the desire to operate all the lines of a large system by the same motive power so as to avoid transfers; in other cases because the cable apparatus after years of service has become worn out so that some change is necessary, and the extreme change to an entirely different motive power is determined upon as a matter of broad policy; and in still others because the paralleling of cable by competitive electric roads has reduced the cable railway receipts to a point where continued solvency becomes impossible without a radical change. There is no question whatever that the public prefers electric cars to cable as a mode of conveyance. The former ride far more smoothly

and swiftly where chance is given to run at high speeds, and can maintain schedules more closely on account of the reserve power in the motors to make up lost time. Altogether the cable system has undoubtedly seen its best days and little if any additional mileage will ever more be installed. Reasons for this, other than those just mentioned, will appear shortly.

There are three fundamental advantages found in the use of (distributed) electricity as a motive power: first, the high total efficiency possible to obtain in engines, dynamos, transmission circuits and motors, i. e., the percentage of the prime potential energy of the boiler steam which appears as kinetic energy in the car motors; second, the conversion of this kinetic energy at the motors into rotary and uniform torque instead of into reciprocating motion; and third, the almost perfect flexibility of the system as a whole. Let us consider these three advantages in detail.

The efficiency of an electric transmission plant for railway purposes can theoretically be made extremely high—higher, probably, than with any other form of transmitted energy—though, practically, it is limited by the factor of interest on investment. The power station may be located at the most advantageous point possible with respect to delivery of fuel and low price of water for condensing purposes, in this respect possessing a distinct advantage over the cable system, and in many cases over a compressed air or storage battery system. The size of the generating units may be chosen with reference to the operation of an entire system and here there is often an advantage over the cable system where short or lightly loaded sections of cable necessitate smaller units than will bring about the best economy. An electric (distribution) power station is, however, at some disadvantage in comparison with a compressed air or storage battery station in this matter of choice of units and investment in generating plant, inasmuch as its total capacity must be ordinarily from two to three times the average output in order to provide for the maximum requirements, while in charging storage batteries or compressed air cylinders the station generating capacity need exceed the average requirements by hardly more than 20 per cent. The efficiency of dynamos is very high in the large sizes, exceeding 92 per cent, and the total losses from engine shaft to station bus bars are probably less than the loss from engine shaft through cable machinery to the outgoing cable. Balancing up the various economic factors of power station generation only, including interest on the respective investments, with the four systems at the moment under consideration, it seems probable that, given coal and condensing water at equal prices in all four cases, an electric (distribution) power plant would have a very slight advantage over a cable power plant, while both would be at some disadvantage, more or less pronounced, in comparison with a storage battery or compressed air power plant. As in most cases, however, we cannot make an assumption nearly so favorable to the cable, storage battery or compressed air systems as that of equal prices for coal and condensing water, it is more than probable that ordinarily the economy of power generation in the electric (distributing) station would be considerably better than in the other three for the same total output in horse power.

The efficiency of transmission in the electric railway distributing system may be made as high as we please, but ordinarily the wire network is so figured as to provide for what are called "losses" of from 5 to 15 per cent. Now the true average loss from an entire distribution system for the day of twenty-four hours and the year of 365 days, is a very difficult, and indeed impossible thing to find out. If a voltmeter on a car running over a given line shows a minimum voltage of 450, and an average voltage of 500, the voltage at the station being kept meanwhile uniform at 550, the average loss of power *for that trip alone* is about 9.1 per cent. If the trip is made at a period when a line is most heavily loaded with cars, as in the morning or evening hours, when workers are going from, or returning home, it is probable that this average loss is considerably greater than that which will be found in trips made in more lightly loaded hours of the day. Now the peculiar and immense advantage of the electric system over the cable system, so far as efficiency in transmission of power is concerned, lies in the fact that the electric system is absolutely automatic with reference to losses on the line, while the cable system is not. Under the conditions just mentioned while the loss for the particular trip may be 9.1 per cent, as stated, the average loss on the line throughout an eighteen hour day may be not more than 3, 4 or 5 per cent; whereas, with the cable system, the percentage loss of energy to the total power transmitted is least during the heavy traffic of the day and greatest during the light, ranging perhaps from 30 per cent as a minimum to even 70 or 80 per cent as a maximum. Putting this statement in another form, it may be said that the efficiency of cable transmission is greatest with heavy loads and least with light loads, covering a wide range, while the efficiency of electric transmission is least with heavy loads and greatest with light loads covering an extremely narrow range.

It must not be understood, however, that because of this difference in the efficiency of *transmission* of power only, the electric system is immensely superior to the cable system in economy of *power consumption per car*, for, added to the loss in the transmission circuit of an electric railway, is the loss in conversion through the motors, for which there is no corresponding loss, or but an unimportant one, in the cable system. Nevertheless, the modern electric motors are so designed as to work at comparatively high efficiency through nearly their entire range of effort, for example, between 80 per cent and 85 per cent when running from one-quarter load to three-quarter load, and between 60 and 80 per cent when running from one-sixth to full load, and the total loss in transmission circuits and motors in the electric system is undoubtedly less, as an average, in practically every case, than the total loss in the cable system, but any definite figures of comparison are impossible, of course, to obtain. As a check on this conclusion, however, it may be said that the manager of an American system using both cable and electricity on a large scale has determined to his own satisfaction, as a result of most careful investigation, that for about fourteen hours out of each working day the electric system can be operated at a decided advantage over the cable system for exactly the same work, while for about four hours the relative costs of the two systems are more nearly the same, but with still a slight advantage in favor of electricity.

Little work has yet been done on a large scale with either the storage battery or compressed air systems of

traction, and it is impossible to compare their efficiencies in car effort per unit of power at the station with those of the electric distributing and cable systems. It does not seem improbable, however, that these efficiencies may be, theoretically at least, nearly or quite as high as that of any distributing system.

The second advantage of electricity over other motive powers, namely, the conversion of the power by the motors into rotary effort or torque, instead of into reciprocating motion, is one the importance of which is not always fully grasped by street railway managers unfamiliar with mechanical matters. It has a direct bearing on traction and the possibility of surmounting steep grades and rounding curves without slipping of wheels. It is, in fact, in all probability, the full explanation of the remarkable grade work performed by electric motors, accounts of which in the early days of electric traction seemed to railroad engineers the wild exaggerations of overenthusiastic advocates. The "chart of effort" of reciprocating motion, even where cranks on opposite sides of the shaft are set quartering, is one of constant variation between maxima and minima over a considerable range, and where a single cylinder and crank are used, the variation in effort exerted is from zero to a maximum. Moreover, the difficulties of properly handling reciprocating motion in street car work are serious, not only because of the narrow limitations of space under the car, but also because in rounding the sharp curves found in street railway work, particularly in Europe, the necessity of rigid or semi-rigid connections from motor to axle involves trouble, while the dirt and grit of the street must have a most destructive influence upon any reciprocating motion, except when absolutely encased. Notwithstanding the great advantage of rotary over reciprocating motion for self propelled cars on grades, the cable system has, of course, an advantage over both in that there is direct haulage without possibility of slipping even on the most severe grades, and for this reason the cable system has retained its hold in America on a few lines still where the grades exceed 10 to 12 per cent., though on others it has been displaced by electricity assisted by "balance weight systems" on grades impossible to surmount by self propelled cars.

The flexibility of the electric distributing system is in nearly all respects greater than that of other systems. Electric cars can be moved backward as well as forward, and reversed in case of threatened accident, an important advantage over the cable system and, to some extent, over compressed air and steam motors, which cannot be reversed in so short a time nor with such enormous reserve power. The electric current is capable of infinite subdivision, which makes its use by a complete street railway system in suburbs, as well as in the city proper, possible, and its extension still further into the suburbs inexpensive. This is an advantage over the cable system which is of immense importance. Independently propelled cars operated by steam, compressed air or storage batteries possess some features of this advantage in even greater degree, such as, for example, the possibility of extension, where tracks only are necessary, without auxiliary construction; but, on the other hand, these motive powers are handicapped by the possible exhaustion of supply in the longer runs. In an electric distribution system an immense reserve power can be instantly and automatically placed at any point where it may be temporarily required. The only limit of this reserve power is the melting point of the conductors somewhere in the circuit. The cable system, too, has a large reserve power, but not in the same way nor with the same safety as the electric; and one of the chief disadvantages in any form of self propelled motor lies in the impossibility of providing within the limits of space the reserve power which is occasionally needed.

The electric (distributing) system has one serious drawback—the obtrusiveness in one form or other of the necessary street construction. Until the present time the particular form of distribution of current in almost universal use has been the overhead wire system. Originally both trolley and feed wires were placed overhead even in the larger cities, and the consequence was a general and not unreasonable prejudice on the part of the public against the "trolley system." The curve constructions, moreover, were in the early days unsightly and sometimes dangerously insecure. The poles were usually of wood and anything but ornamental, and altogether Europe can hardly be blamed for refusing to instantly adopt the methods of America. To-day, however, things are very different. The overhead construction is reduced to its simplest principles, poles are made of iron and may be as ornamental or as inconspicuous as desired, trolley and span wires only are suspended from these poles, the curve constructions have been simplified and much improved, and the danger from falling wires is extremely small.

Nevertheless there has been developed in response to the necessities of the situation in New York City and Washington—the former the largest city of America, and the latter one of the most beautiful—an open slot underground electric conduit system, which, under the conditions of climate and of grades found in these two cities, has undoubtedly been successful so far as it has yet been tested. The initial expense of this system is, of course, enormous, almost as great, perhaps, for a given line as would be a cable road, since to the cost of electric conduit (which is considerably less than that of a cable conduit) must be added the cost of motors, dynamos, and copper distributing circuits. The investment cost of the underground conduit electric system even when installed in a city *de novo* is so great as to make the earning of anything like adequate return upon the investment, an impossibility except in cities or on routes where the density of traffic is very great, while to demand a change of motive power from the overhead to the underground conduit electric system on roads now using the former, would be to bring about utter insolvency in practically every instance. This open conduit system possesses, however, some points of excellence for the street railway manager as well as for the public, inasmuch as all wires and traveling contacts are under cover and safe from the elements, except that where there are grades, the danger of flooding the conduits, short circuiting the conductors and blocking the road is considerable, in spite of the most ample sewer connections. The cost of repairs in the Washington and New York conduits (except during the first experimental days) has been very small, smaller, perhaps, for the entire distribution system than would have been the case with an overhead construction of the same capacity, though it is hardly fair to judge of this from so short a period of operation.

Surface contact systems have been devised which have considerable promise of success. In point of initial cost

they stand between the overhead electric and the open slot underground conduit systems. So far as distribution circuit alone is concerned, they possess the advantage of doing away with overhead wires, but against this they have the disadvantage of requiring an immense number of pieces of mechanism carried in more or less watertight boxes placed in the streets. How much daily attention these pieces of mechanism will require and whether or not they can be kept in working order for an indefinite length of time without excessive operating charges are problems for the future to solve. Electrically and mechanically there seems to be no reason why they should not be successful, but they have not been tested in practice to a sufficient extent to warrant a confident prediction as to their value. It is certain that in common with the open slot conduit system there will be no increase in gross earning power brought about by their adoption as compared with the overhead electric system, and there seems to be little chance of any increase in net earning power, while the interest charges will, of course, be considerably greater than with the cheaper system.

The third rail system affords a tolerably obvious scheme of electric power distribution for places where rights of way are possessed by an operating company and trespassing can be prevented. Pressures dangerous to life should never be, under any circumstances, transmitted in this way, and for this reason it is probable that 500 volt distribution in local circuits will not be exceeded, though feeder distribution at extremely high potentials will probably be adopted for this work. For elevated railways this system is at present the only one considered and no suggestions for a better one are yet heard. For heavy surface railroad work also this system has proven in practice better than the overhead when speeds of from 40 miles to 60 miles per hour are attempted, although the overhead is used on two or three high speed roads with moderately satisfactory results. A large part of the initial expense of installing this system comes in the extremely perfect joint connections which have to be made on both third and service rails in order to prevent large losses on the line, particularly where considerable distances are covered, for in the just commencing struggle for traffic between the railroads proper, which possess their own costly rights of way, and their electric railway competitors which have been built so extensively on public highways, the factors of quick acceleration and frequency of service play an important part, and mean in the end the transmission of currents heavier probably than have ever before been used on single circuits. In another year we shall know better how this heavy railroad work is to be attacked and how the distribution circuits necessary, for example, in the frequent suburban train service, will be engineered, for both in this country and abroad railroad managers are carefully laying their plans to adopt electricity on a large scale for certain classes of work.

We have spoken at length of the electric distributing system and have compared its principal features with those of other motive powers, the cable, compressed air, steam and the storage battery systems. It remains now to briefly recapitulate the claims made for the last three systems for street railway work.

The steam locomotive is by no means inefficient or excessively wasteful, as is sometimes asserted by uninformed advocates of electric motors. On the contrary, it is wonderful how small an amount of coal is burned under its boilers, considering the severe conditions under which its power is developed. So far as we can learn, no comparative tests of value have ever been made bearing on the coal consumed and total transportation cost per ton mile hauled on steam and electric trains working under the same conditions, nor would such a comparison, even if made, reach the real heart of the problem of relative values of the two competitive agencies. The great trouble with steam for heavy suburban work where stops are made at frequent intervals lies in the comparatively low acceleration and tractive effort possible to be obtained with its reciprocating motion, and the small proportion of the total train weight available for traction. On the Nantasket Beach line of the New York, New Haven & Hartford system a service was given by electric motors during the past summer which would be absolutely impossible for steam locomotives to equal, and in fact, this was demonstrated in a practical way, when for a brief time the electric service was partly withdrawn and locomotives were run in between electric cars, the result being that the locomotive trains could not keep out of the way of the electric trains, and the timetable was soon in inextricable confusion.

Elsewhere in this issue Mr. Potter gives us acceleration and braking data of the most valuable kind, the results of actual tests made in service. The acceleration curves of steam locomotives, even when specially designed for suburban service, are unquestionably flatter than is possible to obtain with electric motors. With electricity the transportation agencies owning their rights of way can run electric trains at maximum speeds of from 40 to 60 miles per hour, even in extremely short runs, as has been demonstrated so clearly at Nantasket Beach, and the competing highway electric roads will, in many cases, be seriously handicapped in this matter of speed except, as Professor Short points out, for distances less than 5 miles away from the business centers.

There are many who see in compressed air the motive power of the future. Independently propelled cars involving no distribution system whatever are certainly a crying need at present in municipal transportation. There are so many cases where such cars would be appreciated that the problem will certainly be solved in some form, and we trust before long. Compressed air, we believe, has inherent probabilities of success in this direction, though we hardly expect it to replace electricity in many of the fields in which the latter is at present pre-eminent. There is room enough for both compressed air and electricity, and with more experience with the former it may easily be found that there are many economical advantages in its use.

The storage battery system which has been for fifteen years the hope of many an anxious and worried street railway manager has made comparatively little progress in this country as tested by results, but is in more general use abroad where the "mixed system" of electric construction is being tested on a somewhat large scale. The great difficulty at present in the way of the larger use of storage batteries in traction work lies in the necessary use of lead, one of the heaviest of metals, in the battery cell, and the consequent heavy weight of an equipment of any size. If further chemical research shall develop possibilities in the storage of electricity by the use of lighter metals or if some means shall be found to increase the present low percentage of effective lead to the total lead used in a battery plate, we may yet see storage battery results of a very important character.

Officers and Executive Committee

: : : OF THE : : :

American Street Railway Association

The ten men to whom the American Street Railway Association at St. Louis entrusted the conduct of its affairs for the year 1896–97, are probably as fine types of broad-minded and progressive trustees of corporate interests as can be found in any industry, and each and all are representative Americans. Three of the ten, Messrs. Sergeant, Littell and Smith, are from the Eastern States; one, Mr. Dyer, from the South; four, Messrs. McCulloch, Scullin, Hippee and Holmes, from the West; two, Messrs. Penington and Bradford, from the Central States.

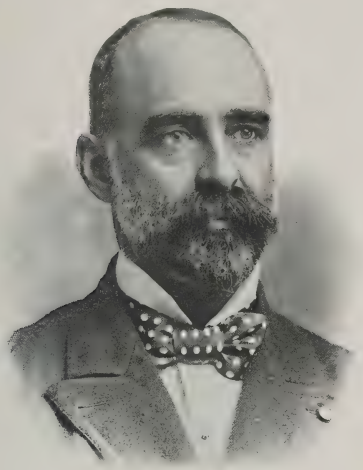
ROBERT McCULLOCH,
PRESIDENT.

Robert McCulloch was born Sept. 15, 1841, of Virginia parents, who were of Scotch descent. His ancestors settled in Virginia in the colonial days, the male members on both sides having been soldiers of the Revolution. He was left an orphan at an early age, entered the Virginia Military Institute, at Lexington, Va., in 1859, and remained there until the beginning of the war. When Virginia seceded, all the cadets at the Institute were ordered to Richmond to drill the recruits, and Cadet McCulloch served as drillmaster until Apr. 19, 1861, when he entered the Confederate service. He took part in all the great battles of the Army of Northern Virginia and was wounded five times, once at the first battle of Manassas, once at the second battle of Manassas, once at the battle of Frazier's Farm, and twice at the battle of Gettysburg. At the last named battle, his regiment took part in the celebrated charge of Pickett's Division, and every man in his company was either killed or wounded. He was adjutant of the Eighteenth Virginia regiment and afterwards captain of Company B of this regiment After the battle of Gettysburg, he was sent to the military hospital in Baltimore, and afterwards to the military prison on Johnson's Island in Lake Erie, where he remained until the close of the war. In 1869, he went to Missouri and resided for four years in St. Louis County near Florissant. In 1874, he accepted the position of secretary of the Bellefontaine Railway Company, and retained this position until 1893. In 1889, he was made vice-president and general manager of the Citizens' Railway Company, the Cass Avenue & Fair Grounds Railway Company and St. Louis Railroad Company, which had just been bought by a syndicate of Chicago capitalists.

In 1889, Captain McCulloch was elected one of the vice-presidents of the American Street Railway Association, and in 1896 he was elected president of the association. He has always had the interests of this association at heart, and has been untiring in his efforts, especially at the St. Louis convention in 1896, to broaden the field of the association's usefulness.

Captain McCulloch is recognized as one of the most able and progressive street railway managers in the country. Under his management the Cass Avenue & Fair Grounds Railway lines have been changed from horse to electric, the Broadway line of the St. Louis Railroad Company, from horse to cable, and the Baden line of the St. Louis Railroad Company, from horse to electric; the Southwestern electric line has been projected and built; the Easton Avenue line of the Citizens' Railway Company and the Grand Avenue line of the same company have been changed from cable to electric, and the Marcus Avenue line of the Citizens' Railway Company, from horse to electric. It is interesting to note that he was the first street railway manager in America to undertake and, in fact, insist upon the installation and operation of a direct coupled generator, the first to use the cast welded joint, the first to use 60 ft. rails and the first to use a water car propelled by its own motors. Broad-minded and courageous always, he has never hesitated to take the responsibility of putting his well digested convictions into practice.

C. S. Sergeant, first vice-president of the American Street Railway Association, was born in Northampton, Mass., in 1852. He was graduated from the Northampton High School in 1868, and at once engaged in business, spending four years as a bank clerk in Easthampton, Mass., then going to Lake Superior as cashier and paymaster of the Marquette, Houghton & Ontonagon Railroad. He was also connected with several iron, mining and furnace companies. He returned East in 1876 to take the position in Boston of general clerk of The Eastern Railroad. He was afterwards made general auditor of this company, and while filling this position thoroughly reorganized the company's entire accounting system. He left the employ of this company shortly before its lease to the Boston & Maine Railroad, and was for a time employed in the Boston office or fiscal agency for a large number of Western railroads, land companies, etc., taking the position of auditor of the West End Street Railway Company, of Boston, in December, 1887, at the time of its consolidation with the former street railway companies of Boston.



D. B. DYER,
SECOND VICE-PRESIDENT.

C S. SERGEANT,
FIRST VICE-PRESIDENT.

C. F. HOLMES,
THIRD VICE-PRESIDENT.

THOMAS C. PENINGTON,
SECRETARY.

Here again arose the necessity of organizing an accounting system, and adapting it to a large business. Mr. Sergeant successfully did this, his steam railroad experience coming well into play. In 1891 he was elected second vice-president, and in 1892 general manager, of the entire West End Street Railway system. Under Mr. Sergeant's management the greater part of this system has been converted from horse traction to electricity, many

extensions built, and the entire property thoroughly overhauled and improved.

During the past six months Mr. Sergeant's attention has been largely devoted to the equipment, for the cars of the West End road, of the Boston Subway, which was successfully opened on Sept. 1, for a portion of its length.

G. B. HIPPEE,
MEMBER EXECUTIVE COMMITTEE.

HARRY SCULLIN,
MEMBER EXECUTIVE COMMITTEE.

D. B. Dyer, second vice-president of the Association, was born at Joliet, Ill. His education was begun in the common schools and continued at the State Normal University. When a mere boy he, with his father and brother, went into the army and served during the entire war. In 1864 he was captured by General Price after the battle of Pilot Knob, and held a prisoner for two weeks before he made his escape. Colonel Dyer has had something of a varied experience since that time. In 1869 he went West and either traded with the Indians or acted as a representative of the Government until 1885, when he resigned and removed from the Indian Territory to Kansas City. During his Indian service he had in charge eight tribes in the northeast part of the Indian Territory; these Indians he induced to take up civilized pursuits, and later on he took charge of the wild and warlike Cheyennes and Arapahoes. He has the largest private collection of Indian curiosities in the world and was given a diploma and medal at the World's Fair.

Colonel Dyer has promoted a number of important enterprises and is now at the head of street railway and electric lighting plants at Augusta, Ga., besides being interested in one of the street railways at Kansas City, in a steamship line, and a large office building that bears his name. He is also president of the Georgia Railroad, Land & Colonization Company. He has always been very popular

H M LITTELL,
MEMBER EXECUTIVE COMMITTEE.

as shown by the fact that when Oklahoma was opened, 18,000 people elected him the first mayor of Guthrie.

Conway F. Holmes, third vice-president of the association, has been connected with street railway work since he was a boy fifteen years of age. At that time his father owned the Kansas City & Westport Horse Railroad (the first street car line ever built in Kansas City), and Mr. Holmes drove a car on this line. He continued as driver for some six or eight months, when he went into the car house, doing car repair work, and from there to the office as cashier. In 1887 he was made general manager of the Grand Avenue Railway Company, which was a reorganization of the Kansas City & Westport Horse Railroad. In April, 1894, the Grand Avenue Railway Company and the Kansas City Cable Railway Company were brought together under the name of the Kansas City Cable Railway Company, Consolidated. Mr. Holmes was largely instrumental in effecting this consolidation as he was also in uniting the Kansas City Cable Railway Company, Consolidated, and the Metropolitan Street Railway Company, into the Metropolitan Street Railway Company, Consolidated, of which he is now general manager.

H. M. Littell has been connected for many years with street railway interests. He commenced his street railway career in 1874 with the Louisville City Railway Company as clerk, starter, timekeeper, track foreman, etc. He then went into the service of the Louisville & Nashville Railway Company, finally reaching in the steam railroad

H. P. BRADFORD,

MEMBER EXECUTIVE COMMITTEE.

field the position of general freight and passenger agent, with what is now known as the Chicago, St. Paul & Kansas City Railroad Company. In the meantime, in 1883-85, he filled the position of general manager of the St. Paul City Railway Company. In 1888 he left the steam railroad field to take charge of the Cincinnati Inclined Plane Railroad, which was changed from horses to electricity under his administration. In January, 1893, he was engaged by the Seligmans of New York, as president of the New Orleans City & Lake Railroad Company, the Crescent City Railroad Company, and general manager of the New Orleans Traction Company, all in the city of New Orleans. During the next two years the work of equipping this system by electricity was carried on under his superintendence. After its completion in June, 1892, he resigned to take the office of president and general manager of the Atlantic Avenue Railroad Company, Brooklyn. He operated this property for six or eight months, until its lease to the Nassau Electric Railroad Company, of Brooklyn, which took place in 1896.

Mr. Littell then accepted the position of vice-president and general manager of the Metropolitan Street Railway Company, of New York, but resigned last spring in order to take a long needed vacation which was spent in Great Britian, France, Germany, Italy and other foreign countries.

H. P. Bradford was born July 20, 1856, at Memphis, Tenn., and after a short tuition in the public schools began active life as a messenger for the Western Union Telegraph Company. Afterwards he branched out as a news agent, and at the same time handled the team delivery of coal for the Memphis Coal Supply. Later, during the yellow fever epidemic of 1873, Mr. Bradford was given the entire charge of the coal fleet and yard of Haight & Lewis and Brown & Jones, two of the largest coal dealers in Memphis. After two years in this capacity Mr. Bradford went East in the steam railroad service, drifting South again in the employ of the Missouri Pacific, as local freight and passenger agent at Little Rock Resigning this office in 1885, Mr. Bradford began his street railway work by securing valuable franchises at Pine Bluff, Ark., 42 miles south of Little Rock. Here he built and equipped a line 10 miles long, building and operating at the same time a steam freight elevator for loading and unloading the river steamboats of the Mississippi.

In 1890, under Mr. Bradford's management the street railway system at Little Rock was consolidated under one company, and all the lines changed from horse or steam to electric. He was made president and general manager of the new company, from which office he resigned to take his present position as general manager of the Cincinnati Inclined Plane Railway Company, of Cincinnati, O. Mr. Bradford is very much interested in the work of the American Street Railway Association, and is a member of the Executive Committee.

Charles H. Smith was born at Albany, N. Y., Sept. 7, 1854 He entered the employ of the Troy City Railway Company, Dec. 1, 1870, as a lamp cleaner. In 1880

CHARLES H. SMITH,

MEMBER EXECUTIVE COMMITTEE.

he was appointed assistant superintendent and in 1885 was appointed general superintendent, which position he now occupies. Upon the opening of the Troy & New England Railway two years ago he was appointed general manager of that road and still holds that position in conjunction with the position of superintendent of the Troy City Railway. He is also a director and one of the Executive Committee of the Troy & New England Railway Company. He was elected a member of the Executive Committee of the American Street Railway Association in 1896 at St. Louis.

THE NIAGARA FALLS CONVENTIONS

AMERICAN STREET RAILWAY ASSOCIATION.

The following programme has been arranged for the sixteenth annual convention of the American Street Railway Association at Niagara Falls, Oct. 19-22, 1897.

TUESDAY.

10 A. M. Meeting called to order by Robert McCulloch, president.
Address of welcome by A. C. Hastings, mayor.
Calling of the roll.
Invitat on extended to join the association.
Address of the president.
Report of the Executive Committee.
Report of the secretary and treasurer.
Reading of paper on "Municipal Ownership of Street Railways;" by P. F. Sullivan, general manager Lowell & Suburban Railway Company, Lowell, Mass.
Reading of paper on "Some of the Difficulties Existing in the Construction and Operation of Electric Street Railways," by G. W. Knox, electrical engineer Chicago City Railway Company, Chicago, Ill.

2:30 P. M. A visit will be made to the power house of the Niagara Falls Hydraulic Power & Manufacturing Company, after which the cars of the Niagara Falls & Suspension Bridge Railway Company will convey the party to the power house of the Niagara Falls Power Company and the factories of the Niagara Falls Paper Company and the Carborundum Company.
Pleasant entertainment will be provided in the evening at the hotels—music, dancing etc., and if weather is pleasant, trolley party excursions to visit the Rapids, etc.

WEDNESDAY.

Convene at 9:30 A. M.
Reading of paper on "Application of the Storage Battery to Electric Traction," by Charles Hewitt, electrical engineer Union Traction Company, Philadelphia, Pa.
Reading of paper on "Power Distribution and Use of Multiphase Current Transmission for Ordinary Street Railways," by Maurice Hoopes, electrical engineer Lynn & Boston Railroad Company, Lynn, Mass.
Appointment of Committee on Nomination of Officers and next Place of Meeting.

2:30 P. M. Party will walk across the upper suspension bridge to the Canadian side, where the cars of the Niagara Falls, Park & River Railroad will convey the party to Chippawa and Queenston, where the steam ferry of the Niagara Falls Navigation Company will be taken to Lewiston, thence by the Niagara Falls & Lewiston Railroad Company (Great Gorge Route) through the Gorge to Niagara Falls.
The committee will provide pleasant entertainment in the evening.

THURSDAY.

Convene at 9:30 A. M.
Reading of paper on "Discipline of Employes," by Geo. H. Davis, superintendent Canal & Claiborne Railroad Company, New Orleans, La.
Reading of paper on "Application of Electricity to Railroads now Operated by Steam Power," by N. H. Heft, president Meriden Street Railway Company, Meriden, Conn.
Reading of paper on "Best Method of Settling Damage Cases and Prevention of Accidents, by Use of Fenders or Otherwise," by C. G. Goodrich, vice-president and general manager Twin City Rapid Transit Company, Minneapolis, Minn.
Election of officers.

9:30 A. M. A trip will be arranged for the ladies to Youngstown and Fort Niagara over the Great Gorge Route and the Frontier Railroad, in charge of the Ladies' Reception Committee, assisted by gentlemen of the Reception Committee.

7 P. M. Annual dinner at the International Hotel.

FRIDAY.

Convene at 9:30 A. M.
Unfinished business.
Installation of officers.
Adjournment.

The natural attractions of Niagara Falls make the city an especially pleasant one to visit, and the outside excursions and entertainments for which arrangements have been made by the local committee are particularly enjoyable. Ladies will be especially welcome and special excursions, as already stated, will be tendered them. Following is a list of the members of the different committees which have the entertainment of the attendants in charge :

General Committee.

A. C. HASTINGS, mayor, chairman.
W. C. ELY, president Buffalo & Niagara Falls Electric Railway Company.
CHARLES B. HILL, treasurer Niagara Falls & Suspension Bridge Railway Company.
JOHN M. BRINKER, president Niagara Falls & Lewiston Railway Company.
W. A. HELLER, superintendent Lewiston & Youngstown Frontier Railroad Company.
JOHN FOY, general manager Niagara Navigation Company.
HENRY M. WATSON, president Buffalo Street Railway Company.
H. H. LITTELL, president Crosstown Railroad Company, Buffalo.
J. M. BOSTWICK, treasurer Niagara Falls & Clifton Suspension Bridge Company.
W. PHILLIPS, superintendent Niagara Falls, Park & River Railway.
BURT VAN HORN, general manager Buffalo & Niagara Falls Electric Railroad Company.
FRANK LEBLOND, manager Maid of the Mist Steamboat Company.
THOMAS V. WELCH, superintendent State Reservation.
JAMES WILSON, superintendent Victoria Niagara Falls Park.
ARTHUR SCHOELLKOPF, secretary and treasurer Niagara Falls Hydraulic Power & Manufacturing Company.
W. A. BRACKENRIDGE, engineer Niagara Falls Power Company.

JOSEPH P. DEVINE,	EUGENE CARY,
L. W. PETTEBONE,	THOMAS MCDOWELL,
JAMES LOW,	D. ISAACS,
A. H. G. HARDWICKE,	BENJ. FLAGLER,
WM. RICHMOND,	RICHARD WILLIAMSON,
BENJ. F. THURSTON,	LAWRENCE DAVIS,
WM. S. HUMBERT,	ANDREW DICKEY,
W. H. BARNES,	JOHN M. HANCOCK,
WALTER MCCULLOCH,	JAMES SIMMONS,

H. W. BEARDSLEY.

Committee on Banquet.

A. C. HASTINGS, W. CARYL ELY,
T. V. WELCH.

Committee on Exhibits.

H. W. BEARDSLEY, W. A. HELLER,
W. PHILLIPS.

Committee on Entertainment.

W. S. HUMBERT,	WALTER MCCULLOCH,
JAMES LOW,	DAVID ISAACS,
JAMES S. SIMMONS,	H. W. BEARDSLEY,
MRS. W. C. ELY,	MRS. A. C. HASTINGS,
MRS. W. S. HUMBERT,	MRS. H. E. WOODFORD,
MRS. A. G. HARDWICKE,	MRS. F. W. OLIVER,
MRS. GEORGE NYE,	MRS. H. A. FRANCIS,
MRS. BURT VAN HORN,	MRS. N. L. BENHAM,
MRS. F. A. DUDLEY,	MRS. F. E. JOHNSON,
MISS BESSIE LOW,	MRS. E. O. BABCOCK,
MISS GRACE CUDDABACK,	MRS. C. W. DILL,
MRS. J. M. HANCOCK,	MRS. J. C. MORGAN,
MRS. M. COHN,	MRS. W. RICHMOND,
MRS. ELI NICHOLS,	MRS. W. R. CAMPBELL,
MRS. F. K. PADDOCK,	MRS. A. THIBAUDEAU,
MRS. H. W. BEARDSLEY,	MISS ROSE,
MRS. W. W. REED,	MRS. THOMAS MCDOWELL,
MRS. W. D. HOUGH,	MRS. W. L. LAMONT,
MRS. E. H. STEWART,	MRS. W. C. JOHNSON.

THE STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA

The first regular annual convention of the Street Railway Accountants' Association of America will also be held

at Niagara Falls, Oct. 19-22. The selection of the same date and location of meeting as those of the American Street Railway Association was made largely at the suggestion of the officers of the latter body, President McCulloch, Secretary Penington, and other members of the executive committee having expressed themselves as most cordially in sympathy with the aims and purposes of the younger body. The badges of the American Street Railway Association will be furnished to and worn by members of this association in addition to a designating ribbon of this association, and in all matters of entertainment, admission to meetings, etc., the members of this association are to be considered the same as members of the American Street Railway Association and will receive the same attention and accommodations. One feature of the accountants' convention which is of special importance will be an exhibition of blanks and forms used in accounting, and it is earnestly urged that every delegate bring a complete assortment.

The programme arranged for the meeting is as follows:

MONDAY.

7:30 P. M. Meeting of the Executive Committee at the International Hotel.

TUESDAY.

10 A. M. Regular business session as follows:
Meeting called to order by the president.
Roll call.
The reading of the minutes of the Cleveland meeting.
The annual addre s of the president.
The annual report of the Executive Committee.
The annual report of the treasurer.
Appointment of Convention Committees.

Paper on "The Care and Handling of Fares from Passenger to Bank," by C. L. Wight, auditor Toledo Traction Company, Toledo, O.

WEDNESDAY.

9 A. M. Roll call.

Paper on "The Handling and Checking of Transfers from Printer to Furnace," by J. F. Calderwood, auditor Twin City Rapid Transit Company, Minneapolis, Minn.

Paper on "Pay Rolls, Time Keeping and Method of Paying," by Frank R. Henry, secretary Missouri Railroad Company, St. Louis, Mo.

Paper on "Materials and Supplies Accounts from Purchase to Use," by W. G. Ross, comptroller Montreal Street Railway Company, Montreal, Can.

THURSDAY.

9 A. M. Roll call.

Report of a committee appointed at Cleveland, O., Mar. 24, 1897, on "A Standard System of Street Railway Accounting; Covering the Classification of Operating Expenses, Classification of Construction and Equipment Accounts and Form of Annual Report." Chairman, C. N. Duffy, secretary Citizens' Railway Company, St. Louis, Mo.; J. F. Calderwood, auditor Twin City Rapid Transit Company, Minneapolis, Minn.; W. F. Ham, secretary Nassau Electric Railway Company, Brooklyn, N. Y.

2:30 P. M. Report continued.

FRIDAY.

9 A. M. Roll call.

Paper on "Car Mileage: How Arrived at and Its Use", by by H. L. Davies, assistant secretary Cleveland Electric Railway Company, Cleveland, O.

Paper on "Statistics: Their Use and Abuse," by E. D. Hibbs, auditor Consolidated Traction Company, Jersey City, N. J.

Election of officers.

Appointment of committees.

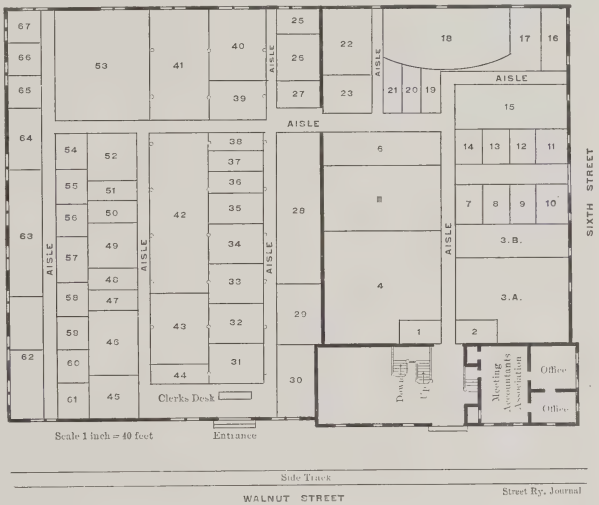
Adjournment.

THE EXHIBITS

The Exhibition Hall is at the corner of Walnut and Sixth Streets, and has recently been enlarged to accommodate the exhibits at the convention. The hall is easily accessible from the hotel district by the electric cars of the Niagara Falls & Suspension Bridge Railway, which run at frequent intervals, the time required to make the trip from the International Hotel by car is about four minutes, or on foot about ten minutes. A diagram of the hall with the spaces engaged by the different exhibitors is shown on this page. The largest space has been secured by the General Electric Company, which will occupy 1100 sq. ft. Next will come the Johnson Company, which has engaged 950 sq. ft. The headquarters of the STREET RAILWAY JOURNAL are close to the stairs leading to the convention hall and cannot be missed by anybody. The meetings of the association will be held on the second floor of the hall where the delegates will not be disturbed by any noise in the exhibition hall. The meeting of the Association of Street Railway Accountants will be held on the first floor of the convention hall to the left of the aisle leading from the headquarters of the STREET RAILWAY JOURNAL. The only entrance to the hall will be on Walnut Street.

The following is of list of exhibitors who have already engaged space:

		Sq. ft.
1	STREET RAILWAY JOURNAL, New York City	100
2	Windsor & Kenfield Publishing Company, Chicago	100



PLAN OF EXHIBITION HALL—NIAGARA FALLS CONVENTION.

3a	Westinghouse Electric & Manufacturing Company, Pittsburg, Pa	920
3b	Barney & Smith Car Company, Dayton, O	350
4	General Electric Company, Schenectady, N. Y	1100
5	Walker Company, Cleveland, O	700
6	Wells & French Company, Chicago	350
7	Cambria Iron Company, Philadelphia	100
8	John T. McRoy, Chicago	100
9	Paul Jones, Cincinnati, O	100
10	Adams & Westlake Company, Chicago	100
11	Mica Insulator Company, Chicago	100
12	Trojan Button Fastener Company, Troy, N. Y	100
13	Charles N. Wood, Boston, Mass	100
14	Corning Brake Shoe Company, Buffalo, N. Y	100
15	Murphy Manufacturing Company, Pittsburgh, Pa	480
16	Edison-Brown Plastic Rail Bond Company, New York	150
17	Consolidated Car Fender Company, Providence, R. I	200
18	Christensen Engineering Company, Milwaukee, Wis	900
19	The Cutter Electric & Manufacturing Company, Philadelphia	100
20	American Railway Supply Company, New York	100
21	Fuel Economizer Company, Matteawan, N. Y	100
22	Central Electric Company, Chicago	300
23	E. T. Burrowes Company, Portland, Me	175
25	Pomeroy & Fischer, New York City	100
26	Cleveland Frog & Crossing Company, Cleveland	150
27	D. J. Sinclair, New York	100
28	J. G. Brill Company, Philadelphia	650
29	Standard Air-Brake Company, New York City	250
30	William Wharton, Jr., & Company, Philadelphia	250
31	Ohio Brass Company, Mansfield, O	200
32	Creaghead Engineering Company, Cincinnati, O	200

33	Falk Manufacturing Company, Milwaukee, Wis.	200
34	R. D. Nuttall Company, Allegheny, Pa.	200
35	Clarence Whitman & Company, New York.	150
36	W. F. Ellis, Boston, Mass	100
37	Electric Mutual Casualty Association, Philadelphia.	100
38	Detroit Stove Works, Detroit, Mich	100
39	H. W. Johns Manufacturing Company, New York City	200
40	Pennsylvania Steel Company, Steelton, Pa	350
41	McGuire Manufacturing Company, Chicago	600
42	Peckham Motor Truck & Wheel Company, New York City.	800
43	Taylor Electric Truck Company, Troy, N. Y	340
44	Forsyth Brothers & Company, Chicago.	100
45	Rochester Car Wheel Works, Rochester, N. Y.	200
46	New York Car Wheel Works, Buffalo, N. Y	300
47	The New Haven Car Register Company, New Haven, Conn.	100
48	A. O. Norton, Boston, Mass	100
49	The Meaker Manufacturing Company, North Chicago	200
50	International Register Company, Chicago	100
51	Springfield Manufacturing Company, Bridgeport, Conn	100
52	St. Louis Register Company, St. Louis	200
53	The Johnson Company, Lorain, O, and Johnstown, Pa	950
54	Sargent Company, Chicago	100
55	Edward P. Sharp, Buffalo, N. Y.	100
56	W. T. Van Dorn Company, Chicago	100
57	Gold Street Car Heating Company, New York City	150
58	F. H. Newcomb, Brooklyn, N. Y.	100
59	Cleveland Construction Company, Akron, O	100
60	Chas. Scott Spring Company, Philadelphia	100
61	Monarch Stove & Manufacturing Company, Mansfield, O	100
62	Diamond Truck & Car Gear Company, Kingston, N. Y.	400
63	Consolidated Car Heating Company, Albany, N. Y	500
64	Crane Company, Chicago	200
65	Standand Underground Cable Company, Pittsburgh, Pa	100
66	Electric Storage Battery Company, Philadelphia	100
67	National Water Tube Boiler Company, New Brunswick, N.J.	100

TRACK SPACE.

J. G. Brill Company, Philadelphia.
Duplex Car Company, Boston, Mass.
McGuire Manufacturing Company, Chicago.
Peckham Motor Truck & Wheel Company, New York City.
American Car Company, St. Louis.
G. C. Kuhlman Company, Cleveland, O.
McCardell, West & Company, Trenton, N. J.
Taunton Locomotive Manufacturing Company, Taunton, Mass.

TRANSPORTATION TO NIAGARA FALLS

A special rate of fare and one-third for the round trip has been granted to attendants at the convention as usual. Persons purchasing tickets will pay full fare one way, ask the ticket agent for a certificate, which, when properly countersigned at Niagara Falls, will entitle the holder to a return ticket at one-third fare. The following special trains have been arranged for by the members of the Transportation Committee :

FROM THE EAST.

Special sleeping car train will leave Grand Central Station, New York, via New York Central & Hudson River Railroad, at 7.30 P. M., Monday, Oct. 18. From Boston, via Boston & Albany Railroad, regular 3 P. M. train same date, connecting with special at Albany, arriving Niagara Falls 8:25 A. M., Tuesday, Oct. 19. From Philadelphia, via the Lehigh Valley (Reading Station), 7:30 P. M., arriving Niagara Falls 7:25 A. M. From Washington, via Pennsylvania Railroad, 7:10 P. M.; Baltimore 8:25 P. M; Harrisburg 12:01 A. M., arriving Niagara Falls 10:43 next morning.

FROM THE WEST.

Michigan Central ("Niagara Falls Route"), Wabash or Lake Shore & Michigan Southern lines. Leaving Chicago, via Michigan Central, 3 P. M., Detroit 11:10 P. M., Monday, Oct. 18. Leaving Chicago, via Wabash Railroad, 3:15 P. M., Monday, Oct. 18. Leaving Chicago, via the Lake Shore & Michigan Southern, 3 P. M.; Toledo 11:25 P. M., Monday, Oct. 18. From Pittsburgh, via the Pittsburgh & Lake Erie Railway, 10:20 P. M.; arriving Niagara Falls early next morning.

FROM THE SOUTHWEST.

Big Four or Wabash line. Leaving St. Louis, via the Big Four, 12 noon, Indianapolis 6:25 P. M., Cincinnati 6:30 P. M., Columbus 10 P. M., Monday, Oct. 18; arriving Niagara Falls early next morning. Leaving St. Louis, via Wabash Railroad, 8:45 A. M., Monday, Oct. 18; arriving Niagara Falls 6:48 A. M. next morning.

Inquiries relating to tickets, certificates and sleeping car berths should be addressed to

MILTON C. ROACH, G. E. P. A., N. Y. C. & H. R. R. R. Co., 413 Broadway, New York City.

J. L. WHITE, Passenger Agent, Boston & Albany R. R. Washington Street, Boston.

L. D. HEUSNER, G. W. P. A., Michigan Central R. R., Chicago.
C. K. WILBER, A. G. P. A., Lake Shore & M. S. Ry., Chicago.
W. P. DEPPE, A. G. P. A., Big Four Route, St. Louis.
J. E. REEVES, G. S. Agent, Big Four Route, Cincinnati.
H. M. BRONSON, A. G. P. A., Big Four Route, Indianapolis.
F. A. PALMER, A. G. P. A., Wabash Railroad, Chicago.
C. S. CRANE, G. P. and T. A., Wabash Railroad, St Louis.
E. C. DUNNEVANT, C. P. Agent, P. & L. E. R. R., Pittsburgh,

and to general or city agents roads named at all other points.

THE NEXT CONVENTION

In connection with the selection of the city at which the next convention will be held, the following letter is of interest:

THE CINCINNATI LEAGUE.

CHAMBER OF COMMERCE BUILDING.

CINCINNATI, Sept. 14, 1897.

EDITORS STREET RAILWAY JOURNAL:

At the Niagara Falls meeting of the American Street Railway Association, the City of Cincinnati will present an invitation asking the association to hold its 1898 session in the Queen City of the West. The acceptance of this invitation will be urged by "The Cincinnati Street Railway Company," and "The Cincinnati, Newport & Covington Street Railway Company," the active members of the association from our city.

The native beauty of Cincinnati, her ample hotel accommodations, her accessibility at low rates of fare from all directions, and her unstinted hospitality recommended her as the preferable city for your convention. The great majority of those in attendance would not have to spend more than one night on the cars to reach here. Our renowned music hall and exposition buildings—all under one roof—represent an investment of over $550,000, presenting the finest convention buildings in America. In the power halls —189 × 316 ft.—will be found room for a magnificent exposition of railroad appliances and supplies at a nominal cost of exhibit, as the shafting, etc., are all in place.

Our fine streets, magnificent street railway system, with double trolley equipment, cable service, etc., our large parks, beautiful suburbs, our many pleasure resorts, our great and small manufactories, our Northern thrift and enterprise, with our Southern warmth and hospitality; all these and many more appeal to you to let us entertain you in 1898. The American Street Railway Association has not visited us as a convention for many years, and we feel that next year will be our turn among the great cities of our country to have the railway men, and the representatives of the supply houses attending the convention, as our welcome guests.

WM. B. MELISH,
Chairman.

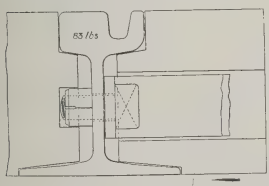
RAILWAY SYSTEM OF SYDNEY, N. S. W.

The recent announcement that the street railway system of Sydney, N. S. W., is to be equipped with electric power has attracted a great deal of interest. This is not only because the system will be by far the largest of any in the antipodes, but also because it is owned and operated by the Colonial Government under the supervision of whose engineer the transformation will be made. The motive power employed at present is steam dummies with the exception of two cable lines, one electric line and one very short horse line. The successful experience with the existing electric equipment has been the reason of the present decision. The chief assistant engineer of the Government, Gustave Fischer, is at present in this country arranging the details of the proposed installation with the manufacturers and supervising the construction of the apparatus.

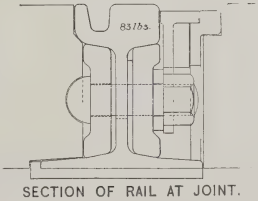
The city of Sydney, which at present has a population of about 450,000, has a fine harbor which divides the city into two parts, the North and South sides; the latter is the larger and contains the main business districts. The grades are severe on both sides of the harbor and the line usually descends to the water line by a very steep grade. This has prevented the steam trams from reaching the shore in a number of cases, although the grades on the lines equipped with steam power run frequently as high as 6 per cent. With the introduction of electric power, when this difficulty will be overcome, the lines will be extended to the different wharves on the shore. The present arrangement of the lines in Sydney is shown in the accompanying map. The two existing cable lines are shown by dash lines and the present electric line on the north shore by crosses; the other lines shown are all operated by steam with the exception of a short line in the suburbs on which animal power is used. The entire length of line at present in operation is 82 miles of which 67½ are steam, 9 cable, 3½ electric and one horse.

The following is taken from the annual report of the Railway Commissioners of New South Wales for the year ending June 30, 1897.

Total spent on construction and equipment	£1,452,670
Total cost per mile open	23,243
Total mileage open for traffic	62½
Gross revenue	£306,695
Working expenses	£248,881
Net profit (after paying working expenses)	£57,814
Percentage of working expenses to revenue	81.15
Earnings per average mile open	£4,987
Working expenses per average mile open	£4,047
Gross earnings per tram mile	1 11¾
Working expenses per tram mile	1 7¼
Net profit per tram mile	4½
Percentage of profit to capital invested	£3 19 9
Number of passenger fares collected	72,343,812
Tram mileage	3,088,138

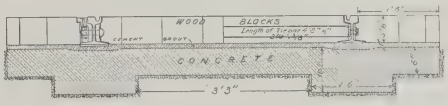


SECTION OF RAIL AT TIE ROD.



SECTION OF RAIL AT JOINT.

A large power station for the operation of the city system will be located on William Henry Street, and is now being erected. It is a steel frame building, with walls of wrought iron and concrete, and measures 100 ft. × 132 ft. The engine equipment will consist of four 850 k. w. direct connected units. The engines will be supplied by the E. P. Allis Company, and will have cylinder dimensions 26 ins. and 48 ins. × 48 ins. stroke. The generators will be General Electric make and the switchboard will be a panel board of American standard contruction. The boilers will be multitubular, each 16 ft. long × 7 ft. 4 ins. in diameter. The auxiliary apparatus will include two Blake marine type air pumps and Wheeler surface condensers, as water from the harbor will be used for condensing. The tracks of the company lead on to a trestle in the rear of the boiler room, from which fuel is dumped into coal cars and conveyed thence to the boiler room, where it is fed to the furnaces by hand. Coal is extremely cheap and abundant in Sydney, as there are many coal deposits in the immediate neighborhood. The cost, delivered, of coal is about $1.75 per ton.



SECTION OF ROADBED.

As an auxiliary to the station, the managers of the line will install a large accumulator plant, which will be located in the upper floor of the power station. The capacity of this plant has not yet been decided. The Government engineers have had considerable experience with storage batteries as station auxiliaries, having now one plant of this character acting as a feeder for the present Mosman Bay line. The results have been so satisfactory that three auxiliary plants of this character will be installed in addition to that in the power station. Of the three for which the type of battery has been determined, two are of the chloride type and one of the E. P. S. type.

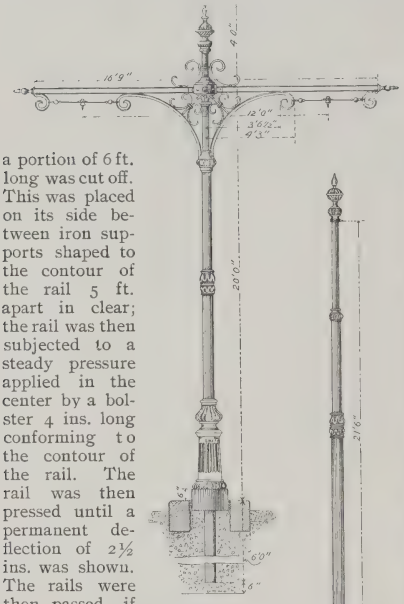
MAP OF TRAMWAY SYSTEM—SYDNEY.

In its track construction, the company used a 6 in., 83 lb. grooved rail of the special type shown on this page. This type while having, as will be seen, a very narrow groove, has been in use for a long time in the city of Sydney. The chemical composition of the rail as shown from the engineer's specifications, is as follows:

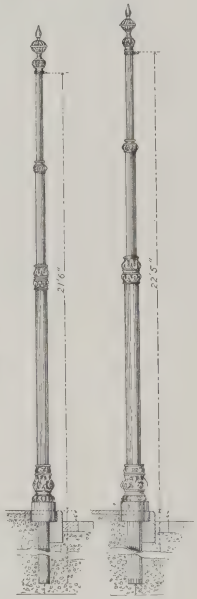
Carbon between .6 and .75 per cent.

Silicon between .1 and .15 per cent.
Manganese between .8 and 1 per cent.
Sulphur not to exceed .069 per cent.
Phosphorous not to exceed .06 per cent.

The test applied the rails was as follows: certain rails of each day's make were selected and from each rail tested a portion of 6 ft. long was cut off. This was placed on its side between iron supports shaped to the contour of the rail 5 ft. apart in clear; the rail was then subjected to a steady pressure applied in the center by a bolster 4 ins. long conforming to the contour of the rail. The rail was then pressed until a permanent deflection of 2½ ins. was shown. The rails were then passed, if this test was sustained without the exhibition of any sign of fracture.



BRACKET POLE.

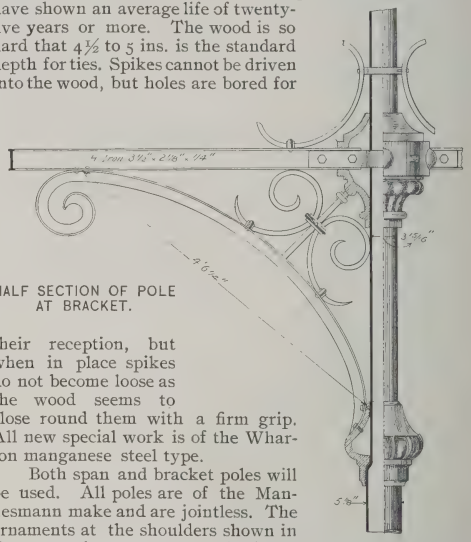


SPAN POLE. PULL-OFF POLE.

The sub-construction is shown on page 661. As will be seen, the rails rest on a layer of cement grouting, 1 in. in depth, supported on a bedding of concrete extending 1 ft. 6 ins. underneath the rails. The engraving shows the construction on streets paved with wood which is the kind of paving used on the majority of the streets of the city. Tie rods are employed every 5 ft. 3 ins., the wooden blocks being mortised where necessary to receive the rods. The kind of wood employed is black-butt and tallow wood which have shown such excellent wearing qualities that no stone toothing is required on either side of the rail. In fact at the point where the wooden block abuts against the head of the rail the wear does not exceed ⅛ in. in ten years, making the life of the wooden paving equal to that of the rail.

The joints are made with six bolt angle plates and on the outside of each joint is a joint box with cover, as shown on page 661. The cover has cast upon it a lip which projects into the joint box and acts as a nut lock for the joint bolts. The girder rails at present in use are of English manufacture, but it is interesting to note that the last two rail orders, which were for 2000 tons each and called for T rails for government railways, were awarded to American mills.

The concrete sub-construction outlined was not adopted through scarcity of wood suitable for ties. The colonial hardwoods form a most durable tie, and in the tie construction now in use on the government railways have shown an average life of twenty-five years or more. The wood is so hard that 4½ to 5 ins. is the standard depth for ties. Spikes cannot be driven into the wood, but holes are bored for their reception, but when in place spikes do not become loose as the wood seems to close round them with a firm grip. All new special work is of the Wharton manganese steel type.

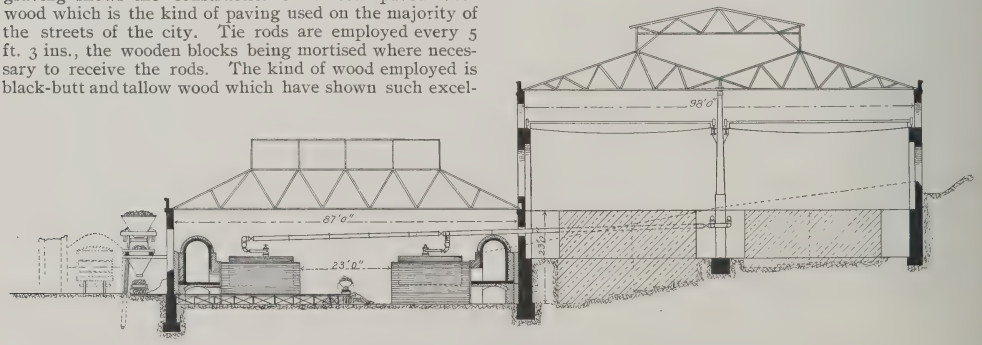


HALF SECTION OF POLE AT BRACKET.

Both span and bracket poles will be used. All poles are of the Mannesmann make and are jointless. The ornaments at the shoulders shown in the engravings are cast and slipped down over the top. The cross arms, brackets, etc., are clamped on to the pole which is not drilled.

For a trolley wire the company will use the figure 8 wire of the John A. Rœbling's Sons Company, with a capacity equal to a No. 000 wire. The make of line appliances has not yet been determined upon.

The feeders are all laid underground. In the lower part of the city it is decided to lay the feeders for the ultimate carrying capacity of the line. They are, therefore, iron armored and laid directly in concrete without ducts.



SECTION OF POWER STATION.

The present rolling stock of the company includes about 114 steam motor cars; 226 35 ft. trail cars; 86 cable cars and 10 electric cars. The determination of the best type of car for use in Sydney is a difficult matter and this point has not yet been entirely settled. The frequen

tropical rains, which are very severe, prevent the use of open cars, and double deck cars are not regarded with much favor by the management. For immediate use 18 ft. cars have been ordered. These will be mounted on Peckham cantilever extension trucks and will be equipped with General Electric motors. The car bodies will be of local make. A very careful test has been made of air brakes on both the cable and electric division of railway. The Standard air brake has been the one employed and the engineers have been so well satisfied with the results secured that they have adopted it for all their new equipments. Much trouble has been experienced with wheels on account of the narrow groove employed. Cast steel wheels are being used, but experiments are being made with steel tired wheels, as it is found that the flange of a chilled iron wheel will become chipped with the type of rail used.

The work of installing the power plan is being carried on by H. H. Kingsbury & Company as contractors, under the supervision of Gustave Fischer, Chief Assistant Engineer for Tramways, acting under the immediate direction of the Engineer in Chief for Railways of the New South Wales Government.

TRAMWAY SITUATION IN VIENNA, AUSTRIA.

BY E. A. ZIFFER.

There has been for years an aggressive war going on between the "Wiener Tramway Gesellschaft" (Vienna Tramway Company) and the municipal authorities, resulting in 1895 in a change in the company's shareholders. The "Wiener Bankverein (Vienna Banking Association) bought up the shares held by the banking firm of Reitzes, reconstructed the board of directors, and applied to the city of Vienna for permission to introduce electric traction on its lines, which are 156.7 km. (97 miles) in length of track, laid in 80.5 km. (50 miles) of street.

The difficulties existing between the municipality and the company, however, could not be smoothed over, and it was only after protracted negotiations that the tramway company received permission to apply electric traction on the overhead system to its so-called transversal line, a line 9.76 km. in length, connecting the different railway termini of the city—the Northern, Northwestern, Franz Josef and Western railways. This line was opened to traffic on Jan. 28, 1897, and has been in operation ever since without interruption. The authorization was, however, granted only provisionally, for the period of two years, as the definite franchise was made conditional upon satisfaction to the authorities and to the public.

The franchise of the tramways company expires in 1925, and according to the terms of the contract, the city cannot grant permission for the use of the streets in which the tracks are laid, to any other concern. The city contends, however, that while it cannot grant permission for the use of the streets to other companies, it possesses the right to build and operate a tramway itself in such streets. The Vienna Tramways Company is, however, of different opinion, and believes that it has also the right to build underground and elevated railways in those streets.

These conditions led to an effort on the part of the city to acquire the property of the Vienna Tramways Company, to extend the existing system and introduce electric traction. The further fact that in 1898, on the occasion of the Jubilee of the fiftieth anniversary of the Emperor of Austria's accession to the throne, an industrial exhibition is to be held, and that the committee of the exhibition, as well as the Vienna Trotting Association offered to build electric lines to the exhibition and to the race course, led to the appointment of a committee to study the question of the construction of electric roads in Vienna.

This committee made a report to the Municipal Council on the project presented by the firm of Siemens & Halske, in conjunction with the Trotting Association, for the construction of an electric road from the City Hall to Stefanie Bridge, Rotunda and Freudenau, and this report contained the following resolutions:

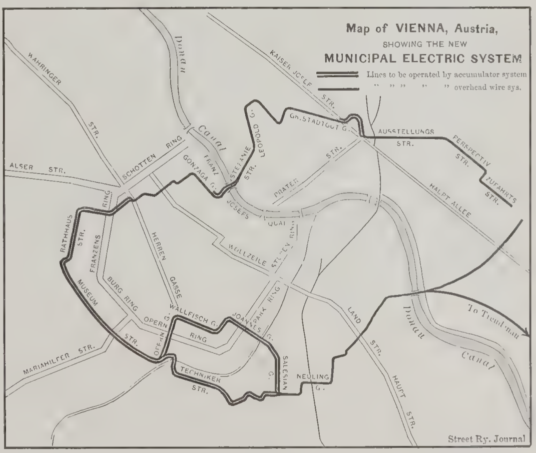
1. The city of Vienna should, by all means, own the electric lines to be built.

2. The Mayor should be empowered to negotiate and to close a contract for the construction and operation of electric lines:

a With the firm of Siemens & Halske (eventually also with other concerns) for carrying out their project, of which the route is from the Rotunda, across Sophie Bridge along the left bank of the Danube, across the Stefanie Bridge, behind the Stock Exchange, crossing Ringstrasse near the University and turning into Ringstrasse near Alserstrasse (including a section of the crosstown line in front of the Academy of Fine Arts) to Alserstrasse and from the Prater Star to the Francis Bridge.

b With the Committee on the Jubilee Exhibition in 1898, for carrying out their project, of which the route is from the Lusthaus in the Prater to Sophie Bridge, Neulingasse, Wallfischgasse on one side and Sophie Bridge, Wassergasse, Wallfischgasse on the other side, connecting with the Section Sophienbrücke Freudenau.

In regard to these lines, the city reserves the right to claim a part of the gross receipts, and the bidders shall be entitled severally or jointly to build and operate the respective lines with the understanding that the city of Vienna is to enter at once into ownership of the lines to be built, while only a contract for the construction and operation of the lines is to be closed with the contracting party.



The lines referred to are to be completed and opened to traffic by May 1, 1898, in time for the inauguration of the Jubilee Exhibition.

These resolutions resulted in proposals made to the city for the construction of electric lines by eight different concerns, as follows:

By the firm of Siemens & Halske, now changed into a stock company; by the Union Elektrizitäts Gesellschaft of Berlin, representing the Thomson-Houston system; by the Bank für elektrische Untermehmungen, und Elektricitäts Action-Gesellschaft Felix Singer & Company, in Berlin, in conjunction with the Union Bank-Gesellschaft in Vienna—representing the Walker system and the Dickinson current transmission system; the Schukert works in Nuremberg; Bartelmus in Brunn; Ritschl in Vienna; Vienna Tramways Company.

These bids, which are said to be all very favorable to the city, are now being examined by the committee on construction of the Municipal Council, and it has been decided to first build the lines shown in the accompanying map.

A part of this system is to be completed by May 1, 1898, and the remainder by Aug. 1, 1898. The cost of construction is estimated at about 3,000,000 florins ($1,450,000). The committee was not disposed to sanction the proposition to use the overhead construction for the whole system above mentioned, and decided upon the mixed system, and the Municipal Council approved of the committee's suggestions.

While these negotiations were going on, the daily press published reports of the acquisition by the city of the Vienna Tramways Company's property on payment to the shareholders of a dividend of 19 florins ($9.12) and distribution of the sinking fund. In the session of the Municipal Council of July 6, the Mayor explained, in reply to an urgent question, that he was not negotiating directly or indirectly either with the Vienna Tramways Company or any other concern, and that all statements to the contrary were mere inventions.

In the interim several Berlin financial and electrical firms took an interest in the Vienna tramways, and the Deutsche Bank in Berlin, jointly with the Actiengesellschaft, Siemens & Halske, in Berlin, secured 30,000 shares of the Vienna Tramways stock from the Wiener Bankverein, which has been, since 1895, intimately connected with the Vienna Tramways Company, and which withdraws completely from the enterprise. In consequence of the change of ownership, the present board of directors will return its powers to the shareholders in a special meeting called for Aug. 2, 1897, for the express purpose of taking action upon the resignation of the board of directors.

The price at which the shares of the Wiener Bankverein were acquired is not known, but it is hardly likely to be less than the rate at which the Bankverein acquired them in 1895, which was 410 florins. The shares are now quoted on 'Change in Vienna at 480 florins on a par of 200 florins.

The tramway question has now assumed a new phase. A member of the Vienna directors of the Actiengesellschaft Siemens & Halske advised the Mayor on July 21, that the Siemens group owned a majority of the shares of the Vienna Tramway Company and hinted that within a short time the new directory would place before the municipal authorities a proposition for the equipment of the tramway system with electric power, in a form such that the city will have a share in the management and receive a right of redemption on a graded basis. The Mayor explained to the representative of the firm of Siemens & Halske that such a question could only be discussed from the following points of view :

(*a*) That the city would itself acquire the concession for the electric lines to be constructed; (*b*) that the Tramways Company would from time to time return to the city concessions for the horse car lines as fast as they are changed to electric traction; (*c*) that the city would merely close a contract with the concern erecting the electric lines for the construction and operation of the same, in such a manner that the city would at any time have the right to assume the operation of the lines by payment of a price to be determined beforehand, and to be graded according to the period of operation. Of course, there could be no question of an acquisition at the prevalent high rates of the Tramway's shares, as quoted on 'Change.

THE OPENING OF THE LEEDS ELECTRIC RAILWAY.

OPENING OF THE LEEDS ELECTRIC RAILWAY.

The accompanying engraving, taken on the occasion of the recent opening of the new Leeds (England) electric lines (owned by the municipality), shows the type of cars popular in Great Britain and of which many will doubtless be built. The side running trolley is one of the peculiar features of British practice and the roof seats form another. These cars are equipped with the Peckham trucks whose extended spring base is claimed to be of special value with this type of car.

Incidentally, the solid and substantial British citizen appears to good advantage in the illustration.

MILE CK.	CAPITAL LIABILITIES. TOTAL.		PER MILE TRACK.		CAPITAL LIAB. PER CAPITA POPULATION.	POPULATION PER MILE OF TRACK.	POPULATION. (IN 1890).	STATES.
1897	1896	1897	1896	1897				
								New England States
15,900	4,230,875	4,893,875	36,800	31,600	7.40	4,300	661,100	Maine
10,000	923,100	1,418,500	17,800	21,200	3.77	5,600	376,500	New Hampshire
11,500	873,000	900,500	30,100	25,800	2.71	9,500	332,400	Vermont
17,800	60,315,100	63,619,800	52,300	46,600	28.41	1,600	2,239,000	Massachusetts
54,700	16,677,400	17,004,400	119,100	107,600	49.22	2,200	345,500	Rhode Island
24,100	16,322,740	18,653,840	48,900	50,100	25.00	2,000	746,300	Connecticut
21,100	99,342,215	106,490,915	54,500	49,500	22.65	2,200	4,700,800	TOTALS AND AVERAGES
								Eastern States.
85,100	347,967,757	370,821,217	182,800	177,800	61.83	2,900	5,997,900	New York
53,300	68,662,250	72,137,250	117,600	106,800	49.93	2,100	1,444,900	New Jersey
45,100	207,930,133	219,116,608	139,500	128,200	41.67	3,100	5,258,000	Pennsylvania
23,400	1,019,480	1,364,284	37,700	42,600	8.09	5,300	168,500	Delaware
31,100	19,270,500	19,509,900	137,600	125,900	84.68	1,500	230,400	District of Columbia
43,700	25,811,150	27,048,150	96,000	87,200	25.95	3,400	1,042,400	Maryland
29,500	10,400,250	11,371,250	58,700	57,800	6.87	8,400	1,656,000	Virginia
13,600	1,840,000	2,300,000	44,800	41,100	3.02	13,600	762,800	West Virginia
60,600	682,901,520	723,668,659	147,300	138,600	43.70	3,200	16,560,900	TOTALS AND AVERAGES
								Central States.
21,300	16,382,400	19,771,546	36,400	39,800	9.44	4,200	2,093,900	Michigan
22,300	83,182,300	92,982,302	73,300	75,400	25.32	3,000	3,672,300	Ohio
26,800	18,927,550	19,898,550	57,300	56,100	9.07	6,200	2,192,400	Indiana
30,600	14,050,900	14,185,200	66,300	65,100	7.63	8,500	1,858,600	Kentucky
31,600	18,254,000	18,479,000	66,400	64,600	10.95	5,900	1,686,900	Wisconsin
63,600	142,552,955	183,308,925	134,500	147,300	47.91	3,100	3,826,400	Illinois
45,000	33,837,000	32,457,100	115,900	107,100	24.93	4,300	1,301,800	Minnesota
18,500	13,054,000	12,376,000	55,100	53,300	6.47	8,200	1,911,900	Iowa
53,500	58,536,300	62,329,500	96,100	101,500	23.26	4,400	2,679,200	Missouri
38,800	398,777,405	455,788,123	86,600	91,500	21.48	4,300	21,223,400	TOTALS AND AVERAGES
								Southern States.
16,500	1,321,000	1,321,000	30,700	30,700	.82	37,600	1,617,900	North Carolina
4,600	655,000	667,000	14,200	14,900	.58	25,600	1,151,100	South Carolina
19,600	9,404,900	9,332,400	37,800	38,200	5.08	7,500	1,837,400	Georgia
100	341,100	331,100	7,000	6,100	.85	7,300	391,400	Florida
14,400	8,092,800	8,172,800	41,800	44,200	5.40	8,200	1,513,000	Alabama
1,000	211,500	214,000	10,700	10,700	.17	64,500	1,289,600	Mississippi
17,300	9,661,100	8,958,500	41,300	38,600	5.01	7,600	1,767,500	Tennessee
48,000	20,649,100	20,516,400	112,300	107,400	18.34	5,900	1,118,600	Louisiana
13,300	2,304,075	2,512,375	29,900	34,000	2.23	15,200	1,128,200	Arkansas
20,700	52,640,575	52,025,575	48,000	47,800	4.40	10,900	11,814,700	TOTALS AND AVERAGES
								Western States.
5,800	425,000	350,000	25,000	26,900	1.06	25,300	328,800	South Dakota
21,000	12,857,500	12,857,500	60,400	61,200	12.14	5,000	1,058,900	Nebraska
16,100	6,300,000	4,700,000	46,400	36,400	3.29	11,100	1,427,100	Kansas
15,700	11,616,100	10,982,500	33,900	34,200	4.91	7,000	2,235,500	Texas
36,500	19,774,000	20,074,000	74,100	75,400	48.70	1,600	412,200	Colorado
25,500	2,950,000	2,950,000	60,200	60,200	22.31	2,700	132,200	Montana
. . .	54,000	54,000	13,500	13,500	.64	21,100	84,400	Idaho
10,000	2,456,000	2,756,000	24,600	27,600	13.26	2,100	207,900	Utah
26,700	15,876,457	15,070,457	68,500	64,900	43.13	1,500	349,400	Washington
15,600	4,994,500	4,751,300	36,500	33,200	15.14	2,200	313,800	Oregon
29,100	64,444,900	66,691,840	78,600	82,100	55.20	1,500	1,208,100	California
24,400	141,748,457	141,237,597	61,100	62,000	18.20	3,400	7,758,300	TOTALS AND AVERAGES
40,300	1,375,410,172	1,479,210,869	95,000	94,100	23.84	4,000	62,058,100	United States
12,000	22,542,300	23,179,600	48,800	45,400	4.80	9,500	4,829,411	Canada

STREET RAILWAY MILEAGE AND CAPITALIZATION IN AMERICA.

STATES.	No. of Roads.		Electric Railways. Track Mileage.		Electric Railways. Motor Cars.		Electric Railways. Trail Cars.		Cable Railways. Track Mil'age		Cable Railways. Grip Cars.		Cable Railways. Trail Cars.		Horse Railways. Track Mileage.		Horse Railways. Cars.		Miscellaneous Railways. Track Mil'age		Miscellaneous Railways. Cars, Engines, Etc.		Totals. Track Mileage.		Totals. Cars.	
	1896	1897	1896	1897	1896	1897	1896	1897	1896	1897	1896	1897	1896	1897	1896	1897	1896	1897	1896	1897	1896	1897	1896	1897	1896	1897
New England States.																										
Maine	13	17	98	152	165	225	64	87							17	3	34	4					115	155	263	316
New Hampshire	5	6	38	63	80	109	35	28							14	4	38	21					52	67	153	158
Vermont	5	5	29	35	37	45	9	4															29	35	46	49
Massachusetts	59	76	1,093	1,325	3,445	4,286	240	194							54	33	692	444	6	6	9	3	1,153	1,364	4,386	4,927
Rhode Island	8	8	137	158	379	476	212	152							3		2	1					140	158	593	629
Connecticut	23	26	334	372	702	850	200	95									21	15					334	372	923	960
Totals and Averages	113	138	1,729	2,105	4,808	5,991	760	560							88	40	787	485	6	6	9	3	1,823	2,151	6,364	7,039
Eastern States.																										
New York	109	111	1,382	1,559	4,559	4,921	688	814	55	55	967	1,214	55	55	295	295	2,058	2,939	172	173	2,054	2,052	1,904	2,085	10,381	11,995
New Jersey	36	40	543	653	1,202	1,422	135	196	2	2	2	2			40	21	200	66					585	676	1,539	1,686
Pennsylvania	110	110	1,451	1,658	3,715	3,510	239	285	27	27	156	156			10	14	174	143	3	10	14	7	1,491	1,709	4,208	4,101
Delaware	2	3	27	32	63	85																	27	32	63	85
District of Columbia	10	10	59	83	100	245	171	253	28	28	142	142	175	234	53	44	289	211					140	155	877	1,085
Maryland	6	11	233	285	464	761	95	136	36	21	132	72	60	36		2	100	100		2		2	269	310	851	1,107
Virginia	17	17	163	184	247	291	39	63							10	9	27	25	4	4	5	5	177	197	318	384
West Virginia	4	6	26	41	32	38	6	4							6	6	7	8	9	9	24	24	41	56	69	74
Totals and Averages	294	308	3,884	4,495	10,382	11,273	1,373	1,751	148	133	1,399	1,586	290	325	414	394	2,855	3,492	188	198	2,097	2,090	4,634	5,220	18,396	20,517
Central States.																										
Michigan	31	31	438	494	1,004	1,121	222	166							3		5		9	3	9	4	450	497	1,240	1,291
Ohio	62	58	1,073	1,174	2,087	2,347	954	960	44	45	154	251	103	108	15	10	28	21	3	3	13	13	1,135	1,232	3,339	3,700
Indiana	26	25	395	343	479	494	228	230							25	12	40	30					339	355	747	754
Kentucky	10	11	167	178	291	331	220	228							45	40	139	125					212	218	650	684
Wisconsin	16	15	271	282	330	458	137	79							4	4	2	2					275	286	169	539
Illinois	48	57	877	1,113	1,787	2,124	2,662	2,702	82	82	677	617	329	522	74	28	427	109	27	20	383	229	1,060	1,243	6,265	6,303
Minnesota	11	11	278	292	667	671	318	318	7	7	40	40			7	4	11	6				6	292	303	1,036	1,041
Iowa	24	23	212	219	273	283	140	154	7		14		20		13	11	19	22	5	2	8	4	237	232	474	463
Missouri	31	31	434	489	963	962	696	696	101	101	326	326	490	490	24	24	62	62					609	614	2,585	2,556
Totals and Averages	259	262	4,105	4,584	7,881	8,811	5,577	5,533	241	235	1,211	1,234	942	1,120	210	133	733	377	44	28	413	256	4,600	4,980	16,757	17,331
Southern States.																										
North Carolina	8	8	39	39	62	59	9	12							2	2	3	3	2	2	2		43	43	76	74
South Carolina	6	6	10	10	6	12	4	4							36	35	63	93					46	45	73	109
Georgia	13	13	225	224	311	325	72	42							15	11	21	9	9	9	11	10	249	244	415	386
Florida	7	6	37	43	23	40	6	10							12	11	23	16					49	54	52	66
Alabama	15	14	76	88	99	111	53	68							15	14	23	42	103	83	111	107	194	185	286	328
Mississippi	5	5	4	6	4	3		8							12	12	23	17	4	2	28	28	20	20	55	56
Tennessee	19	19	208	216	302	345	92	91	1	1	2	2			16	5	21	12	6	16	10	10	234	232	427	460
Louisiana	11	11	156	172	427	470	4	4							22	13	54	19	6	6	56	58	184	191	541	551
Arkansas	9	9	38	40	61	59	35	41							34	29	78	57	5	5	4		77	74	178	157
Totals and Averages	93	91	793	838	1,295	1,424	275	280	1	1	2	2			164	132	309	268	138	117	222	213	1,066	1,088	2,103	2,187
Western States.																										
South Dakota	4	3	11	7	5	3	2	3							6	6	7	7					17	13	14	13
Nebraska	12	13	187	187	207	210	221	206							26	23	28	21					213	210	456	440
Kansas	12	10	103	107	118	118	77	77							22	22	30	30	11		18		136	129	344	225
Texas	32	30	254	267	304	337	49	56	4		1				73	54	149	129	11	2	19	4	342	321	522	522
Colorado	10	10	208	207	256	269	254	213	30	30	79	62	78	80	7	7	4	5	22	22	14	4	267	266	655	633
Montana	3	3	47	47	34	36	16	16	2	2	4	4	1	1			2	1					49	49	57	55
Idaho	1	1	4	4	2	2																	4	4	2	2
Utah	4	4	92	92	105	105	17	17							4	4	6	6					232	232	246	270
Washington	22	22	210	210	155	186	27	18	18	18	45	45	15	15	5	5	4	4	21	21	42	14	137	143	239	248
Oregon	10	11	105	114	163	186	14	28	3	3	16	16			200	127	469	316	67	67	121	71	820	812	1,072	1,023
California	47	47	401	501	527	706	67	119	152	117	718	661	70	48												
Totals and Averages	157	154	1,622	1,743	1,876	2,160	744	753	209	170	863	788	164	144	343	248	699	522	143	118	216	91	2,317	2,279	4,562	4,458
United States	916	953	12,133	13,765	26,242	29,659	8,729	8,877	509	389	3,475	3,610	1,396	1,589	1,219	947	5,383	5,111	519	467	2,957	2,653	14,479	15,748	48,182	51,532
Canada	30	32	450	498	714	836	436	376							13	12	37	33					462	510	1,187	1,245

STATES.	Capital Stock. Total.		Capital Stock. Per Mile Track.		Funded Debt. Total.		Funded Debt. Per Mile Track.		Capital Liabilities. Total.		Capital Liabilities. Per Mile Track.		Capital Liab. per Capita Population.	Population per Mile of Track.	Population. (in 1890).	STATES.
	1896	1897	1896	1897	1896	1897	1896	1897	1896	1897	1896	1897				
New England States.																**New England States**
Maine	1,977,875	2,427,875	17,200	15,700	2,253,000	2,466,000	19,600	15,900	4,230,875	4,893,875	36,800	31,600	7.40	4,300	661,100	Maine
New Hampshire	373,100	750,000	7,200	11,200	550,000	668,500	10,600	10,000	923,100	1,418,500	17,800	21,200	3.77	5,600	376,500	New Hampshire
Vermont	472,000	499,500	16,300	14,300	401,000	401,000	13,800	11,500	873,000	900,500	30,100	25,800	2.71	9,500	332,400	Vermont
Massachusetts	37,114,200	39,330,900	32,200	28,800	23,200,900	24,288,900	20,100	17,800	60,315,100	63,619,800	52,300	46,600	28.41	1,600	2,239,000	Massachusetts
Rhode Island	8,320,200	8,360,200	59,400	52,900	8,357,200	8,644,200	59,700	54,700	16,677,400	17,004,400	119,100	107,600	49.22	2,200	345,500	Rhode Island
Connecticut	9,646,740	9,686,740	28,900	26,000	6,676,000	8,967,100	20,000	24,100	16,322,740	18,653,840	48,900	50,100	25.00	2,000	746,300	Connecticut
Totals and Averages	57,904,115	61,055,215	31,800	28,400	41,438,100	45,435,700	22,700	21,100	99,342,215	106,490,915	54,500	49,500	22.65	2,200	4,700,800	Totals and Averages
Eastern States.																**Eastern States.**
New York	174,374,161	193,317,661	91,600	92,700	173,593,596	177,503,556	91,200	85,100	347,967,757	370,821,217	182,800	177,800	61.83	2,900	5,997,900	New York
New Jersey	35,035,250	36,123,250	59,900	53,500	33,627,000	36,014,000	57,700	53,300	68,662,250	72,137,250	117,600	106,800	49.93	2,100	1,444,900	New Jersey
Pennsylvania	134,862,445	142,038,445	90,500	83,100	73,067,688	77,078,163	49,000	45,100	207,930,133	219,116,608	139,500	128,200	41.67	3,100	5,258,000	Pennsylvania
Delaware	419,480	614,284	15,500	19,200	600,000	750,000	22,200	23,400	1,019,480	1,364,284	37,700	42,600	8.01	5,300	168,500	Delaware
District of Columbia	14,910,500	14,690,100	105,500	94,800	4,360,000	4,819,800	31,100	31,100	19,270,500	19,509,900	137,600	125,900	84.68	1,500	230,400	District of Columbia
Maryland	12,826,150	13,498,150	47,700	43,500	12,985,000	13,550,000	48,300	43,700	25,811,150	27,048,150	96,000	87,200	25.95	3,400	1,042,400	Maryland
Virginia	5,600,250	5,600,250	31,600	28,300	4,800,000	5,805,000	27,100	29,500	10,400,250	11,371,250	58,700	57,800	6.87	8,400	1,656,000	Virginia
West Virginia	1,240,000	1,540,000	30,200	27,500	600,000	760,000	14,600	13,600	1,840,000	2,300,000	44,800	41,100	3.02	13,600	762,800	West Virginia
Totals and Averages	379,268,236	407,388,140	81,800	78,000	303,633,284	316,280,519	65,500	60,600	682,901,520	723,668,659	147,300	138,600	43.70	3,200	16,560,900	Totals and Averages
Central States.																**Central States.**
Michigan	9,137,990	9,194,846	20,300	18,500	7,244,500	10,576,700	16,100	21,300	16,382,400	19,771,546	36,400	39,800	9.44	4,200	2,093,900	Michigan
Ohio	57,146,800	65,485,700	50,400	53,100	26,035,500	27,496,502	22,900	22,300	83,182,300	92,982,302	73,300	75,400	25.32	3,000	3,672,300	Ohio
Indiana	10,276,550	10,397,550	31,100	29,300	8,651,000	9,501,000	26,200	26,800	18,927,550	19,898,550	57,300	56,100	9.07	5,200	2,192,400	Indiana
Kentucky	7,465,900	7,521,900	35,200	34,500	6,585,000	6,663,300	31,100	30,600	14,050,900	14,185,200	66,300	65,100	7.63	8,500	1,858,600	Kentucky
Wisconsin	9,510,000	9,435,000	34,600	33,000	8,744,000	9,044,000	31,800	31,600	18,254,000	18,479,000	66,400	64,600	10.95	5,900	1,686,900	Wisconsin
Illinois	78,450,395	104,202,325	74,000	83,700	64,102,650	79,106,400	60,500	63,600	142,552,955	183,308,925	134,500	147,300	47.91	3,100	3,826,400	Illinois
Minnesota	19,714,000	18,869,100	67,500	62,100	14,123,000	13,648,000	48,400	45,000	33,837,000	32,457,100	115,900	107,100	24.93	4,300	1,301,800	Minnesota
Iowa	8,756,000	8,083,000	37,100	34,800	4,265,000	4,293,000	18,000	18,500	13,054,000	12,376,000	55,100	53,300	6.47	8,200	1,911,900	Iowa
Missouri	24,375,300	29,490,500	48,200	48,000	29,161,000	32,839,000	47,900	53,500	58 536,300	62,329,500	96,100	101,500	23.26	4,400	2,679,200	Missouri
Totals and Averages	229,862,755	262,620,221	49,900	52,700	168,914,650	193,167,902	36,700	38,800	398,777,405	455,788,123	86,600	91,500	21.48	4,300	21,223,400	Totals and Averages
Southern States.																**Southern States.**
North Carolina	611,000	611,000	14,200	14,200	710,000	710,000	16,500	16,500	1,321,000	1,321,000	30,700	30,700	.82	37,600	1,617,600	North Carolina
South Carolina	462,000	462,000	10 000	10,300	193,000	205,000	4,200	4,600	655,000	667,000	14,200	14,900	.58	25,600	1,151,100	South Carolina
Georgia	4,436,400	4,548,400	17,800	18,600	4,968,500	4,784,000	20,000	19,600	9,404,900	9 332,400	37,800	38,200	5.08	7,500	1,837,400	Georgia
Florida	326,500	326,500	6,900	6,000	1,600	4,600	100	100	341,100	331,100	7,000	6,100	.85	7,300	391,400	Florida
Alabama	5,617,800	5,597,800	29,000	20,300	2,175,000	2,695,000	12,800	14,400	8,092,800	8,172,800	41,800	44,200	5.40	8,200	1,513,000	Alabama
Mississippi	195,000	195,000	9,800	9,700	16,500	19,000	900	1,000	211,500	214,000	10,700	10,700	.17	64,500	1,289,600	Mississippi
Tennessee	5,773,500	4,937,500	21,700	21,300	3,887,600	4,021,000	16,600	17,360	9,661,100	8,958,500	44,300	38,600	5.01	7,600	1,787,500	Tennessee
Louisiana	11,619,700	11,353,000	63,200	59,600	9,029,400	9,163,400	49,100	48,000	20,649,100	20,516,400	112,300	107,400	18.34	5,400	1,118,600	Louisiana
Arkansas	1,530,375	1,530,375	19,900	20,700	773,700	982,000	10,000	13,300	2,304,075	2,512,375	29,900	34,000	2.23	15,200	1,128,200	Arkansas
Totals and Averages	30,582,275	29,471,575	27,900	27,100	22,058,300	22,554,000	20,100	20,700	52,640,575	52,025,575	48,000	47,800	4.40	10,900	11,814,700	Totals and Averages
Western States.																**Western States.**
South Dakota	350,000	275,000	20,600	21,100	75,000	75,000	4,400	5,800	425,000	350,000	25,000	26,900	1.06	25,300	328,800	South Dakota
Nebraska	8,437,500	8,437,500	39,600	40,200	4,420,000	4,420,000	20,800	21,000	12,857,500	12,857,500	60,400	61,200	12.14	5,000	1,058,900	Nebraska
Kansas	2,635,000	2,615,000	27,000	20,300	2,635,000	2,085,000	19,400	16,100	5,300,000	4,700,000	46,400	36,400	3.26	11,600	1,427,100	Kansas
Texas	6,335,500	5,952,500	18,500	18,500	5,260,000	5,030,000	15,400	15,700	11,616,100	10,982,500	33,900	34,200	4 91	7,000	2,235,500	Texas
Colorado	10,355,000	10,355,000	38,800	38,900	9,419,000	9,719,000	35,300	36,500	19,774,000	20,074,000	74,100	75,400	18 70	1,600	412,200	Colorado
Montana	1,700,000	1,700,000	34,700	34,700	1,250,000	1,250,000	25,500	25,500	2,950,000	2,950,000	60,200	60,200	12.31	2,500	132,200	Montana
Idaho	54,000	54,000	13,500	13,500					54,000	54,000	13,500	13,500	.64	21,100	84,400	Idaho
Utah	1,450,000	1,750,000	14,600	17,600	1,000,000	1,000,000	10,000	10,000	2,450,000	2,750,000	24,600	27,600	13 26	2,100	207,300	Utah
Washington	9,802,000	8,870,000	42,300	38,200	6,074,457	6,200,457	26,200	26,700	15,876,457	15,070,457	68,500	64,900	14 13	1,600	349,400	Washington
Oregon	2,684,500	2,510,300	19,600	17,600	2,310,000	2,335,000	16,900	16,400	4,994,500	4,781,300	36,500	33,200	13 21	2,200	313,800	Oregon
California	42,385,600	43,095,240	51,700	53,000	22,085,000	23,626,600	26,900	29,100	64,470,600	66,721,840	78,600	82,100	18.20	1,800	1,208,100	California
Totals and Averages	87,196,100	85,596,540	37,600	37,600	84,552,057	55 841,057	23,500	24,400	141,748 157	141,235,597	61,100	62,000	18.20	3,400	7,758,300	Totals and Averages
United States	781,813,781	810,131,041	54,200	53,300	590,506,391	633,079,178	40,800	40,300	1,375,410,172	1,479,210,869	95,000	94,100	23.84	4,000	62,058,100	United States
Canada	16,877,300	17,056,800	36,500	33,400	5,665,000	6,123,000	12,300	12,000	22,542,300	23,179,600	48,800	45,400	4.80	9,500	4,829,411	Canada

DISTRIBUTION OF STREET RAILWAY MILEAGE AND CAPITALIZATION IN AMERICA.

For almost the first time in the history of American street railroading it is now possible to obtain a measure of the remarkable expansion in mileage and capital investment since the early days of the electric era, and to correctly distribute this mileage and capitalization among the several states and sections of the country. For the first time, too, it is possible to measure the changes of a single year with a fair approximation to accuracy.

In 1880 the street railway mileage *of road* in the United States, as reported in the tenth census was 2050. In 1890 the mileage *of track* was 8123 miles. In 1897 the total track mileage of the country was 15,718 an increase of 93.5 per cent over the figure of 1890. By far the larger part of this increase has taken place in the smaller cities of the country and in the suburban and country districts, although all cities have shared in the increase.

The changes in distribution of mileage by motive powers between 1890 and 1897 are shown in the following table:

	1890.	1897.	Per cent increase or decrease.
Animal	5661	947	83.3 dec.
Electric	1262	13,765	990.7 inc.
Cable	488	539	10.5 inc.
Miscellaneous	711	467	34.3 dec.
Total	8,123	15,718	93.5 inc.

The miscellaneous mileage is largely in elevated railroads in the Eastern and Central States, and in steam dummy lines in the Southern and Western States, Alabama particularly having a number of dummy roads

The distribution by sections of the increase in total mileage between 1890 and 1897 is as follows, the grouping of states being the same as in the large table.

	1890.	1897.	Per cent increase.
New England States	916	2,151	134.8
Eastern States	2,393	5,220	118.1
Central States	2,554	4,980	95.0
Southern States	823	1,088	32.2
Western States	1,437	2,279	58.6
Total	8,123	15,718	93.5

The number of passenger cars in operation on American street railways has grown from 32,505 in 1890 to 51,532 in 1897, an increase of 58.5 per cent.

Turning now to the statistics of capitalization, we find the changes between 1890 and 1897 represented by the following table:

	1890.	1897.	Per cent increase.
Capital stock	$211,277,798	$ 846,131,691	300.5
Funded debt	151,872,289	633,079,178	316.8
Total capitalization	363,150,087	1,479,210,869	307.3
Capital stock per mile of track	26,010	53,800	106.8
Funded debt per mile of track	18,696	40,300	115.6
Total capitalization per mile of track	44,706	94,100	110.5

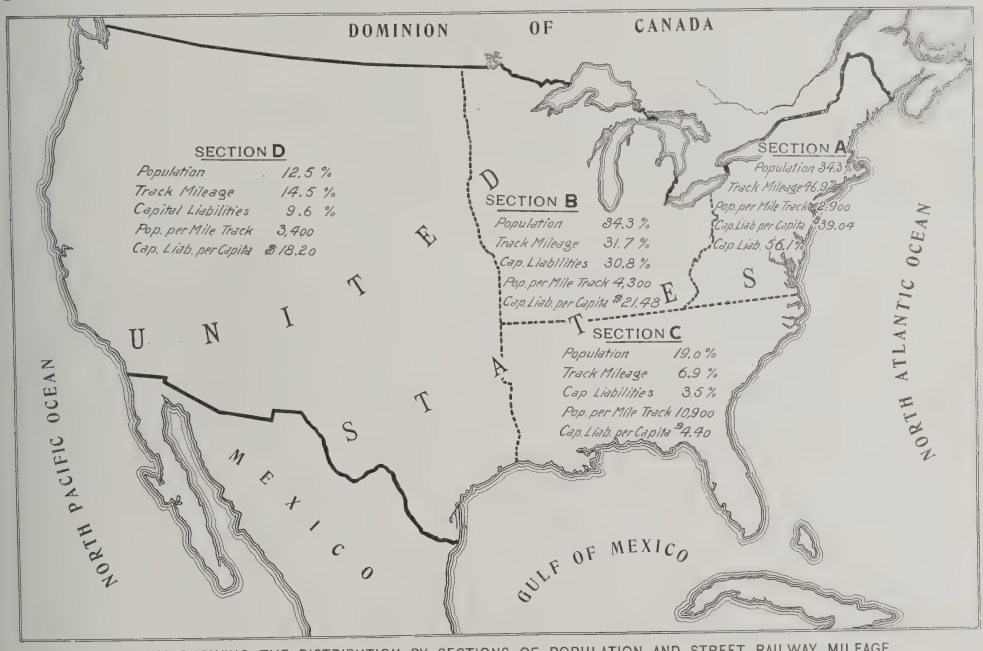


DIAGRAM SHOWING THE DISTRIBUTION BY SECTIONS OF POPULATION AND STREET RAILWAY MILEAGE AND CAPITALIZATION IN THE UNITED STATES.

The comparative density of population in different sections of the United States and the concentration of street railway capital in the districts of heaviest population are shown very clearly by the accompanying map, in which the New England and Eastern States together form section *A*, and the Central, Southern and Western States form sections *B*, *C* and *D* respectively. Section *A*, though extremely small in area, contains 34.3 per cent of the entire population of the country and has a population density of 89.1 per square mile (by the census of 1890 in all cases). Section *B*, likewise, contains 34.3 per cent of the population, but its population is but 43.4 per square mile. Section *C* contains 19 per cent of the total population and its population density is 27 4 per square mile, and section *D* contains 12.5 per cent of the total population, and its population density is 4.3 per square mile.

An interesting side light is thrown upon the distribution of population by the figures showing the population

per mile of track in the four different sections. In section *A*, where the population density is very great, there is 1 mile of track for every 2900 inhabitants; in section *D*, where the population density is extremely small, there is, strange to say, 1 mile of track for every 3400 inhabitants—this figure indicating better street railway facilities to the people than is found in either section *B* or section *C*, and almost as good as in section *A*. Now the explanation of this peculiarity is doubtless found in the larger proportion of urban population to the total in the states of section *D*, than in sections *B* or *C*. This inference is borne out by the census figures, which show that the percentage of urban population to the total in the Western States is about thirty as against but twenty-six in the Central States and less than twenty in the Southern States. Another fact to be borne in mind as explaining this excellent street railway service in section *D*, is the overbuilding with street railway track of many, if not most, of our Western cities.

An investigation of the improvement in street railway earning power in the United States would be a most interesting and valuable one were it possible to carry it on with success, but it is not probable that this can be done, at least until the census of 1900, on account of the disinclination of a large proportion of the medium sized and smaller companies of the country to giving out statements of their earnings to the public. It is only possible, therefore, to make the merest guess at the total earning power of our street railways to-day, but the figures of 1890 will serve as a basis for such a guess. The total earning power given in the census of 1890 for all the street railways then in existence was $91,721,845; the total operating expenses were $62,011,185; the total fixed charges were $13,978,903; and the net income was $15,731,757, from which were paid $10,180,726 in dividends and $1,217,193 for miscellaneous purposes; leaving a net surplus of $4,333,838.

It is nearly certain that our street railways to-day are earning at least $150,000,000 gross, and it is probable that the net earnings applicable to return on investment as figured by the companies themselves, would be between $40,000,000 and $50,000,000.

Several interesting things are brought out in the accompanying table under "Capital Liabilities per capita Population."

The states in which these figures are the largest are the following given in order:

CAPITAL LIABILITIES PER CAPITA POPULATION.

District of Columbia	$84.68
New York	61.83
California	55.20
New Jersey	49.93
Rhode Island	49.22
Colorado	48.70
Illinois	47.91
Washington	43.13
Pennsylvania	41.67

The leader in this list is the District of Columbia, in which practically the entire population is grouped together in a city. For this reason and also because of the costly motive powers—cable and underground electric—which have been imposed upon the street railways, their capital liabilities would necessarily be far greater than are found in even the most thickly populated states where there are large tracts of farming country. It is rather a surprise to see California so far up in the list, with $55.20 of capital liabilities per capita. This is probably due to the large percentage of urban to the total population of that state, and to the accumulated expense of the cable and electric systems in San Francisco and Los Angeles. The position of New York is due in part to the enormous investment required in New York City and Brooklyn, and in part to the large population density of the state. In Rhode Island nearly or quite half the population is urban, and in Washington and Colorado the percentage is also large.

In North Carolina, South Carolina, Florida, Idaho and Mississippi less than $1 per capita has been spent on street railways and in the last named state only $.17 per capita. From $1 to $6 per capita have been spent in New Hampshire, Vermont, West Virginia, Georgia, Alabama, Tennessee, Arkansas, South Dakota, Kansas and Texas. The agricultural character of these states is clearly shown by these low investment figures, as well as by the figures showing the population per mile of track. Note the following list of states which stand at the bottom of the list in street railway mileage per capita.

POPULATION PER MILE OF TRACK.

Mississippi	64,500
North Carolina	37,600
South Carolina	25,600
South Dakota	25,300
Idaho	21,100
Arkansas	15,200
West Virginia	13,600
Kansas	11,100
Vermont	9,500

At the head of the list in street railway mileage per capita stand the following states:

POPULATION PER MILE OF TRACK.

California	1,500
Washington	1,500
District of Columbia	1,500
Massachusetts	1,600
Colorado	1,600
Connecticut	2,000
New Jersey	2,100
Utah	2,100
Oregon	2,200
Rhode Island	2,200

It is certainly curious and interesting to find that the inhabitants of such states as Colorado, Washington, California, Utah and Oregon have a street railway service equal to those of Massachusetts, District of Columbia, Rhode Island, Connecticut and New Jersey and a much better service than New York, Pennsylvania and Illinois, and to see that the Western States, taken as a whole, have spent almost as much money on street railways per capita population as the New England and Central States. The Southern States as a whole have spent but $4.40 per capita and have but 1 mile of track for each 10,900 inhabitants; while the Eastern States have spent $43.70 per capita and have 1 mile of track for each 3200 inhabitants.

The statistics given in the accompanying table were made up from reports furnished by the street railway companies of the United States to "American Street Railway Investments" in the year 1896 and 1897. They are believed to be reasonably accurate, over 80 per cent of all the railways of the country having directly furnished the information during the first five months in each year, while the reports of nearly all of the remaining companies were made up from official sources. For this reason the comparisons between the figures for 1896 and 1897 are entitled to confidence, and probably are in the aggregate correct to at least 10 per cent.

The increase in the total mileage and cars during the year is shown by sections in the following table:

	Increase Miles track. Total	Per cent	Increase Cars. Total	Per cent.
New England States	328	18	675	10½
Eastern States	586	13	2,121	11½
Central States	380	8½	574	3½
Southern States	8 dec.	1 dec.	84	4
Western States	38 "	1½ "	104 dec.	2¼ dec.
Total	1,248	8½	3,350	7

The increase in capitalization during the year is shown by the following table:

	Increase Capital stock Total	Per cent.	Increase Funded debt. Total	Per cent.
New England States	$ 3,151,100	5.4	$ 3,997,600	9.6
Eastern States	28,119,904	7.4	12,647,235	4.2
Central States	32,757,466	14.3	24,253,252	14.4
Southern States	1,110,700 dec.	3.6 dec.	495,700	2.2
Western States	1,599,860 "	1.8 "	1,089,000	2.0
Total	61,317,910	7.8	42,482,787	7.2

The distribution of mileage by motive powers of the entire street railway mileage of the United States in 1897, shows that 87.7 per cent was operated by electricity, 3.4 per cent by cable, 6 per cent by horses and 3 per cent by miscellaneous motive powers.

A CHAPTER OF ACCIDENTS.

BY WM. J. CLARK.

Probably no question that is so frequently and universally discussed is so little understood as that of street railway accidents and the effect thereon of mechanical traction. It is not strange, however, that such is the case. Could the historical facts be obtained, covering every step forward in the evolution of transportation, from the time when the first naked savage produced a crude protection for his feet to facilitate his movements amid his peculiar surroundings, we should probably find that each and every improvement in transportation methods from such early period up to the present time has been opposed on the ground of supposed increase in the risk of accident because of its adoption. Fortunately for the human race, however, such misunderstanding has had to contend against the operation of a natural law, and the inevitable result has been progress. With each improvement in the method of transportation the public death rate has diminished, and the chances of accident have been reduced. This fact can be distinctly traced and proven for as long a period as statistics are available, yet frequently, in connection with each step forward, such prejudice has thrown whole communities into an hysteria over the introduction of improved methods; and while the world always hears of such attacks and of all the wild theories then evolved, it never notes the recovery therefrom, for the nature of prejudice is to always ooze away in a quiet and unostentatious manner. The extent of such epidemics of misunderstanding has, however, been in direct proportion to the importance of the advancement, which has been their reason for existence. Consequently, the importance of mechanical traction in connection with street railway operation can be correctly gaged by the extent of prejudice and opposition that it has created, yet such waves of public opinion are always extremely contagious, especially in their modern epidemic form, encouraged by the public press. For this reason many hesitate to state the truth itself, when in their innermost souls they know it is their best friend. This, we presume, accounts for the fact that street railway managers have not, long ere this, fairly and squarely taken up the question of their accidents in a public way and demonstrated that improvements have come in this respect through the introduction of mechanical traction, instead of permitting the world at large to form mistaken impressions from those who have no general knowledge upon the subject, or who, for the sake of sensation, have exaggerated each particular instance.

It is, however, a public duty for those who thoroughly and conscientiously believe in the advantages to the people of the new motive powers, to call attention to these exaggerations and present the actual figures necessary for true comparisons. The situation, is not a new one, for practically the same condition existed, and comparatively more prejudice was excited, as early as 1852, when the first horse railway in the world, the New York & Harlem, was constructed in New York City, and as wild and disastrous tales of the effect of its operation were then told in the public press as the misleading statements that are published to-day.

In a recent paper covering the general development of electric and mechanical traction, the writer quoted some figures relative to accidents, and at the urgent request of friends interested in the subject now undertakes to go more carefully into the question of statistics bearing upon the matter, not with any desire to overrate the importance of this serious question, but to state the facts exactly as they are. To this end he first quotes from public records relating to

NEW YORK CITY.

The average citizen has little conception as to what the yearly mortality in a great city means, so the following table from the reports of the Board of Health will be interesting:

DEATHS FROM ALL CAUSES IN NEW YORK CITY DURING A PERIOD OF TEN YEARS.

	Total Deaths.	Rate per 1000.
1887	38,933	26 32
1888	40,175	26.39
1889	39,679	25.32
1890	40.103	24.87
1891	43,659	26.31
1892	44,329	25.95
1893	44,486	25.30
1894	41,175	22.76
1895	43,420	23.11
1896	41,622	21.52

While noting the percentage of decrease in the death rate from all causes during the past few years, we should, in justice to the street railways call attention to the fact that the commencement of such decrease practically dates from the introduction of mechanical traction in the city, and to make a literal quotation from the report of the Board of Health for 1892: "The substitution of cable traction for surface railroad cars in place of horses will soon remove a large number of horses from this city. This will be a very important sanitary advance."

From the foregoing it can be judged whether or not mechanical traction is accountable in a sanitary way for the reduced death rate or whether it and the result shown form a mere coincidence. But in this paper we are dealing with the question of accidents only, so we will not presume to extend credit to the street railways for results that cannot be distinctly traced. With the facts correctly stated, progressive street railway corporations need go no further to have results for the past ten years appreciated. The enormous number of deaths from accidents and violence which annually occur in New York City, together with their causes, are as little comprehended generally as is the entire mortality. In order that the principal causes may be noted, and compared with results on street railways, the following table is given:

CERTAIN PRINCIPAL CAUSES OF ACCIDENTAL AND VIOLENT DEATHS IN NEW YORK CITY, FOR A PERIOD OF TWENTY-FIVE YEARS.

Year.	Sunstroke.	Homicide.	Suicide.	Burns and Scalds.	Drowning.	Falls.	Suffocation.
1872	320	69	144	137	223	305	32
1873	54	73	118	102	155	248	24
1874	19	59	180	108	176	275	33
1875	19	62	155	110	173	250	36
1876	206	55	150	104	188	274	30
1877	21	57	148	101	184	229	16
1878	52	58	142	90	177	235	29
1879	41	48	117	96	145	268	29
1880	116	58	152	125	224	323	36
1881	134	65	166	124	168	354	24
1882	103	76	199	116	196	348	26
1883	83	62	161	95	232	365	40
1884	107	55	229	110	173	364	34
1885	146	59	207	94	177	327	43
1886	44	63	223	107	183	381	43
1887	216	70	235	110	207	443	60
1888	96	57	247	117	173	382	73
1889	32	72	244	97	214	414	75
1890	62	61	239	120	222	433	96
1891	95	56	300	178	194	398	110
1892	320	38	241	179	187	464	47
1893	43	47	314	152	190	449	50
1894	115	61	331	147	201	410	52
1895	85	76	376	156	209	448	59
1896	765	71	384	171	213	385	53

To make a subdivision of some of the figures above quoted, as well as to touch upon certain features not included therein, the following may be of interest: in 1896, *530* people died as the result of surgical operations; *42* persons were suffocated by illuminating gas, while at least *5* other fatalities can be attributed to the same cause in other ways. Compared with these, but *4* were killed by electric shocks, and *none* of these from railway current. Kerosene was responsible for, at least, *10* fatalities; *59* or

more were killed by falling down stairs and steps of various descriptions, while the operation of elevators seems to be responsible for the death of but *20*; *66* were killed by falling from windows and *28* from fire escapes; from a cause that would scarcely be thought of—"being lain upon" —*35* infants were suffocated in bed by their parents; while the accidental use of poison was responsible for the death of *54*. Taking every form of violent or accidental death mentioned, it will be seen that the number is constantly increasing.

Now, as to the actual results on street car accidents: to show this, is introduced a table compiled from the reports of the Board of Health covering a period of twenty-five years. This table is self explanatory, and from it will be noted that on a population basis, the chances of fatal accidents in 1872 were twice as great as those in 1896, and that the actual number of such accidents was within one as great in the former year as in the latter, although 1896 has been considered an extraordinary year for fatalities of this character:

FATAL ACCIDENTS IN NEW YORK CITY FOR A PERIOD OF TWENTY-FIVE YEARS.

Year.	Population.	Total Fatal Accidents.	Total Fatal Street Accidents.	Total Fatal Street Car Accidents.	Ratio of Street Car Accidents to Population, One to	Ratio of Street Car Accidents to Total Accidents, One to	Ratio of Street Car Accidents to Street Accidents, One to
1872	968,710	1,428	135	55	17,613	25.96	2.45
1873	981,671	1,002	142	55	17,849	18.22	2.58
1874	1,030,607	1,027	113	35	29,446	29.34	3.23
1875	1,044,396	986	108	37	28,227	26.65	2.92
1876	1,075,532	1,108	93	35	30,726	31.66	2.66
1877	1,107,597	841	109	21	52,743	40.05	5.19
1878	1,140,617	861	125	36	31,684	23.91	3.47
1879	1,174,621	878	117	26	45,177	33.77	4.50
1880	1,209,196	1,223	139	36	33,588	33.99	3.86
1881	1,244,511	1,193	130	35	35,557	34.09	3.71
1882	1,280,857	1,202	155	36	35,579	34.09	4.31
1883	1,318,264	1,183	112	31	42,525	38.16	3.61
1884	1,356,764	1,162	113	35	38,765	33.20	3.23
1885	1,396,388	1,214	117	27	51,718	44.96	4.33
1886	1,437,170	1,218	139	34	42,269	35.81	7.09
1887	1,479,143	1,504	132	34	43,504	44.23	2.88
1888	1,522,341	1,181	130	21	72,492	56.24	6.19
1889	1,566,801	1,180	155	24	65,283	49.16	6.46
1890	1,612,559	1,511	115	17	94,856	88.88	6.77
1891	1,695,654	1,692	164	37	45,828	45.73	4.43
1892	1,708,124	2,220	186	47	36,346	47.23	3.96
1893	1,758,010	1,650	150	44	39,955	37.50	3.41
1894	1,809,353	1,843	186	41	44,130	44.89	4.54
1895	1,879,195	2,130	212	47	39,983	45.32	4.51
1896	1,934,077	3,406	221	56	34,537	60.82	3.94

As will be seen from all the accident statistics quoted, large numbers of particular classes of accident are liable to occur in certain years. It is, therefore, considered but fair to rearrange the foregoing table, covering periods of five years each; hence the following is submitted:

From this it will be noted that the result during the last period of five years is much more favorable than that of the first five year period, and equally so with the second period. However, there are intermediate periods when the proportion of accidents on the basis taken was less than during the last period, yet looking at the comparative proposition in a disinterested way, is it not fair to presume that the same causes which have reduced the tendency to accident on street railway lines in the past will also have even a greater effect upon mechanical traction methods than they have had on horse car operation, which, as shown later, has not departed from its old tendencies? The first street railway was installed in New York twenty years before the period which is covered by our statistics, yet, as will be seen, the proportion of accidents was greater in the early '70s than at the present time. True, this has been reduced by managers and men becoming more familiar with the methods of operation, although upon the basis of miles traveled by each class of car respectively, the mechanically operated car has already become safer than the horse car. Therefore, it is not unreasonable to suppose that when years of experience have been acquired with mechanical traction, its operation will become so safe that it will be considered by all an unimportant factor in the accidents in a great city.

FATAL ACCIDENTS IN NEW YORK CITY FOR A PERIOD OF TWENTY-FIVE YEARS.—(AVERAGE NUMBER PER YEAR FOR FIVE YEAR PERIODS.)

Period.	Population.	Total Fatal Accidents.	Total Fatal Street Accidents.	Total Fatal Street Car Accidents.	Ratio of Street Car Accidents to Population, One to	Ratio of Street Car Accidents to Total Accidents, One to	Ratio of Street Car Accidents to Street Accidents, One to
1872–1876 Inclusive	1,022,183	1,110	118	43	23,771	25.81	2.72
1877–1881 Inclusive	1,775,308	999	124	31	38,558	32.19	4
1882–1886 Inclusive	1,357,888	1,196	105	33	41,148	36.24	5
1887–1891 Inclusive	1,575,499	1,414	139	27	59,222	53.14	5.2
1892–1896 Inclusive	1,817,752	2,250	191	47	38,675	47.87	4.06

Other comparisons are interesting, hence we introduce the following table covering accidents from vehicles in New York City for a period of twenty-five years, which demonstrates, as will be noted, the rather surprising result that from 1872 to the present time, the general tendency has been toward a material increase in accidents from this cause against the decrease of street car accidents.

VEHICLE ACCIDENTS.

Year.	Fatal Vehicle Accidents.	Ratio to Population, One to	Ratio to Total Accid'ts, One to	Ratio to Street Accidents, One to
1872	40	24.218	35.70	3.37
1873	46	21.342	21.78	3.09
1874	42	24.538	24.45	2.69
1875	33	31.648	29.88	3.27
1876	29	37.087	38.21	3.21
1877	39	28.400	21.56	2.79
1878	47	24.268	18.32	2.66
1879	47	24.992	18.68	2.49
1880	59	20.495	20.72	2.35
1881	39	31.911	30.59	3.33
1882	58	22.084	20.72	2.67
1883	43	30.657	27.51	2.60
1884	44	30.835	26.41	2.57
1885	42	33.247	28.90	2.79
1886	45	31.937	27.07	3.09
1887	56	26.413	26.86	2.35
1888	61	24.956	19.36	2.13
1889	60	26.144	19.67	2.55
1890	52	31.011	29.06	2.21
1891	54	31.401	31.33	3.04
1892	73	23.495	30.41	2.55
1893	55	31.964	30.00	2.73
1894	85	21.286	21.68	2.19
1895	100	18.792	21.30	2.12
1896	109	17.744	31.25	2.03

For a comparison of the foregoing results with those on street railways, as stated, we have rearranged this into periods of five years each:

While the comparative showing given cannot be controverted, it may be claimed that the individual vehicle is not comparatively as great a cause of accident as the street car. According to the Board of Health reports, in December, 1896, however, there were 73,476 horses in the City of New York, below the Harlem River. To ascertain the exact number in the entire city, we have interviewed the

city officials most familiar with the subject, and it is their opinion that there is not a total of *80,000* horses in the entire city. Assuming this is the number, for the purposes of our calculations, we must deduct 10,000 which are used by the street railway companies, and at least 4000 more not in use upon the streets. This leaves *66,000* horses that are used upon vehicles. The estimate of the city officials as to the number of vehicles which these horses represent is two vehicles for every three horses, which aggregates *44,000* vehicles. As statistics show that the average street car horse in the city travels an average of 2130 miles per year it is certainly conservative to estimate the average yearly mileage of all vehicles in the city at not over 2000 miles per year, which gives a total of *88,000,000* miles traveled by the same. As they killed *109* people in 1896, we have one for each *807,340* miles traveled, or an average of approximately 25 per cent higher than for the mileage run by the street cars. The fatal accidents above quoted do not include fourteen deaths caused by horses independent of vehicles.

VEHICLE ACCIDENTS DURING A PERIOD OF TWENTY-FIVE YEARS.—(DIVIDED INTO PERIODS OF FIVE YEARS EACH.)

Period.	Fatal Vehicle Accidents.	Ratio to Population, One to	Ratio to Total Accidents, One to	Ratio to Street Accidents, One to
1873–1876 Inclusive	38	26,899	29.21	3.10
1877–1881 Inclusive	46	25,550	21.71	2.69
1882–1886 Inclusive	46	29,216	26.26	2.28
1887–1891 Inclusive	56	28,133	25.25	2.12
1892–1896 Inclusive	84	21,639	26.78	2.27

Thus far, with a single exception, our calculations have been made from the official reports of the Board of Health of New York City, and as stated, relate entirely to fatal accidents. It is possible the claim may be made that we have not covered the entire field of accidents in all its phases nor made all of the calculations which properly should be made. We therefore turn to the official reports of the Board of Railroad Commissioners and their predecessors for further information, but, unfortunately these are not quite complete for the full period of twenty-five years covered by our Board of Health statistics. In fact, it is not considered wise to rely upon the figures therein quoted as being exact except for the later period of ten years, yet to permit a somewhat indefinite comparison with what follows, we make the following quotations therefrom prior to giving tables which are considered reliable, the latter covering a period extending over the past ten years.

INCOMPLETE STATISTICS ON STREET RAILWAYS IN NEW YORK CITY, COMPILED FROM STATE ENGINEERS' AND RAILROAD COMMISSIONERS' REPORTS.

Year.	Passengers Carried.	Total Accidents of all Descriptions.	Damages paid by Street Railway Companies.
1872	Not given.	Not given	Not given
1873	135,983,891	114	$39,776.18
1874	152,162,105	77	30,258.33
1875	164,816,508	78	42,053.56
1876	165,844,516	104	92,023.58
1877	160,924,436	70	55,029.39
1878	160,952,832	97	43,708.53
1879	142,038,291	81	61,460.63
1880	152,390,592	90	42,813.48
1881	Not given.	Not given	Not given
1882	166,510 617	90	75,735.10
1883	Not given	Not given	Not given
1884	Not given	Not given	Not given
1885	193,615,035	144	156,102.84
1886	210,280,070	150	142,128.94

To come down to a later period, we quote a table for ten years covering all street railway accidents in New York City as compiled from Railroad Commissioners' reports. This is believed to be entirely correct, with the exception of car mileage, which has been estimated upon the comparative basis of passengers carried to car mileage, which figure is official for 1896.

ALL STREET RAILWAY ACCIDENTS OF NEW YORK CITY FOR TEN YEARS COMPARED ON BASIS OF CAR MILEAGE AND PASSENGERS CARRIED.

Year.	Total Passengers Carried.	Estimated Car Mileage.	Total St. Car Accidents.	Ratio of Accidents to Passengers Carried, One to	Ratio of Accidents to Car Mileage, One to
1887	203,251,927	32,730,000	160	1,270,325	204,562
1888	199,492,725	32,124,000	140	1,338,877	215,600
1889	208,504,723	33,576,000	109	1,912,887	308,040
1890	221,060,583	35,597,000	121	1,826,947	252,868
1891	226,884,535	36,535,000	132	1,718,822	276,780
1892	236,403,537	38,068,000	145	1,630,366	262,538
1893	245,807,337	39,582,000	168	1,463,139	235,607
1894	251,031,840	40,424,000	117	2,145,571	345,504
1895	274,227,918	44,159,000	113	2,426,796	390,788
1896	345,64,3406	55,630,262	178	1,941,822	312,530

For the purpose of definite comparison, we subdivide the foregoing into fatal and non-fatal accidents, arranging the table on the same basis of car mileage and passengers carried.

STREET RAILWAY ACCIDENTS OF NEW YORK CITY FOR A PERIOD OF TEN YEARS, COMPARED ON BASIS OF CAR MILEAGE AND PASSENGERS CARRIED, SUBDIVIDED BETWEEN FATAL AND NON-FATAL.

	FATAL.		NON-FATAL.	
Year.	Ratio to Passengers Carried, One to	Ratio to Car Mileage, One to	Ratio to Passengers Carried, One to	Ratio to Car Mileage, One to
1887	5,977,998	962,764	1,691,682	259,762
1888	9,499,653	1,529,714	1,558,536	250,969
1889	8,687,696	1,399,000	2,450,644	395,012
1890	13,003,505	2,093,941	2,146,219	345,602
1891	6,132,014	987,432	2,488,458	384,579
1892	5,029,862	809,958	2,390,853	388,449
1893	5,586,530	899,591	1,982,317	319,209
1894	6,122,728	985,951	3,303,050	531,893
1895	5,834,636	939,553	4,154,969	669,076
1896	6,107,918	993,398	2,833,143	455,986

Following this we show what the street railways of New York City have paid in damages as a result of their accidents, during a period of ten years, which is as follows:

DAMAGES PAID BY STREET RAILWAY COMPANIES OF NEW YORK CITY DURING A PERIOD OF TEN YEARS.

Year.	Damages.
1887	$107,004.44
1888	101,573.57
1889	121,074.85
1890	145,290.90
1891	125,733.48
1892	164,218.80
1893	192,266.71
1894	146,665.28
1895	160,672.28
1896	218,732.40

These payments, it will be noted, have increased even more rapidly than the number of accidents, car mileage or passengers carried; or even the population of New York City. Thus, it will be distinctly seen that every street railway manager has a strong financial incentive to avoid accidents in every possible way.

Were we able to show what the owners of vehicles have been obliged to pay as a result of carelessness on the part

of their drivers, we do not believe it would equal a small fraction of the continued draught upon the funds of the street railway companies, attributed to the acts of their employes. The speed of mechanically propelled cars, as is well known, is much higher than that of either the horse car or the independent vehicle, and the natural supposition would be that the number of accidents arising from its operation must be greater, but let these facts be borne in mind: the dangers from collision with such a car are well known to the public; its course is well defined, and the character of intelligence and the judgment which guides it on its way must be, and is, far superior to that of the horse car driver or of the driver of the random vehicle, who goes at will where he pleases on the public streets, usually, as an exemplification of more "cussedness" than is possible to center in a human being not similarly employed. If this is doubted, let one but take a ride down Broadway and compare the conduct of the much maligned gripman with that of any one of the dozens or hundreds of vehicle drivers whom he will encounter. Despite this argument, the truth of which is borne out by the facts stated, our skeptic reader may still doubt, but let him divorce himself from all preconceived ideas on street railway accidents, gather about him a dozen friends who are residents of the metropolis, and inquire from each and all as to whether or not they have ever personally seen a street railway accident. The chances will be that not one will have had such an experience. On the other hand, it will probably be found on inquiry that every one has seen accidents from vehicles, some of which have been fatal.

That the results from accidents in New York City are not exceptions to those of other cities will be taken up and shown in subsequent articles.

TRAIN ACCELERATION AND BRAKING.

BY W. B. POTTER.

The high rate of acceleration commonly employed in the operation of electric cars is seldom appreciated, being so constant and uniform as to occasion no discomfort to the passengers. The electric motor operating with a continuous rotary movement, and limited in effectiveness only by slipping of the car wheels, is so eminently adapted to traction work as to require no special advocacy here.

The problem of acceleration and braking, considered as a principle in mathematics, is comparatively simple, but in its application to actual operating conditions it admits of endless study. The character of equipment, rolling stock, roadbed, air resistance and numerous minor details introduce variables, each of which requires consideration. I shall not attempt a general discussion in this article, but shall give a few fundamental formulæ and endeavor to show how far they are borne out by actual tests.

In the ordinary trolley or suburban service where stops are frequent, the greater part of the power applied at the axle is used to accelerate the train, while it is coming up to speed, the remainder being utilized in overcoming train friction, so that the actual energy consumed in accelerating the train will be divided into energy of acceleration $= \frac{mv^2}{2}$ and friction losses. Treating of acceleration as applied to train service, it is more convenient to express the factors in tons and miles per hour rather than the usual terms of pounds and feet per second. For a given distance and time the tractive effort in pounds per ton for acceleration $= \frac{\text{Distance run in feet}}{(\text{Seconds})^2 \times .0084}$, and to this should be added the train friction in pounds per ton, the sum giving the total tractive effort per ton. In the case of electric traction, by reference to the tractive effort curve of the motor, the current input may be closely estimated for any desired degree of acceleration. The distance or time with a given tractive effort may be easily ascertained by transposition of the above formula.

The formulæ for the braking effort while the train is coming to rest are the same as the accelerating formulæ, except that the train friction should be added to the net braking effort at the brake shoes to make the total effective or gross braking effort. Another convenient formula for braking effort is as follows:

$$\text{Gross braking effort per ton} = \frac{\text{Speed in miles per hour} \times 91.5}{\text{Time of stopping in seconds.}}$$

It is very instructive to note the rate of acceleration and braking in pounds per ton on some of the more important steam and electric roads operating with frequent stops and high average speeds. The data in the table on this page and on page 672 were obtained during service runs, and represent an average practice for the roads mentioned.

The advantages of rapid acceleration and braking are becoming more fully appreciated and the tendency at present is toward a higher average speed, with less time in getting up to speed and less time lost in bringing the train to rest. As a result, under these conditions roads are operated with a less expenditure of energy expressed in watt hours per ton mile than they would be if the accelerating rate were lower; hence to operate an elevated or rapid transit road at the best efficiency for energy, the train should be brought up to speed as quickly as possible and allowed to coast until the brakes are applied. As this efficiency is equally affected by the rate of retardation, to secure the best results the rate of braking should also be as high as practicable. In order to give a practical demonstration of the rapid train acceleration easily obtained by electric motors, a series of tests with a 10 ton single truck car and also a 25 ton double truck car were made on the experimental track at the Schenectady Works of the General Electric Company, for the informa-

RAILWAY COMPANY.	REMARKS.	No. of Cars.	Weight of train in net tons.	Grade.	Tractive Effort per net ton.				10 Seconds.			20 Seconds.			30 Seconds.			40 Seconds.		
					Maximum for given time		Average for total time.		Average rate of acceleration.	Speed miles per hour.	Distance run feet.	Average rate of acceleration.	Speed miles per hour.	Distance run feet.	Average rate of acceleration.	Speed miles per hour.	Distance run feet.	Average rate of acceleration.	Speed miles per hour.	Distance run feet.
					Sec.	Lbs.	Sec.	Lbs.												
METROPOLITAN ELEVATED	Elect. (15 lbs. per ton friction)	2	44	L	10	158	40	91	1.64	16.4	120	1.12	22.3	330	1	30	660	.87	34.8	1020
LAKE STREET ELEVATED	Elect. (15 lbs. per ton friction)	2	44	L	10	121	40	75.2	1.22	12.2	90	1.02	20.3	300	.773	23.2	510	.69	27.6	870
ALLEY ELEVATED	Steam (15 lbs. per ton friction)	3	72	L	10	121	40	87.4	1.22	12.2	90	.975	19.5	285	.80	24	540	.715	28.6	840
ILLINOIS CENTRAL	Steam (15 lbs. per ton friction)	4	116	L	10	86	40	71	.817	8.17	60	.715	14.3	210	.682	20.5	450	.64	25.6	750
MANHATTAN ELEVATED	Steam (15 lbs. per ton friction)	4	95	L	10	80	40	60	.75	7.5	548	.675	13.5	198	.58	17.5	386	.52	21	615
SPECIAL TEST GEN. ELEC. CO.	Elect. (20 lbs. per ton friction)	1	25	L	10	282	20	186	3.	30	220	1.9	38	556						
SPECIAL TEST GEN. ELEC. CO.	Elect. (20 lbs. per ton friction)	1	9	L	10	264	20	199	2.8	28	206	2.05	41	600						
SPECIAL TEST GEN ELEC. CO.	Elect. (20 lbs. per ton friction)	1	9	L	10	163	20	126	1.64	16.4	120	1.22	24.5	360						

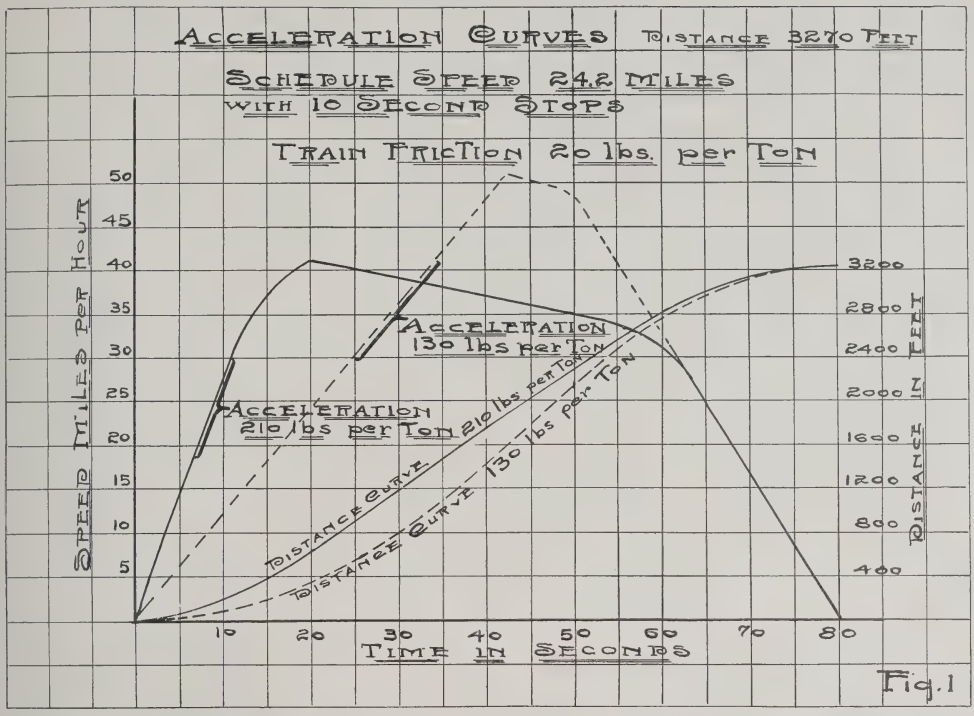

Acceleration Curves Distance 3270 Feet
Schedule Speed 24.2 Miles
with 10 Second Stops
Train Friction 20 lbs. per Ton
Speed Miles per Hour
50
45
40
35
30
25
20
15
10
5
Acceleration
130 lbs per Ton
Acceleration
210 lbs per Ton
210 lbs per Ton
Distance Curve
Distance Curve 130 lbs per Ton
3200
2800
2400
2000
1600
1200
800
400
Distance Feet
10
20
30
40
50
60
70
80
Time in Seconds

Fig. 1

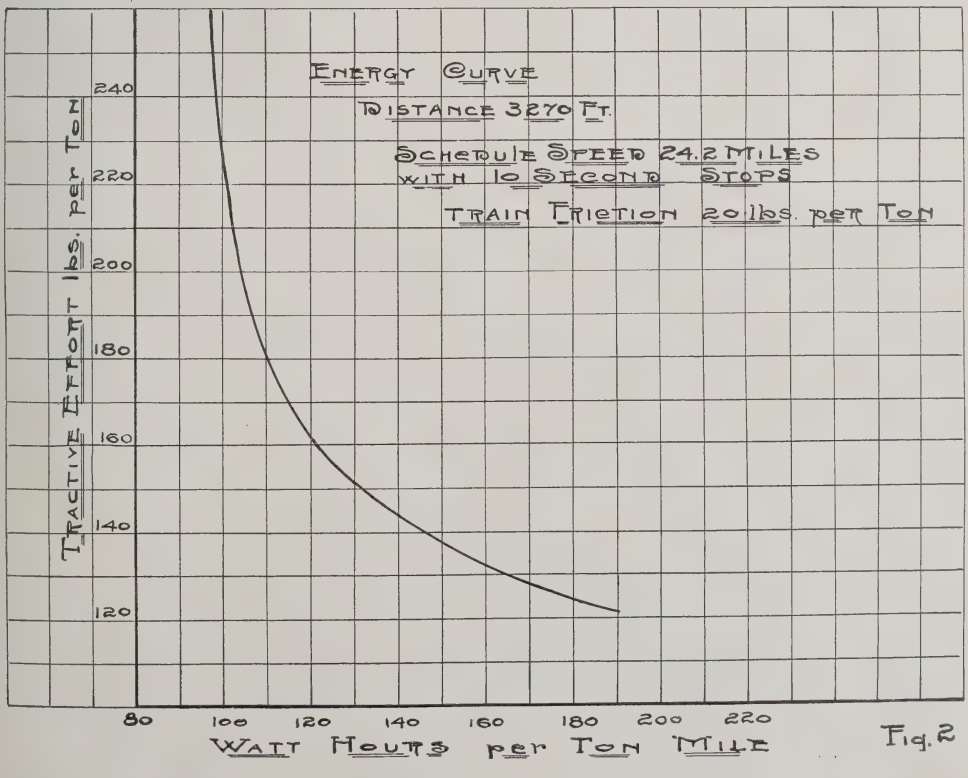

Energy Curve
Distance 3270 Ft.
Schedule Speed 24.2 Miles
with 10 Second Stops
Train Friction 20 lbs. per Ton
Tractive Effort lbs. per Ton
240
220
200
180
160
140
120
80
100
120
140
160
180
200
220
Watt Hours per Ton Mile

Fig. 2

tion of Mr. John Lundie, of Chicago. A curve of one of such experimental runs is shown in Fig. 1. That portion of the curve showing the acceleration is made up from actual test, but as the car was not fitted with power brakes

RAILWAY COMPANY.	REMARKS.	No. of Cars.	Weight of train in net tons.	Grade.	Type of Brake.	Speed in miles per hour on application of brakes.	Distance stopping in feet.	Time stopping in seconds.	Average rate of retardation per second in miles per hour.	Equivalent braking power in lbs. per ton.
METROPOLITAN ELEVATED	Service	2	44	L	STRAIGHT AIR	19	181	13	1.46	133
LAKE STREET ELEVATED	Service	2	44	L	AUTOM. AIR	25	293	16	1.56	142
ALLEY ELEVATED	Service	3	72	L	AUTOM AIR	31	522	23	1.35	125
ILLINOIS CENTRAL	Service	4	116	L	AUTOM AIR	40	1086	37	1.08	98
MANHATTAN ELEVATED	Service	4	95	L	VAC.	22	387	24	.92	84
CLEVELAND PAINESVILLE & EASTERN	Service	1	20	L	ELEC.	40	585	20	2.0	183
CLEVELAND PAINESVILLE & EASTERN	Emergency	1	20	L	ELEC.	30	220	10	3.0	275
LORAIN & CLEVELAND	Emergency	1	23	L	ELEC.	45	461	14	3.21	295
SCHENECTADY ST. RY.	Service	1	9	L	ELEC.	23	135	8	2.88	263

been required with the slower rate of 130 lbs.

While for a given schedule, the total energy required will be less, as the rate of acceleration is higher, the power during the time of acceleration will be greater. This entails additional expense for motor equipment and sufficient reserve in the power station and feeder system to meet the greater fluctuations of current. These various details make the study of rapid transit problems a subject of great importance and the design of motors for such service a matter of careful calculation.

the remainder of the curve is taken at 20 lbs. per ton friction and 150 lbs. per ton for braking, in accordance with the results obtained from tests which have been made on roads in actual operation. The experimental run indicated by the heavy line shows that the car reached a speed of 41.2 miles in 20 secs., which corresponds to an average

Referring again to the curve (Fig. 1), the average current input to the motors, during the acceleration was 27.3 amps. per ton weight of car, giving an input of 6.06 h. p. minutes. Hence the efficiency during acceleration, that is, the ratio of useful work expended in moving the train (3.82 h. p. minutes), to the energy input was 63 per

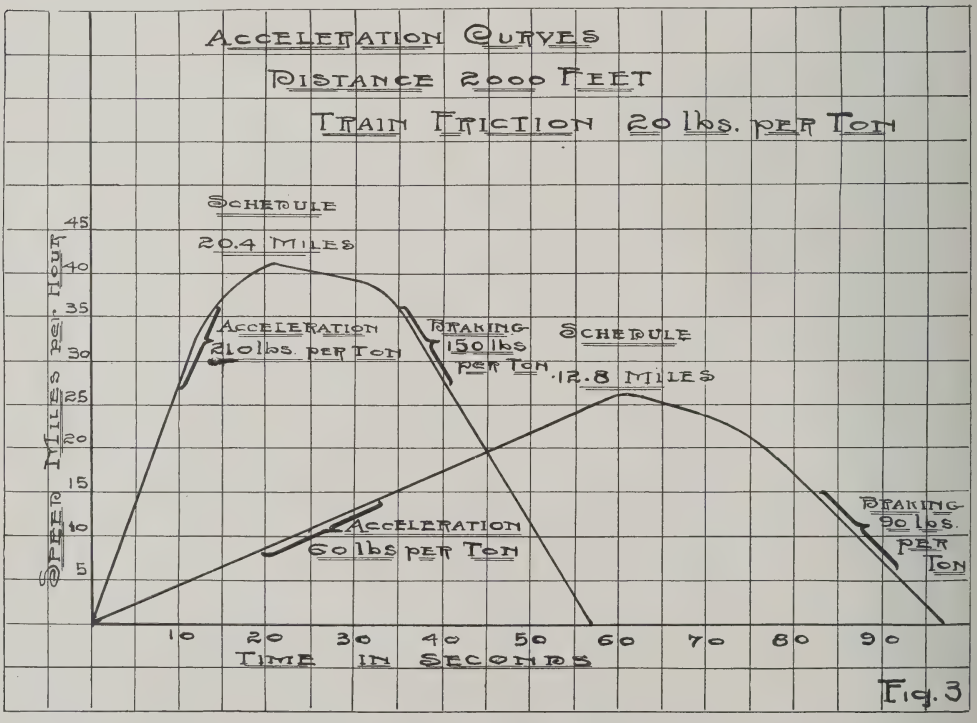


Fig. 3

force of acceleration of 190 lbs. per ton. To this must be added 20 lbs. per ton for train friction, making the tractive effort during acceleration average 210 lbs. per ton. The actual work done per ton weight of car up to the time of shutting off the power was 3.82 h. p. minutes output of the motors. If the force of acceleration had been only 130 lbs. per ton, as shown in the dotted line, the maximum speed would have been increased to 51 miles and the energy output of the motors to 6.05 h. p. minutes, an increase of 58 cent, the total loss in the rheostats, controller, gearing and motors being 37 per cent of the input. This efficiency is based on a constant potential at the motors, and, therefore, does not include line losses. It is a fair sample of what may be expected in this class of work. This efficiency is based upon series parallel control, with two motors in series at starting, and connecting them in parallel combination immediately after the resistance is cut out from the series combination. After the controller has been turned to full

speed position, the losses are only those in the motor itself which amount then to only 15 per cent or 20 per cent. Assuming the efficiency during acceleration to be an average of 65 per cent, the energy required to move a train in a service consisting wholly of acceleration at a given schedule speed and for different distances may easily be calculated, and the proper size of the motors determined for the work to be done. Other conditions being unchanged, the energy input is directly proportional to the weight of the train. With double the weight of train motors of twice the power are required. With different schedule speeds for the same voltage, weight of train and distance between stations, the minimum difference in power and energy will vary at least as the cube of the speeds, and may be considerably in excess of this difference.

Increasing the schedule speed 25 per cent would, therefore, call for motors of about double the capacity. With a given motor the C^2R losses would vary approximately as the sixth power of the difference in schedule, an increase of 25 per cent in schedule causing nearly four times the heating effect. While the above holds true for acceleration only, and although the heating of the motors would be modified by the amount of free running, these facts have an important bearing upon the practical limitations of a motor. Where trains are running at constant speed the energy varies directly as the weight and also as the speed, excepting air resistance. Under these latter conditions the heating effect upon a given motor would vary only as the square of the speed.

The requirements for different kinds of service depend largely, therefore, upon the relative amount of acceleration and free running.

The curve (Fig. 2), based on the test shown in Fig. 1, has been prepared to illustrate the relation between the rate of acceleration and the work to be done, all values being given in pounds per ton and watt hours per ton mile. The increased energy required with a decreasing rate of acceleration is clearly indicated. The train friction is assumed to be 20 lbs. per ton constant at all speeds, an average fairly high enough to include the total friction losses; and the tractive effort as given in the curve includes this 20 lbs. per ton train friction. The watt hours per ton mile are based upon an assumption of 65 per cent efficiency during acceleration as before mentioned. It will be seen from this curve (Fig. 2), that at 210 lbs. tractive effort, the watt hours per ton mile are 104, while at 130 lbs. the watt hours are increased to 164, an increase in energy of 58 per cent. With the lower tractive effort, the maximum speed is higher and the time of coasting reduced with a consequent greater loss of energy in braking.

The advantage of rapid acceleration is well shown by the curves (Fig. 3), both representing the same distances between stations. The rapid acceleration is from the General Electric tests before mentioned, while the other curve is taken from actual service of a steam elevated system. Assuming the stops to occupy 10 seconds each, the schedule with the more rapid acceleration is 20.4 miles per hour; in the other case 12.8 miles per hour only. This means a saving of 16.8 minutes for a run of 10 miles. With a given headway between trains and the more rapid acceleration only 60 per cent of the number of trains would be required to give the equivalent traffic capacity of the lower acceleration.

As a matter of comparison, assuming the use of electricity for the above mentioned steam service, the actual energy expended per train is about 2.5 times greater with the higher acceleration, but as 60 per cent of the number of trains would suffice, the total energy required is increased about 50 per cent only. The power required during acceleration, however, is about five and a half times greater with the faster acceleration, requiring motors of high current capacity and excellent commutation.

Electric motors for work of this character have been developed, and have rendered feasible a service impossible with steam locomotives. The advantages of electric traction are compelling appreciation, as the demand for rapid transit increases in urgency.

ELECTRICITY AS A MOTIVE POWER FOR THE SUBURBAN RAILWAY SERVICE OF NEW ENGLAND.

BY SIDNEY H. SHORT.

The New England States are dotted with cities varying in population from 100,000 to 500,000 inhabitants, and each is located in the center of a suburban railroad service, which is, in most cases, proportional in extent to the population of the city whose traffic it transacts. In this treatise we may conveniently consider the suburban service about Boston as representative of that of all the territory under discussion, because we shall here encounter the problem of the application of electric power to New England suburban steam railroads in its most difficult form. At Boston the enterprise would be more extensive and its accomplishment more costly than anywhere else. Land is more expensive and privileges of all kinds are more difficult to secure. The traffic will be very extensive, necessitating frequent turnouts and perhaps separate tracks or elevated structures in order that the through steam traffic and the electric suburban traffic can be simultaneously handled without interference. Last, but not least, the suburban steam systems of Boston experience greater competition with the local steam railroads than those of any other New England city. Therefore, in demonstrating that it is profitable to replace the steam service on the suburban system of Boston with electric traction, we shall also show that the change can be made even more profitably on the roads of the other New England cities, all of which present simpler problems.

That the passenger traffic between Boston and its many outlying towns is not handled to the best advantage by the steam railroads, is conclusively proved by the fact that electric street railroads have found it possible to parallel them successfully. It must be obvious that something is wrong with the steam line, the established patronage of which can be sufficiently sapped to pay substantial dividends on the stock of a parallel street railway system. The steam line has much that a passenger would prefer; better terminal accommodations, and higher speed, and the great advantage of eminent domain over its right of way. The electric line, on the other hand, has to pay heavily for the privilege of using the streets, and owing to the other traffic upon them, necessarily operates at a lower speed. The electric road, of course, creates a traffic in short hauls which the steam road could never handle, but this is more than offset by the long haul and freight business, which, in the present state of electrical development, the electric street railway can not touch. They remain competitors for the 5 to 15 mile passenger business and it is not infrequent for the steam railroad officials to admit that the competition of the electric road is severely felt.

If it becomes a problem of better investment, between the building of a new parallel street railroad and electrically equipping an existing steam line, it is easy to see where the advantage lies. The steam road has its right of way unquestioned, and even with the same equipment as the street railroad, could make a higher speed on account of this fact alone. Instead of a whole system it has merely a power house, an electric distribution system, and equipment for cars to provide, being exempt from the many expenses of a street railway franchise, and the construction of a costly permanent way. Even if new tracks were necessary, the steam line would have the great advantage of cheaper track construction, and it would not be compelled to pave any part of its roadbed. By utilizing the adjacent steam rails as conductors, it could, at small cost, secure a ground return of double the conductivity that of the street car line, thus effecting a substantial saving in the cost of the feeder system. There is, it is true, a certain danger of overcrowding the approach to the city, but this danger would not be immediate, and New York, Jersey City, Philadelphia and Chicago have shown that

moderate traffic would justify such expensive construction as elevated structures or loops or tunnels.

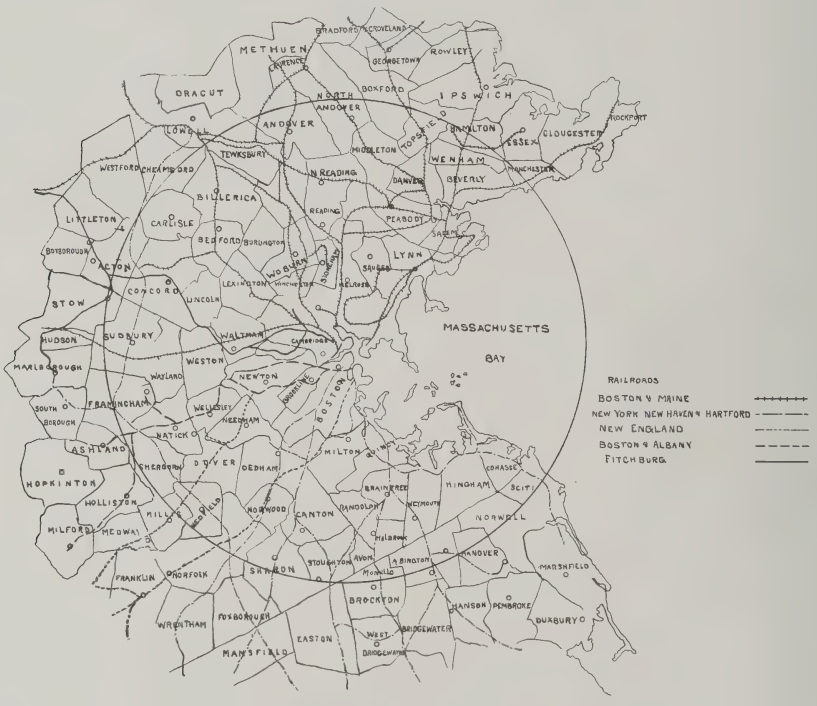
The street railway system has the advantage that it carries the passenger more nearly from his dwelling to his destination in the city, and by this means undoubtedly secures much traffic and creates more. This, however, is not an advantage that is wholly denied to the remodeled steam line, for in connection with electrically equipping such a system, another enterprise can be profitably undertaken. The towns through which the line would pass are quite thickly populated, but, for the most part, have no local street railway system. The franchises for such systems should be secured and the roads should be operated with power from the feeder rails of the fast line. Cars could run to connect with the trains, and passengers should be transferred. The street railway load would have a very beneficial effect on the station load curve, and receiving their power thus, very small lines could be made to pay of themselves, aside from their very important duty of acting as feeders to the suburban line.

All these facts would seem to demonstrate that at a less expense the fast line can provide better passenger accommodations, equal train frequency, and higher speed, and should therefore receive, irrevocably, the bulk of traffic in competition, and create new business in sufficient measure to reap handsome profits.

It, therefore, becomes interesting to investigate the cost of electrically equipping such a line, and the most feasible method of operating it. It is obvious that such equipment will not be profitable unless the net earnings are increased in sufficient measure to pay interest on the added investment. We may look to two sources to increase the net earnings: first, the increased traffic due to better service, and second, a difference in operating expenses which will presently be shown to be largely in favor of electric traction.

In the deduction of an opinion as to the commercial feasibility of the electrical equipment of the steam railroads about the city of Boston, we must construct a hypothetical road that shall fairly represent them all, and apply the calculations just indicated thereto. We will first rehearse the present conditions on such a road, and secondly, the electrical service that it seems desirable to introduce. The figures of both these cases are essential to the argument.

If we draw a circle with a radius of 20 miles about the Boston City Hall, we shall find (see Fig. 1) that it includes all of the residence towns, comes within a mile of including Lowell, and easily surrounds Framingham, Concord, Canton, Stoughton, Walpole and other towns, some of which have between 20,000 and 30,000 inhabitants. Therefore, we may take our hypothetical road as 25 miles long and as fairly representing the suburban service that it is desirable to equip electrically.



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Referring to the time tables of the Boston roads, we find a variable train frequency, increasing as the metropolis is approached. This is due either to the influx of trains from branch lines or the actual making up of new trains at certain points. In order to determine a representative system of trains, the daily numbers of trains on the following systems have been plotted with reference to the length of the lines which they operate and the result is as shown in Fig. 2.

New York and New England system, service between Boston and
1. Norwood Central,
2. Hyde Park.

New York, New Haven & Hartford system, service between Boston and
1. Braintree,
2. Mattapan,
3. Cohasset,
4. Mansfield,
5. Forest Hills,

6. Hyde Park,
7. Dedham, both branches,
8. Stoughton,
9. Easton,
10. Hanover.

Boston & Albany system, service between Boston and
1. Framingham,
2. Newton Circuit service.

Boston & Maine system, service between Boston and
1. Lexington,
2. Lowell,
3. Stoneham,
4. Medford,
5. Reading Highlands,
6. Beverly,
7. Marblehead.

A curve has been drawn to represent the results, which are quite irregular, and from this and other considerations we shall construct the time card of our representative line. The average number of stops seem to be about two to every 3 miles in the densely populated districts, while in the more thinly settled sections they are from 2 to 2½ miles apart. The inward trains are bunched closely together between the hours of seven and nine in the morning, and the outward trains are correspondingly increased between the hours of four and six in the evening. On a 25 mile line there appears to be an average of two places where the inward train service is increased, either by branch trains or new trains started.

The average speed seems to be about 40 miles per hour, and two minutes are consumed at each station.

On the foregoing basis, schedule A has been constructed for the hypothetical road, and it is believed that this time table represents the average Boston suburban service of to-day.

To run such a service as this schedule presents, about ten locomotives would be required. This would allow a margin for accidents and switching. The trains used on such service as this, average four cars each and a locomotive. The cars with their passengers will average 80,000 lbs. each, and the locomotive will probably weigh about 60 tons, making the total train weight 220 tons. The average speed is 40 miles per hour.

From these data we may easily compute the following results:

Drawbar pull, 3300 lbs.

Horse power necessary at 40 miles per hour, 352.

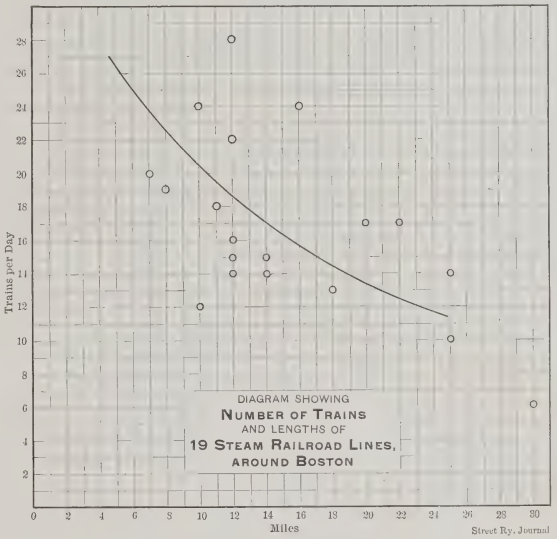
The maximum horse power on grades and on starting would easily reach 800, and it is safe to assume that 600 h. p. average would be necessary. The schedule requires 850 train miles or 3400 car miles per day, due allowance being made for switching and for making up trains. At 40 miles per hour this demands 12,750 h. p. hours.

A locomotive rarely burns coal economically, often using 10 lbs. per horse power hour and seldom reaching an economy as high as 5 lbs. Assuming 6 lbs. per horse power per hour at the driving wheels, a day's traffic on this line will require 38¼ tons of coal.

The installation of the electric system would enable the sale or profitable use of the locomotive elsewhere, and therefore their value should be subtracted from the cost of the power station. They would probably cost $12,000 each, making the total cost $120,000, and we will assume that $90,000 represents their present value.

Having now secured the necessary data from the steam system that we propose to replace, let us consider the schedule with a view to improving it for a maximum increase in traffic.

The prospective passenger will count in both his walk and his wait in the time of making a journey. He is not fond of either waiting or walking, and unless we can get into the city perceptibly quicker than the street car which goes nearest his door, and involves very little wait and walk, he will patronize it in preference. To minimize the walk there must be more stations, and to minimize the wait there must be more trains. The electric train can get under headway very quickly, so that while not increasing the maximum speed we can bring up the average speed of the trains, and thus permit of more stations without seriously lengthening the running time. The daily rider on the Boston roads will note that in the morning to the city and in the evening from the city the cars are crowded, and at other times the seats are sparsely occupied. This argues too many car miles and too few train miles. Therefore in making up the new schedule we must shorten the trains and run them more frequently. Consulting the steam schedule, we find the outlying districts have the poorest train service. The 8 mile service from *e* should be increased to as nearly street car frequency as may be, and the outlying train service should be improved. It is important that street car frequency be maintained up to at least 8 miles. Beyond that limit the



train frequency signifies less, because at that distance the high speed line will beat the street car line into the city in spite of both walks and waits. It is, therefore, advisable to modify the steam schedule as just stated, and also to increase the number of stops between *e* and Boston. The method of increasing these stops is quite systematic, but the following deduction must not be employed in specific cases without being widely modified to suit the local conditions.

Our new service will have an average speed of 24 miles per hour, stops included, and the street railway line in competition will make about 12 miles. It is obvious that we cannot impose on the prospective passenger a walk that will take him longer than the difference in running time between the fast electric system and the street railway system.

It is plain that train frequency being equal and running time faster, passengers living equally distant from the street car line and the fast line, will take the latter. The competition is keen for the patronage of him who lives on or near the street car line, for unless he can make *perceptibly* faster time he will take the road that involves the shortest walk. It would require fully five minutes to influence the average individual. Assume that the passenger lives half way between the stations, this being the extreme case. We must then subtract five minutes from the difference in running time, and the balance will be the time that the passenger will use in walking to the station. Multiplying this by a rate of 3 miles per hour and we shall

get the distance to his home, which is one-half the allowable distance between stations.

The table accompanying, on page 677, is then significant. This table shows that competition inside the 3 mile limit is impossible, but that between 4 and 8 miles more stations could be profitably built on the proposed road. Beyond that point the street car line would be at a disadvantage with the stations arranged as they are.

SCHEDULE "A."

Trains leave Boston: Time given on important stops; others indicated

M																							
2.0	a																						
3.5	b																						
5.0	c																						
6.5	d																						
8.0	e	6.22	7.20	8.02	8.37	9.20	10.22	11.05	12 07	1.05	1.37	2.22	3.20	3.52	4.22	4.50	5.22	5.37	5.52	6 22	7.22	8.20	10.22	12.21
9.5	f																						
11.0	g																						
12.5	h																						
14.0	i																						
16.0	j	6.44		8.24	8.57		10.44				1,57	2.44		4.14	4.44		5.44	5.57	6.14	6.44	7.42			
18.0	k																						
19.5	l																						
21.0	m																						
22.5	n																						
25.0	O	7.06		8.46			11.06		12.51			3.06		4.36	5.06	5.34	6.06		6.36	7.06			11.06	

Trains leave O:

M																							
2.5	n																						
4.0	m																						
5.5	l																						
7.0	k																						
9.0	j		6.24	6.45	7.24	7.39		8.09	8.39	9.24		10.10			12.10	1.24			3.39		6.02	6,24		9.54
11.0	i																						
12.5	h																						
14.0	g																						
15.5	f																						
17.0	e	6.00	6.45	7.07	7.45	8.00	8.15	8.30	9.00	9.45	10.00	10.31	11.15	12.00	12.31	1.45	2.15	3.30	4 00	5 00	6.23	6.45	8.30	10.15
18.5	d																							
20.0	c																							
21.5	b																							
23.0	a																							
25.0	B	6.20	7.06	7 27	8.06	8 20	8.35	8.50	9.20	10.05	10.20	10.51	11.35	12.20	12.51	2.06	2.35	3.50	4.20	5.20	7.43	7.06	8.52	10.36

M																							
2.5	n																						
4.0	m																						
5.5	l																						
7.0	k																						
9.0	j		6.00		7.00	7.15		7.45	8,15	9.00				11.15		1.00			3.15			6.00		9.30
11.0	i																						
12.5	h																						
14.0	g																						
15.5	f																						
17.0	e	6.00	6.45	7.07	7.45	8.00	8.15	8.30	9.00	9.45	10.00	10.31	11.15	12.00	12.31	1.45	2.15	3.30	4 00	5 00	6.23	6.45	8.30	10.15
18.5	d																							
20.0	c																							
21.5	b																							
23.0	a																							
25.0	B	6.20	7.06	7 27	8.06	8 20	8.35	8.50	9.20	10.05	10.20	10.51	11.35	12.20	12.51	2.06	2.35	3.50	4.20	5.20	7.43	7.06	8.52	10.36

more two car trains. To make their schedule the trains will have to average 45 miles per hour. The cars will weigh 80,000 lbs. and a motor car 100,000 lbs., making a two car train weigh 90 tons and a three car train 130 tons,

SCHEDULE "B."

Trains leave Boston: Time given on important stops; others indicated

Mi.																														
2.0	a																													
3.5	b																													
5.0	c																													
5.75	y																													
6.50	d																													
7.25	x																													
8.0	e	6.25	6 53	7.25	7.53	8 25	8 55	9 55	10.48	11.23	11.55	12.53	1.25	1.55	2.25	2.53	3.25	3.53	4.25	4.38	4.53	5.25	5.35	5 45	5.55	6.10	6.25	6.38	6.55	7.25	8.10	8.53	9 40	10.23	12.10	12.38
9.50	f																																			
11.0	g																																			
12.5	h																																			
14.0	i																																			
16.0	j	6.46		7.46		8.46	9 14	10 16			12.16		1.46	2 14	2 46		3 46		4.46			5.46	5.57	6.06		6.31	6.46		7.16	7.46	8.31		10.01		12.31	
18.0	k																																			
19.5	l																																			
21.0	m																																			
22.5	n																																			
25.0	O	7.07		8.07		9.07		10.37			12.37		2.07		3.07		4.07		5.07			6.07		6.27		6.52	7.07		7.37	8.07	8.52		10.22		12.52	

Trains leave O:

Mi.																														
2.5	n																													
4.0	m																													
5.5	l																													
7.0	k																													
9.0	j		6.23		6.53	7.08	7.23	7.38		7.58		8.38	9.30	9,38	10.08		11.38		12.38		1.38	2.38	3.08		4.23		6.08	6.38	7.08		8.38		10.38
11.0	i																													
12.5	h																													
14.0	g																													
15.5	f																													
17.0	e	6.00	6.30	6 45	7.00	7.15	7.30	7.45	8.00	8 10	8.20	8.30	8.45	9.00	9 51	10.00	10.30	11.00	11.30	12.00	12.30	1.00	1.30	2.00	3.00	3.30	4.00	4.45	5.45	6.30	7.00	7.30	8.00	9.00	10.00	11.00
17.75	x																													
18.5	d																													
19.25	y																													
20.0	c																													
21.5	b																													
23.0	a																													
25.0	B	6.22	6.52	7.07	7.22	7 37	7.52	8.07	8.22	8 32	8.42	8.52	9.07	9 22	10.14	10.22	10.52	11.22	11.52	12.22	12.52	1.22	1.52	2.22	3.22	3.52	4.22	5.07	6 07	6.52	7.22	7.52	8 22	9.22	10.22	11.22

On the line of the foregoing discussions, schedule B has been compiled.

It will require about sixteen motor cars to operate this schedule, allowing for a percentage in the repair shop, special runs, etc.

Owing to the more frequent train service which fills the cars more efficiently, the daily car mileage can be safely and at 45 miles per hour these trains will require 162 and 234 h. p. respectively. A 400 h. p. equipment would probably be used to allow for grades and for acceleration. The average horse power per train would be about 300. The train mileage could be run off in twenty-nine hours and therefore 8700 h. p. hours would be necessary.

It is an easy matter to obtain an economy of 2 lbs.

of coal per horse power per hour in stations of 1000 h. p. or more, provided every care is taken. Adding to this 6 per cent for dynamo losses, 15 per cent for line losses, and 15 per cent for motor losses, total, 36 per cent, and we will be obliged to burn .72 lbs. of coal more. Therefore 3 lbs. per horse power per hour is a liberal assumption for the cost of power at the car wheel. This makes the coal consumption per day 13.05 tons or 25.2 tons less than the steam line required. Coal in New England costs about $3.25 per short ton, and at this rate the electric traffic effects a daily saving in coal of $81.90. This takes no account of the fact that a power house can burn much cheaper fuel at high economy, while a locomotive requires the best of coal.

Miles.	Time Difference.	Time difference less five minutes, which is time left for walk.	Distance walked, Miles.	Allowable distance between stations, Miles.
1	2½	. . .	. . .	. . .
2	5	. . .	. . .	. . .
3	7½	2½	⅛	¼
4	10	5	¼	½
5	12½	7½	⅜	¾
6	15	10	½	1
7	17½	12½	⅝	1¼
8	20	15	¾	1½
9	22½	17½	⅞	1¾
10	25	20	1	2
11	27½	22½	1⅛	2¼
12	30	25	1¼	2½
13	32½	27½	1⅜	2¾
14	35	30	1½	3
15	37½	32½	1⅝	3¼
16	40	35	1¾	3½

The only other facts affecting cost of operation is wages, and for this estimate we have the following:

A steam train crew would consist of	
Three brakemen	$4.50
Conductor	3.00
Engineer	3.50
Fireman	2.00
Baggageman	2.00
Total	$15.00
The electric train crew would consist of	
Brakeman	$1.50
Conductor	2.00
Motorman	2.50
Baggageman (every other train)	1.00
Total	$7.00

Two hundred train miles would be considered a day's work, and at that rate the operation of the electric road would cost $45.50 per day in wages, and the steam road $63.75.

In addition there would be a power house force of

Chief engineer	$5.00
Four assistants at $2	8.00
Six firemen at $1.50	9.00
	$22.00

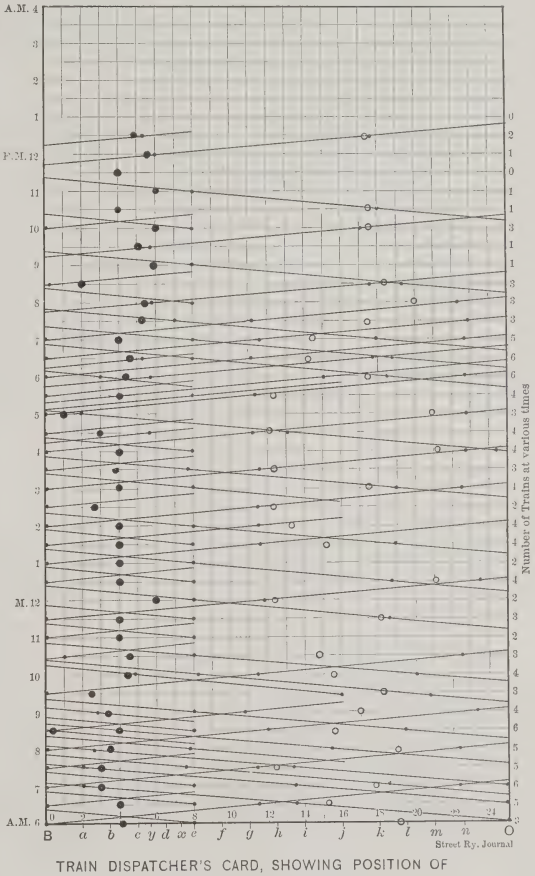
making a daily wage difference of $3.75 in favor of the steam road.

Before proceeding to the computation of the cost of the electric equipment, it will be instructive to consider the following comparative table.

COMPARATIVE TABLE.

	Steam.	Electric.
Train miles per day	850	1,300
Car miles per day	3,400	3,000
Weight of train (tons) average	220	102
Speed, miles per hour "	40	45
Drawbar pull, lbs., at full speed on level	3,300	1,530
Horse power per train, average	600	300
Horse power per train, maximum	800	400
Coal per day, tons	38¼	13.05
Wages for operation per day	$63.75	$67.50
Cost of operation per car mile, wages	.0187	.0225
Cost of operation per car mile, coal	.0366	.0142
Cost of operation per car mile, wages and coal	.0553	.0367

It is obvious that as the electric road increased in car miles the cost of the latter would diminish, because the power station salaries would not be such a large proportion of the total daily wages. Short trains are conducive to expensive car miles, and a pertinent example obtains in the case of these very two car trains on the proposed electric line. A three car train could be handled by the same train crew, the only added cost being that of coal. If



TRAIN DISPATCHER'S CARD, SHOWING POSITION OF TRAINS AT EACH HOUR.

we should make up all the trains of three cars each instead of two, we would have 3900 car miles, making the wage cost per car mile $.0173 and the cost in wages and coal $.0315 as against $.0553 of the steam service.

It is believed that owing to the partly loaded cars of the steam service the lesser car mileage of the electric service will replace it, because its cars will be better occupied, due to its more frequent trains, but the above shows in what direction the increase in car mileage should be made as traffic shall justify it. It would probably be advisable to install 500 h. p. equipments on the cars in anticipation of this increase.

In computing the cost of the electric equipment we must find out the best position of the power station and

the maximum power it is required to exert. Fig. 3, is a plotted diagram showing the train positions at the various hours of the day. It requires a little explanation. The hours are plotted vertically and the distances horizontally, and each train is represented by an oblique line. The

Two 1200 h. p. stations complete	$192,000
Buildings and land for same	15,000
Sixteen 500 h. p. equipments with trucks	80,000
Thirty-two turnouts at stations	24,000
Rails for third rail system	47,000
Bonding	33,000
Insulators	18,000
Labor, connections to stations, etc.	10,000
Two new depots	7,000
Total	$426,000
Less value of locomotives	90,000
New investment	$336,000

train speed is assumed to be uniform, which is very nearly true, and hence all of the lines are straight. The horizontal line representing any time may be traced and the number of positions of its intersections with the oblique lines indicates the number and positions of the trains on the line at that time.

These intersections are represented by a dot, and the maximum number is six, which means the load on the power station is not likely under the present service to exceed 2400 h. p. The trains are about equally divided on either side of *E*, and aside from the necessary distributing points of high potential along the line, this argues the advisability of two power stations, one between *B* and *E*, and the other between *E* and *O*. The marks O and o show the best positions of the power stations at various hours of the day, and their distribution seems to show that the first station should be nearer *E*.

Basing the computation on a 700 volt system with a minimum line voltage of 600, the results shown in the table obtain.

The net earnings must be increased 4 per cent of the new investment to keep up repairs on the plant and 6 per cent more for interest, a total of 10 per cent or $33,600. The daily saving in coal effected by the electric road is $81.90, but as wages are $3.75 per day more, the actual saving is $78.15, and in a year of 330 days, it will aggregate $25,789.50, leaving $7,810.50 to be earned each year by increased traffic.

The report of the Interstate Commerce Commission for 1895 places the gross receipts of 1 mile of the Boston & Albany Railroad at $23,492. This road would represent ours better than many, but it is evident that its total population per mile served would be much less. It is, therefore, eminently conservative to assume for our 25 mile road a gross income of $25,000 per mile or $625,000, of which $7,810.50 would be but 1¼ per cent.

The train service has been increased more than 50 per cent, soot and cinders have been abolished and two new stations have been built. An increase in the gross receipts of 1¼ per cent. seems certain and a much larger gain highly probable. The power estimated as necessary to operate these trains has been figured very closely, for, as a rule, there are no heavy grades on New England suburban roads. It will be noted that the steam and electric service have been figured on the same basis, and therefore any increase in the power necessary will result in increased saving for the electric line, and very little is necessary to create a profit, leaving increase in traffic out of the calculation.

This estimate has been based on figures that have seemed to the writer conservative and liberal to the investor, and it is believed that it demonstrates the advisability of adopting electric traction on New England suburban service.

Surface Contact Railway System.

The various surface contact electric railway systems which have been put on the market during the last ten years have been of every conceivable character, mechanical, electrical and magnetic, and of each kind the number of patents has been legion. In spite of these facts the surface contact system has not yet proved even an unimportant competitor of the overhead trolley, so far as practical adoption for commercial use is concerned. For this reason the announcement by the General Electric Company that after experiments extending over many months, it has perfected a surface contact system has attracted much interest.

FIG. 1.—STRETCH OF TRACK AT SCHENECTADY, EQUIPPED WITH SURFACE CONTACT SYSTEM.

In one European city, the first practical surface contact electric railway is already advanced toward completion.

The experiments at Schenectady have been carried out upon a stretch of the track which forms part of the extensive factory tramway system of the General Electric Company's works. As the illustration shows, the addition to the roadbed between the rails of the track consists simply in two parallel rows of iron disks, convexed to a height of about 1 in. above the level of the rail. The car shown in the illustration is a simple factory tramway to which the controller, motor and storage battery equipment have been fitted. It may be said here that the General Electric Company is now engaged in changing over to the surface contact system the entire trolley tramway system in its yards.

The main requirements in a surface contact system are four: low cost of installation and maintenance; absolute absence of current from all disks not covered by the car; freedom from leakage of current, and reliability under all possible conditions of weather, service and location. It is the attempt to meet simultaneously all these requirements that has rendered the problem one of considerable difficulty, demanding long study and costly experiment to overcome. In the G. E. surface contact system, it is claimed that the requirements are adequately complied with.

The only live portions of the G. E. surface contact system on the street surface are the contact plates immediately beneath the car. This is true whatever the position of the car and whatever the speed, each plate in turn communicating current to the motors and becoming inert as the contact shoe on the car leaves its surface. These contact plates are placed in parallel rows between the two rails of the track and are set alternately. In the illustration, the positive or communicating disks are on the right, the negative or discharging disks on the left, one of each between each two of the others. Each positive contact plate is made alive by the operation of an automatic magnetic switch, which, instead of being placed in immediate juxtaposition with its plate or opposite it outside the track, is placed in a manhole with a large number of others, each connected to its own respective plates. Through each negative plate is performed the double duty of closing the contact in the switch which "cuts in" the positive plate and of receiving the return current from the motors. Fig. 2 shows the arrangement of the plates on the street surface.

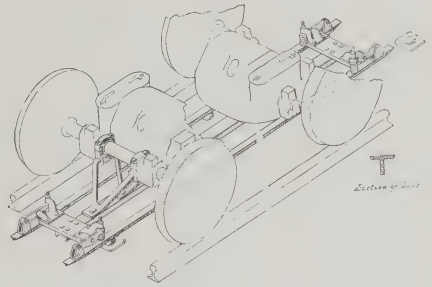


FIG 5.—METHOD OF SUSPENDING SHOES FROM TRUCK.

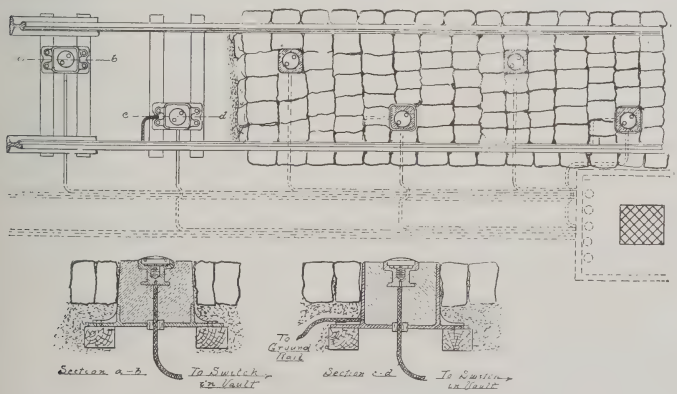


FIG. 2.—PLAN AND SECTIONS OF SYSTEM.

The operation of this system will be understood from the diagram (Fig. 3). A, A', A'' are the negative plates, B, B' and B'' the positive contact plates, placed equal distances apart, a little less than one-half the over all length of the shoe. C, C', C'' represent the automatic magnetic switches and D, D' and D'' their armatures or contact makers. F is the positive or collecting shoe, E the negative or return shoe and G the track return. H and K are switches which form part of the controller, the latter connecting in or cutting out the cells of a small storage battery, which is used only to energize the coil of the first switch through the plates over which the car passes in starting. After the armature of the first switch has been raised into contact and the line current has completed its circuit, the battery is cut out by the forward movement of the controller handle. In the diagram the car is to move to the right and all the magnetic switches are open. The handle of the controller is turned to the first notch and switches H and K closed. Current from the battery flows through a small portion of the motor resistance to the shoe, E, thence to contact plate, A', and the coil, C' completing the circuit to the ground. The coil, C', thus energized, raises the armature, D', closes the circuit through the automatic switch, and the line circuit completes its path through the motors and through the greater part of the motor starting resistance shown by the arrows through the positive plate, B', and shoe, F. Part of the return circuit goes to the storage cells, which are kept continuously charged, and part through shoe, E, negative contact plates, A'

and coil, C, to ground, keeping the latter energized and the automatic switch closed so long as the shoe, E, remains on the contact plate, A'. Moving the controller handle forward from the first notch to the second notch opens the switch, K, cuts out the battery and sends all the return current through the coil, C'. The shoes, E and F, in the diagram are a little longer than the distance between contact plates. Thus when the car moves forward slightly the shoe, E, will be in contact with the two contact plates, A and A', and the return circuit will divide, half going through coil C' and half through coil C, energizing both, and closing the armatures in the switches, D' and D. The car moves forward and the shoe, E, passes beyond the contact plate, A'. The circuit in the coil, C', is broken, the armature, D', drops, cutting out entirely positive plate B'', leaving it dead, but allowing B' still to receive current through the closed switch at D. Shoe F moving forward then makes contact with plate B before it leaves plate B', and the current is uninterrupted in its flow.

The automatic magnetic switch is the heart of this system. It has been designed to endure under the severest strains and to act with such uninterrupted precision that the working of the system may not be impaired. The development of this automatic magnetic switch is a decided step forward. Mechanically the switch is simple, strong and durable, with all chances of derangement reduced to a minimum. In the course of the experiments this switch has been subjected to the roughest possible usage and has withstood it unharmed.

If the leakage is great an arc is likely to form when the armature of the switch drops, and so long as this is held the contact plate in the street would remain alive, while the arc would burn the switch. It is not practicable to allow the armature to drop far enough to break the arc, and, to extinguish it, the magnetic blow-out principle is brought into play. By this means retention of this arc is impossible. But there is also the possibility of another arc forming in case of accidental ground on one of the leads to the positive contact plate, or if the forward switch fails to close when the handle of the controller is on the first notch, giving a path to ground through the battery. This is also taken care of by the magnetic blow-out. All surface contact systems have similar conditions to meet, but none have incorporated the magnetic blow out principle.

The form of the contact plates is shown in Fig. 2. They are first set in iron boxes and then surrounded by insulation. The contact plates consist of two parts—a wearing piece screwed into a support and held by a spring washer. This wearing piece can be removed readily without disturbing the support. The shoe for ordinary cars is about 13 ft. long. Its shape and suspension are shown in the sketch (Fig. 5); the ends being curved upward slightly prevent catching. The shoes are supported from the axles and have a slight upward and downward movement to allow for any irregularities in the height of the contact plates. The amount of drop in the shoe is regulated by a set screw.

The automatic magnetic switches are grouped in manholes where inspection can be readily effected. Fig. 4 shows a group of these temporarily arranged for exhibition. Each manhole will contain about twenty switches, and the wires from the contact plates to them will be protected in similar manner to underground wires for any other purpose.

The battery on a car consists of ten cells with normal capacity of 50 amp. hours at 5 amps. It is equal to all emergencies, being called into requisition only momentarily, while being in charge the balance of the time the controller handle is on the first notch.

A close examination of the design and operation of this system will show that it possesses many striking advantages. The operation of the automatic switches is perfect under all conditions, as the full line voltage can be secured to close them, and they open by gravity. There is no possible chance of the contact remaining electrified after the car has passed, as by the use of the blow-out on the switch and the switch itself, which opens as soon as the current is shut off, all danger and trouble due to live contacts are eliminated, while grouping the switches in manholes renders the working part of the system easily accessible for inspection.

In the city of Monte Carlo, in the principality of Monaco, this system is being laid down by the Cie. Fçaise. Thomson-Houston over a distance of about 3 miles. It is expected that this will be in operation very shortly.

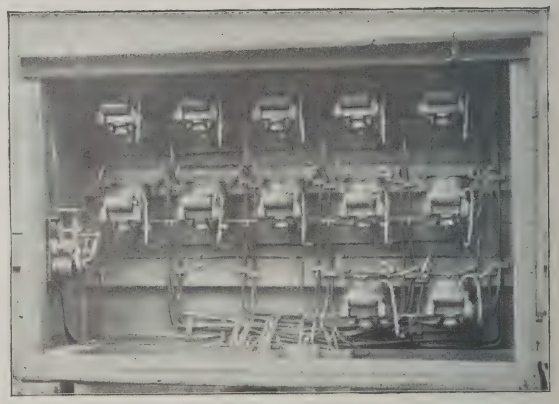


FIG. 4.—AUTOMATIC MAGNETIC SWITCHES.

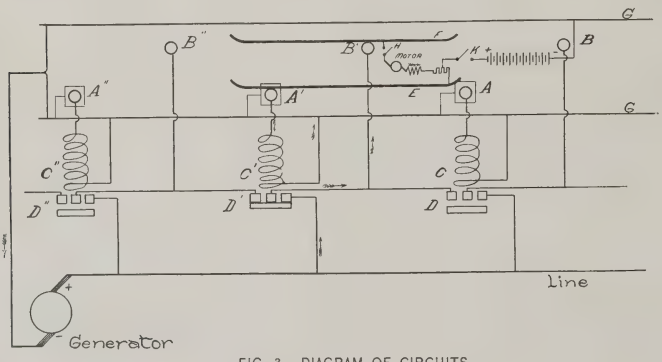
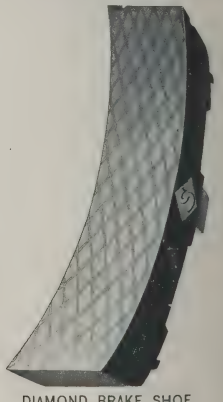


FIG. 3.—DIAMOND OF CIRCUITS.

A New Brake Shoe.

The cut shown herewith illustrates the Diamond "S" brake shoe, which is manufactured by the Sargent Company. The name adopted for this new brake shoe is suggested by the appearance of a sheet of expanded metal as it shows in the face of the shoe, as will be seen from the illustration. The shoe is formed by placing a bundle of expanded metal sheets in the brake shoe mould; this effects a minute subdivision of the space into which the melted cast iron is poured. Notwithstanding the great number of steel strands extending in every direction through the mould, when the fluid cast iron is poured into it, a perfectly solid casting is made and the expanded metal sheets of low carbon steel strengthen the shoe very materially.



DIAMOND BRAKE SHOE.

Every fraction of an inch that the shoe wears means a change in the lateral position of the steel surfaces in contact with the rim of the wheel, thus preventing any irregular action on the tread. The network of soft steel on the shoe face, it is claimed, restrains the granules of cast iron from being removed by the revolving wheel until the steel barriers are slightly worn down, when the granules are carried along to the next diamond and so on.

The tests of this shoe have shown a great resistance to wear,

and this result is obtained without impairing its braking qualities or injuring the wheel tread in any way.

Modern Compressors for Air Braking.

BY E. J. WESSELS.

Although compressed air was known in Aristotle's day, and has long been used for a variety of work, its application in the field of electric traction remained in an undeveloped state until recent years. So long as horse cars were the order of the day, no necessity existed for its use in braking surface cars. Shortly after the first electric car was put in service, the company of which I have the honor to be managing director, met the need which arose by furnishing an air brake system, operated by a single or double acting compressor, for controlling electric and cable cars. As electric traction developed, increased demands were made upon us for apparatus of higher efficiency than had sufficed in the dawn of street railroading. As a result, not only had existing conditions to be confronted and met, but, what was fully as important, a system had to be evolved which would successfully meet the radical changes which became necessary. The air brake system really had to be ready before the need for it had become fully apparent. No time was granted for experimenting, after the high efficiency car motors were in place.

With these special needs in view an electric compressor embodying radical changes had to be designed. Many experiments were made with the initial outfits, and large outlays were necessarily incurred, without always being followed by satisfactory results. It may be admitted with perfect frankness that the first apparatus left much to be desired. We had to rely upon the reports and friendly criticisms of railway managers in order that defects might be cured and that each installation might be an improvement upon its predecessor. Some of our friends realized that their interests and ours were very closely allied, and through them we obtained important help.

The problem of braking by air, high speed, heavy cars running in trains, is not as simple as might appear at first blush to the uninitiated. It becomes more complicated when the factors of heavy grades, frequent stops and numerous crossings are involved. A motor compressor which answered in 1895 falls short of the requirments of 1897. With a full appreciation of this fact our company's aim has been ever to keep in the van. The illustrations accompanying this article are not "manufactured," but taken from real life, and represent the interior and exterior of our latest machine as actually photographed. Reference to some of its features may be timely, and it will be seen wherein this type of air compressor differs from all others. The 1½ h. p. type is illustrated. The motor compressor is very compact, being but 26½ ins. long × 15 ins. wide × 18½ ins. high. The complete weight is 400 lbs. The motor is of the iron clad, multipolar, slow speed, series type. It was found after repeated experiments that the use of gears necessitated a much bulkier machine, and that the noise arising from a geared machine was very much greater than from the other type. This noise was intensified after the gears showed wear. For this and other reasons the "geared" type was abandoned.

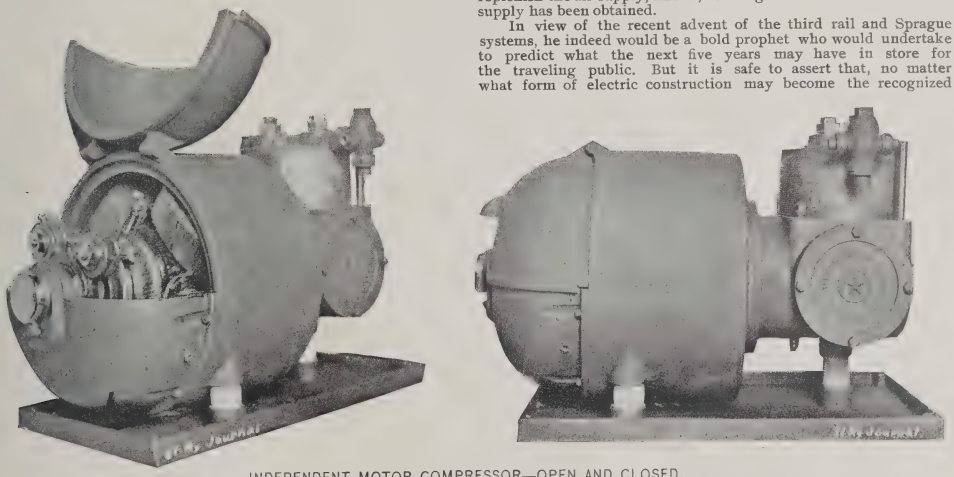
While our motor is absolutely rain and dustproof, nevertheless the construction is such as to make the brushes readily accessible. It will be noticed that the commutator is of very generous proportions, as are also the brushes. Special brush holders are provided which are exceedingly convenient. Their long springs insure even tension of the brushes and require only very infrequent adjustment. The wide insulating surfaces prevent leakage through "creeping." In this motor extraordinary precautions have been observed throughout for obtaining the strongest and most durable insulation.

While the armature is of the slotted drum type (such as is used in the best sort of street railway motors) the winding is special, being of the well known Hochausen type. It should be stated that ours is the only company which is authorized to use the Hochausen patents, in air compressor work. Damaged sections can be renewed (in case of injury) as is common in car motor armatures. The machine is thoroughly protected against ingress of oil from bearings and compressor.

The compressor is of the single-acting type, with double cylinders which are placed vertically, with trunk pistons connecting directly to eccentrics in crank case. The pistons are carefully balanced to insure a minimum of noise and freedom from vibration. The eccentrics are effectively lubricated by revolving in a closed chamber partly filled with oil, which is kept at such height as always to be in contact with the sliding surfaces. The compressor is bolted to the end of the motor, and the shaft is a prolongation of the armature shaft, although it does not form a part of it. The compressor has a capacity of 11 cu. ft. of free air per minute when working under a gage pressure of 60 lbs. per square inch. It is capable of operating with great economy even at 100 lbs. pressure, although in straight air work the maximum pressure required by the Standard system is 60 lbs. The remarkably high efficiency of the compressor is largely due to the design of the valves. These combine ease of access with a minimum loss arising from clearance. Being made of steel, they are very light and are practically indestructible. The air supply is drawn from a chamber which, although dustproof, has so large a filtering surface that the work of drawing the air through the same is inappreciable.

This modern motor compressor has been in operation for a number of months and has been mounted on a number of cars with very satisfactory results. The operation is completely governed by the automatic current controller, which relieves the motorman of responsibility by starting the motor compressor when necessary to replenish the air supply, and by cutting out as soon as the needed supply has been obtained.

In view of the recent advent of the third rail and Sprague systems, he indeed would be a bold prophet who would undertake to predict what the next five years may have in store for the traveling public. But it is safe to assert that, no matter what form of electric construction may become the recognized standard of the future, the modern air compressor will be found doing its work of maintaining a sufficient air supply (in connection with an air brake system) to curb the speed of what would often otherwise prove "wild" trains or cars. For such work it is singularly well adapted and its place is not likely to be usurped by any other forms of braking apparatus, with their pronounced weaknesses and limitations.



INDEPENDENT MOTOR COMPRESSOR—OPEN AND CLOSED.

THE New Rochelle Electric Railway Company, of New Rochelle, N. Y., has been incorporated by William T. Emmet, Charles Nutt and W. H. Neilson, of New Rochelle, and Osten Gerry, of Pelham Manor, to build an electric railway 8 miles long in Westchester County. The capital stock is $80,000.

THE Dayton & Western Traction Company, of Dayton, O., has awarded contracts for the construction of its electric railway between Dayton and Eaton. The contract for the overhead work was awarded to the Chase Construction Company.

THE Homestead & Highlands Street Railway Company, of Pittsburgh, Pa., has secured permission to extend its line from Braddock to McKeesport. The company also has under consideration an extension of its lines to Duquesne.

A New System of Double Trucks.

The rapid increase in interurban electric railways, in which the long double truck car, with its capacity for high speed and ability to carry heavy loads, is used, has resulted in a great demand among electric railway managers for a double truck adapted to electric railway conditions. This demand has been accentuated during the past year by the proven success of the third rail method of transmitting electric power for heavy electric cars. That the lead taken by the New York, New Haven & Hartford Railroad Company in the employment of electric cars for suburban traffic on several of its divisions will be followed in the immediate future by other important companies which have hitherto used steam exclusively for this service, admits of no contradiction. The elevated railways of Brooklyn have already decided upon the adoption of electric power, while the Long Island Railroad Company, the Erie Railroad Company, the Pennsylvania Railroad Company and many others are carefully investigating the same subject for their short suburban lines.

On first thought it might appear that the standard steam railroad truck, which is the evolution of some thirty years or more of experience in the employment of trucks under heavy cars, would best subserve the uses of steam railroad companies in their electric service. Undoubtedly, this is largely true so far as the support of the car body, its easy riding on the track and the durability of the truck are concerned. There are a number of points, however, in which the demands made upon a truck under an electric car differ from those upon a truck under the same car when used for steam railroad service. The two principal points of difference lie

1. In the fact that the car is self-propelling, so that the strains between the car body and truck in starting and while running are just reversed from those in steam railroad service; and

2. The truck is obliged to carry the motor equipment. This necessitates (*a*) accommodation for it on the truck with means for the motor suspension, and (*b*) methods for easy inspection of the motors and for ready removal of them in case of accident.

It will thus be seen that the questions involved in the design of the best double truck for heavy electric railroad service differ in important principles from that of a steam truck pure and simple, and include many points which have already been solved in the construction of trucks for ordinary electric railway service. For this reason the builders of the latter are in several respects better equipped for the solution of this important subject than are those who have given their attention exclusively to steam railroad service.

Acting upon these lines, Edgar Peckham, president of the Peckham Truck Company, whose work in single electric railway trucks is known all over the world, has developed a line of double trucks in which the valuable points of the Peckham single trucks have been combined with the advantageous qualities of the steam railroad truck as employed on the leading steam lines of the country.

The first double truck brought out by Mr. Peckham was the No. 14 double cushioned truck for ordinary street service. In this the truck bolster is supported by half elliptic springs resting in pockets on the top of the side frame of the truck which is of the standard Peckham cantilever type. This truck, which was illustrated in the STREET RAILWAY JOURNAL for July, 1897, combines the advantages of a low center of gravity with short wheel base, and ample room within the axles for the installation and inspection of motors.

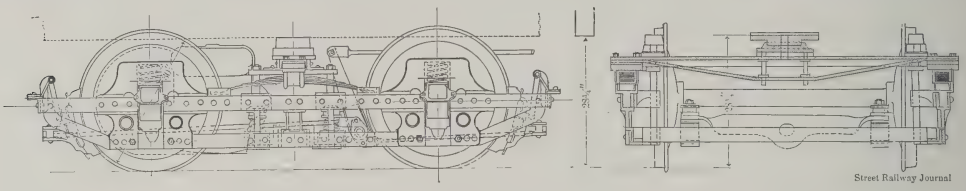


FIG. 1.—NO. 14 DOUBLE CUSHIONED DOUBLE TRUCK.

This truck is built in two weights, namely, light weight, as shown in Fig. 1, for service under city and light interurban cars and heavier for heavy interurban service. The latter, the extra strong No. 14 differs in construction from Fig. 1 by the use of heavier side bars and pedestals and the addition of a bridge truss between the top and bottom members of the side frames, which give increased strength and support for the bolster. The main point kept in view has been to provide a truck so designed that the wheels may swing between the sills of the car when the truck swings in a curve. With this end in view the bolster has been kept down as low as possible. The bolster consists of a truss formed by the combination of a channel bar, and truss bar, supported by adjustable posts. These posts are hollow and receive the bolts which hold the lower half of the swivel plate in position on the bolster.

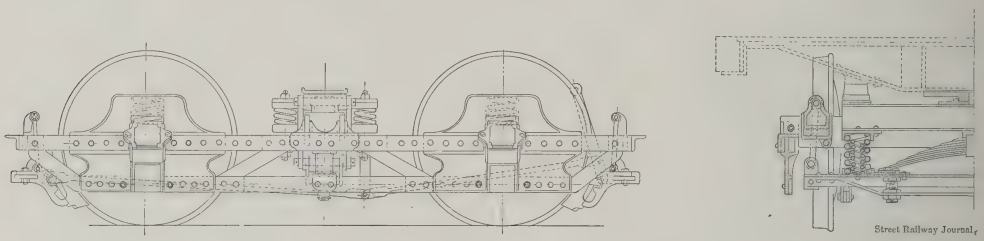


FIG. 2.—NO. 14 A TRIPLE CUSHIONED SWING BOLSTER DOUBLE TRUCK.

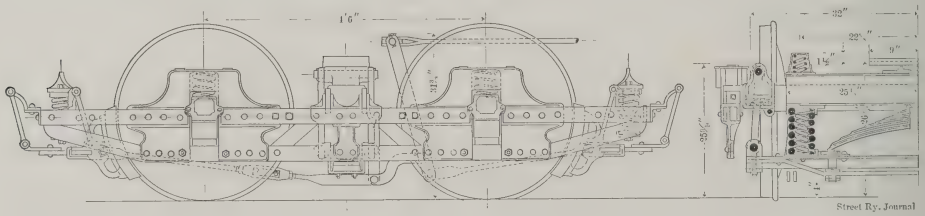


FIG. 3.—NO. 14 B TRIPLE CUSHIONED SWING BOLSTER DOUBLE TRUCK FOR SHORT RADIUS CURVES.

The bolster is carried on two half elliptic springs in pockets on the upper bars of the side frame. These half elliptics, resting as they do more than half way between the center of the truck and the centers of the axles, act as equalizers, permitting any individual wheel of the truck to rise in crossing an obstruction without imparting to the car a corresponding motion. The result of this arrangement, combined with the spiral yoke springs upon which the truck side frames are carried, is a very smooth and even riding truck, no sudden motion or jerk being conveyed from the truck to the car body. The brake rigging supplied with this truck is of the standard double upright lever type, which is designed to give a very powerful leverage. It is arranged to permit the truck to turn under the car body

in a curve without altering the position of the brake shoes, thus permitting a very close adjustment of the brakes.

In the No. 14 double truck as shown in Fig. 1, the bolster is stationary. For heavier high speed service, such as on ordinary electric suburban lines or on elevated railroads where light cars are used, Mr. Peckham has designed the No. 14 A truck, shown in Fig. 2. For a line on which there are many short radius curves Mr. Peckham has designed his No. 14 B truck (Fig. 3). For maximum traction service the company has brought out two maximum traction trucks, No. 14 C and No. 14 D, which are illustrated in Figs. 4 and 5. The former is constructed with all four wheels of the same diameter and is intended for car bodies sufficiently wide to allow all four wheels to radiate between the car sills; the latter is constructed with one small pair of wheels so that they can swing under the car sills. The percentage of weight on the driving wheels is about the same in each case. For heavy suburban or elevated railroad service the company has designed an equal traction truck very similar to the No. 14 A truck, but built extra strong. This is entitled No. 15 and is shown in Fig. 6.; while for heavy trunk line service the company is building its No. 17, all steel double truck, shown in Figs. 7, 8 and 9. As will be seen, this line of trucks makes a complete series, suitable for all classes and conditions of work. In the No. 14 A, No, 14 D, No. 15 and No. 17 trucks, all of which are intended for high speeds, the swinging bolster, which has proved so desirable on steam railroads where high speeds are attained, has been adopted, while in other points certain characteristics which have rendered the Peckham trucks so successful in the past have been retained. The 14 and 14 C are double cushioned, while the 14 A, 14 B, 14 D, 15 and 17 are triple cushioned. In all of these trucks certain parts, such as journal boxes, brake rigging, etc., are made interchangeable.

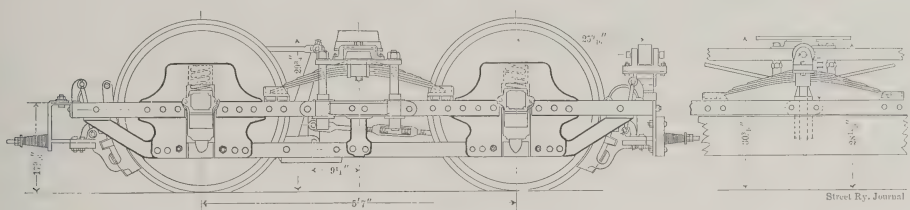


FIG. 4.—NO. 14 C DOUBLE CUSHIONED CENTER BOLSTER MAXIMUM TRACTION TRUCK.

Referring first to Fig. 2, opposite, it will be seen that in the 14 A truck, the car body is kept at a minimum height above the track, the distance between the top of the rail and the car floor with a 30 in. wheel being only 33½ ins. The bolster is composed of two channels set on edge and held together by the cover plates, a female swivel plate and spring caps. This bolster is carried on the spring plank by means of a spring system, consisting of a half elliptic and two spiral nest springs. The side bearing plates attached to the car bolster bear upon the cover plates, admit of a limited rocking motion of the car, governed by the stiffness of the spiral nests. This motion is similar to that imparted by the King side bearing springs used on the No. 14 trucks, and adds greatly in ease of riding, as it permits the wheels on one side of the truck to rise independently of the car body.

The spring plank is supported upon rubber cushions by four links, which in turn are carried on two transverse bars or transoms, which rest in pockets on the side frame of the truck. These bars are secured to both side frames together with the end cross members, holding them in rigid alignment. The transoms likewise act as a guide for the bolster, preventing it from moving in a direction longitudinal with the car. The transoms also carry the motor support nose bars through pockets riveted in them. The four links have a slight outward inclination shown in the cross section. The object of this is to raise that side of the car body towards which the bolster moves when striking a curve, and to give the effect of an additional superelevation of the outside rail of a curve, the rubber cushions supporting the bolsters deaden sound and prevent vibrations.

The brake rigging is fitted with flat beams and M. C. B. shoe heads and double levers. The equalizer or floater secured to the heads of these levers is provided with a segmental piece on which the rod leading to the sway bar on the middle of the car works through a roller, thus providing for an even application of the brakes when running through a curve.

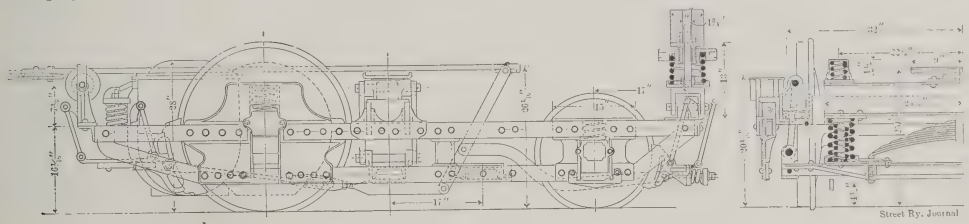


FIG. 5.—NO. 14 D TRIPLE CUSHIONED SWING BOLSTER MAXIMUM TRACTION TRUCK.

The No. 14 B truck is designed with a short wheel base for railways with short radius curves. The wheel base can be made as low as 4 ft. if desired, but the Peckham Truck Company does not recommend a shorter wheel base than 4 ft. 6 ins., when the truck is used on a 4 ft. 8½ in. gage, and a 4 ft. wheel base when employed on a 3 ft. 6 in. gage. The side frame and swinging bolster of this

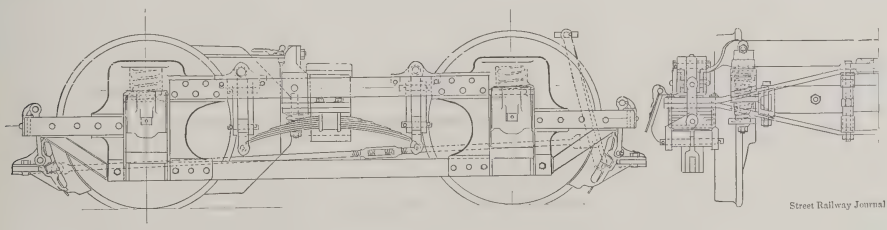


FIG. 6.—NO. 15 EXTRA STRONG TRIPLE CUSHIONED SWING BOLSTER DOUBLE TRUCK.

truck are in every way the same as in the No. 14 A truck, and all parts are interchangeable with it. Owing to the short distance between axles, however, the motors are suspended between the outer end cross bars of the truck and the axles, instead of between the axles. The practical result of this disposition of the motors is to make the truck run very steadily, as the motors, being suspended at the extreme ends of the truck, act as counter balances.

Figs. 4 and 5 show the new trucks recently designed by Mr. Peckham on the maximum traction principle, for use under long electric cars requiring two trucks and where only one motor is used on each truck. The weight available for traction on the driving wheels is not fixed, but can be varied between 70 per cent and 80 per

cent of the total weight of the truck as desired. These trucks, while unsuitable for certain classes of work, are yet strongly recommended by the Peckham Company where great traction is a desideratum, as, for instance, in heavy grade service, or where trail cars are used with double truck cars. The trucks differ in a number of important points from any heretofore put upon the market, as will be seen from the following descriptions:

The No. 14 C truck, for cars with wide sills, is built on the same general plans as the No. 14, the greater proportion of the weight of car body being carried on the bolster and elliptic springs. A portion of this weight is placed on a roller which works on a plate on the under side of the body framing, throwing 70 to 80 per cent of the weight on the two driving wheels, leaving 20 to 30 per cent on the remaining wheels. The casting carrying the roller is supplied with a guide which prevents the side movement of the roller and casting with relation to the truck frame, the roller permitting the truck to swivel under the car.

By this method the advantages of a maximum traction truck are gained without recourse to the bearing plates at the end of the bolster to carry the weight of the car body, the main advantage being that there is very much less friction in curving encountered where the main weight of car body is carried by the king pin and swivel plates at the center on which the truck swivels, than when the weight is carried on side bearing plates at a distance from this center. The location and relative stiffness of the springs can be so varied as to alter the percentage of weight carried on the large wheels from 50 per cent to 80 per cent as desired.

The second type of maximum traction truck is shown in Fig. 5 which is a half section and side elevation of the No. 14 D truck. This truck is constructed on the same general lines as the Peckham No. 14 A truck, the swinging bolster being exactly of the same construction. The large wheels may be 30 ins. or 33 ins. in diameter, as preferred, and the smaller ones about 20 ins. in diameter. The motors in this truck are suspended in the same way as in the No. 14 B truck, that is, outside of the axles. The brakes are arranged so as to apply to each wheel an amount of power in proportion to its traction.

In the No. 14 C the amount of the weight of the car body carried upon the roller bearing supported by the half elliptic spring is regulated by adjustable bearings or pockets for the elliptics which can be raised or lowered as desired, to increase or diminish the weight of the car body upon the spring supported roller. In the No. 14 D in which the motor is hung outside of the axle of the large pair of wheels, the desired amount of traction is secured on the small wheels by a spring supported screw device which is attached to a cross sill of the car. Beneath the spring is a roller that comes in contact with and is supported by a plate secured to the end cross bar of the truck frame.

Fig. 6 illustrates the No. 15 Peckham double truck. As will be seen, it is very similar to the No. 14 A truck; it is also triple cushioned, and it is made extra strong, the side frames being larger, the pedestals heavier, and the springs more powerful to sustain the added weight which will be thrown upon them in the service for which this truck is designed. The two sets of bars composing the middle of the side frame are also placed further apart to permit of the swinging of a nest of half elliptic springs between them. The bolster is built up in truss form of two flat bars of a thickness and width suitable for the car bodies to be carried. These bars are carried by the adjustable posts. Secured to the top bar of the bolster are the regular King side bearing springs to provide for a slight rocking motion of the car body. The bolster is supported at each end on one or more half elliptic springs, depending on the weight of the car body to be carried. The engraving (Fig. 6) shows it supported on two such springs. The ends of these springs are carried in universal links, which permit of a motion both longitudinal and transversal with the axis of the truck, thus permitting the span of the springs to increase as the load comes on them, and at the same time acting as links providing for the transverse swinging of the truck bolster.

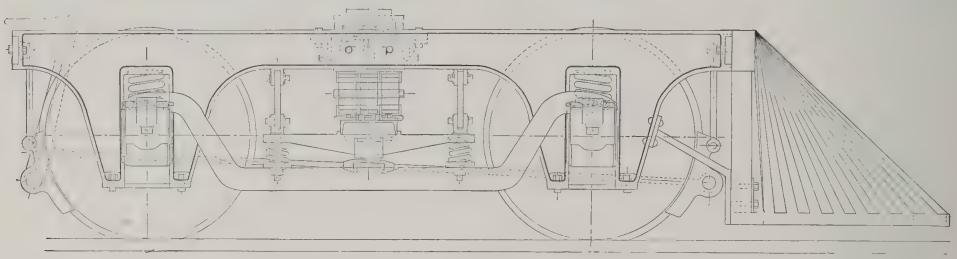


FIG. 7.—NO. 17 TRUCK FOR ELECTRIC LOCOMOTIVES AND HEAVY ELECTRIC RAILWAY SERVICE.

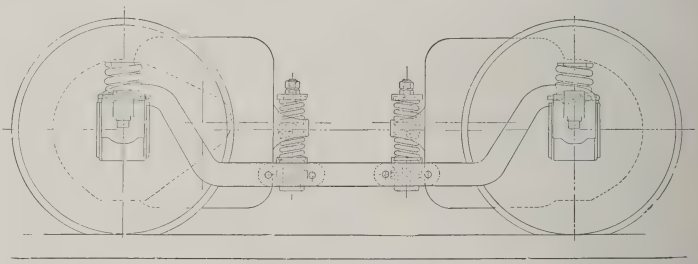
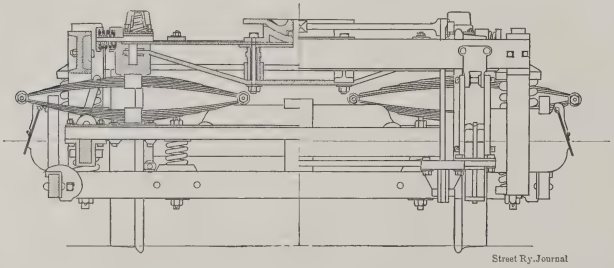


FIG. 8.—NO. 17 TRUCK WITH SIDE FRAME REMOVED TO PROVIDE ACCESS TO MOTORS.



Street Ry. Journal

FIG. 9.—HALF CROSS SECTION AND END ELEVATION OF NO. 17 TRUCK.

The top bolster is guided between the upper bars shown to prevent motion in a direction longitudinal with the car body. These guides serve to transfer the draft of the motors from the trucks to the car body. The location of the half elliptic springs between the bars of the side frames permits the drawing down of the bolster to the narrowest permissible width, thus shortening the wheel base of the truck. This location of the elliptic springs also imparts to them the properties of an equalizer, permitting any of the wheels to rise independently of the car body and supplementing in this direction the action of the yoke springs located directly over the journal boxes. The motors are supported on the transoms. These transoms are rigidly supported to the side frames of the truck and aid in keeping them in line. The brake rigging is very similar to that in the No. 14 A truck. The weight of these trucks is 6600 lbs. each. The total weight of two trucks and four G. E. 1000 motors, making a car equipment is 22,000 lbs.

Figs. 7, 8, and 9 show the No. 17 double truck of the Peckham Truck Company, designed for the heaviest trunk line service. In this truck an equalizer bar is used, hung directly on the boxes, but in other respects there are many divergencies from the standard steam railroad truck. The weight of the car body is carried to the wheels through the cast steel wheel pieces or side frames, while the weight of the motors is carried on the arch, or equalizer bars, independently of the side frames. These arch bars rest directly upon

the boxes. Swung by four links from the side frames, are the equalizing bars supported by the spiral springs. Secured to the center of the equalizer is the spring plank upon each end of which are located the nests of elliptic springs which carry the truck bolster. This bolster is built up in a similar manner to that employed on the No. 14, but of much heavier parts. It is composed of a channel top member stiffened by an under truss rod and adjustable posts.

King side bearing springs are provided to govern the rocking motion of the car body. There are also provided buffer springs, on each end of the bolster to prevent a too free swinging on running into curves at high speed. The usual yoke springs directly over the journal boxes are also provided, thus making a triple spring support for the bolster, insuring ease and smoothness of riding. The brake rigging supplied with this truck is of the standard double, upright lever type which is designed to give a very powerful leverage. It is fitted with flat beams and M. C. B. shoe heads.

The side frames of this (No. 17) truck are constructed in one piece of low carbon cast steel, no rivets or bolts being used in its construction. It is of I beam shape and arched in the center so as to secure the greatest possible strength with the least weight of metal.

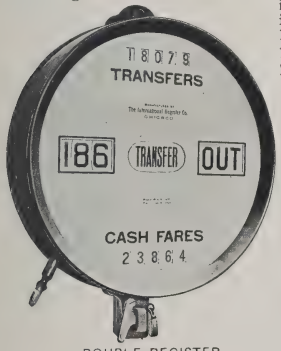
As will be seen, the inspection of the motors is very easily secured. All that is necessary is to remove the four nuts on the bolts passing through the four compression springs which connect the spring plank with the equalizer cross members. The car body with the side frame and truck bolster can then be jacked up, while the motors, wheels, and equalizer bars, as shown in Fig. 6, are run out from under the car. This point of ready motor inspection is one upon which too much emphasis cannot be laid, and is one of the chief points aimed at in the design of this truck. The weight of a car equipment with four motors would be as follows:

Two trucks at 10,000 lbs. each	20,000 lbs.
Four 2000 motors at 4500 lbs. each . . .	18,000 "
Total	38000 lbs.

A New Double Register.

There seems to be a growing tendency of late, especially among street railway companies using a large proportion of transfers, to use a register keeping separate records of cash fares and transfers, or tickets. The machine here illustrated is the latest of this kind and presents some novel features. The trip register shows at all times the total number of fares taken during the trip, thus avoiding the necessity of adding the readings of two trip registers together in checking up a car, and also the unnecessary complication of the machine.

The whole efficiency of a double register depends on the difficulty of ringing the wrong side without detection. If the conductor is not caught in the act of taking a transfer and ringing a cash fare, it will be very hard to detect it afterwards. This feature has been made the most prominent part of this machine, the fare indicator being the largest of its kind,



DOUBLE REGISTER.

and the most prominently located in the center of the dial. The illustration shows the machine after a transfer has been rung. In ringing a cash fare, the word "Cash" appears in the center in place of "Transfer," the background changing from white to red. The lower totalizer records only the cash fares and the upper totalizer only the transfers, the totalizer figures being large enough to be read from any point in the car, thus avoiding the necessity of conductors having to push their way through a crowded car to get the statement.

The exclusive features claimed for this machine are that it has the largest totalizer and trip figures; totalizers that cannot be "beaten" even when the machine is open; a glass signature seal, which in connection with a solid drawn case and iron rim on the bed plate, offers an absolutely secure protection against improper access to the mechanism; a single blind which performs the double office of covering the trip figures during the operation of resetting and during the registration of a fare. The register is manufactured by the International Register Company.

Emergency Trolley Wire Splicer.

An emergency trolley wire splicer, to be all that its name implies, should offer a means of making a quick, durable, strong and effective splice in the trolley wire, and one, withal, which is inexpensive.

The Ohio Brass Company, in placing upon the market the novel form of splicer shown below, which has been designated as the Emergency, had all of these requirements well in mind, and from results which have already been obtained with those put into use, it would seem that this article embodies all the essentials necessary to fulfill the conditions named. Seamless brass tubing of a sufficiently heavy gage to insure the requisite strength and durability is used in making the splicer, which is constructed in two parts in duplicate of each other, joined together at the center by a

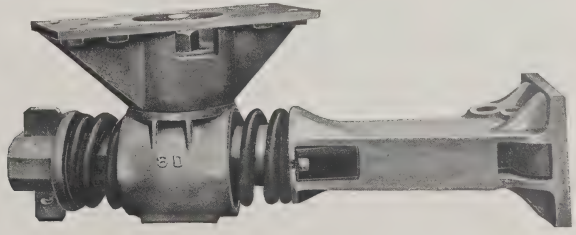
TROLLEY WIRE SPLICER.

hollow threaded coupling piece, in which is seated a coiled spiral spring; the office of the latter is to force the steel caps, which are two in number, and seated at either end of the coupling piece, into the tapered receptacles provided for them. These caps are made of cold rolled steel, slotted lengthwise on the two sides, and are serrated on the inside and tapered on the outside, the taper being such as to correspond to that of the recess made for them. The slots and serration are for the purpose of allowing the caps to compress tightly over the ends of the trolley wire and to secure a firm grasp upon it when the former are drawn into the receptacles in the splicer by the pull of the wire.

In making a splice the ends of the trolley wire are first rounded off slightly with a file, and after being entered into the splicer are forced inwards with enough pressure to seat the caps on them their full length, the normal strain of the wire being sufficient to keep them in their proper place. By the use of this splicer, a strong compact joint is made of a size but very little larger in diameter than that of the trolley wire itself, and one which in consequence will offer but little obstruction to the trolley wheel when passing over it. The electrical connection between the adjacent sections of the trolley wire is also a well nigh perfect one, and as a result but slight resistance is interposed in the line by the use of the splicer.

A New Type of Coupler.

The accompanying illustration represents the Van Dorn coupler No. 8 as applied to the electric motor cars now being built by the Jackson & Sharp Company for one of the underground railroad companies in London, England. This coupler is manufactured by the W. T. Van Dorn Company. This particular style coupler and attachments was especially designed by W. T. Van Dorn, general manager of the company, for the special class of cars to be used on the London underground road. Mr. Van Dorn claims that this type is by far the most compact arrangement for a coupler that has



AUTOMATIC COUPLER FOR UNDERGROUND CARS.

yet been placed upon the market. By making a very slight change, this type of coupler can also be applied to other classes of cars. For trail cars for the underground road of London the couplers are the same, but the mode of fastening to the car body is materially changed. The W. T. Van Dorn Company manufactures a number of different styles of couplers and attachments, its type of couplers for elevated roads being particularly successful. These couplers have been made the standard on the elevated roads of Chicago.

The Buffalo, Hamburg & Aurora Electric Railway Company, of Hamburg, N. Y., has secured right of way for its purposed electric line, 19 miles in length, to extend from Buffalo to Hamburg passing through Windom and Aurora. A branch line will run from Windom to East Aurora, passing Websters Corners and Orchard Park. It is stated that contracts for the construction of the road will be let soon and the road will be in operation in the spring.

Recent Types of Generators and Motors.

The improvements in design and in mechanical details which have been made in the street railway generators, motors and controllers of the Walker Company during the past year, as well as the development of constantly larger types for the heavier work of interurban, elevated railway and steam railroad service, make a brief description of the company's major apparatus as it exists to-day, one of interest and value to all charged with the responsibility of deciding upon purchase.

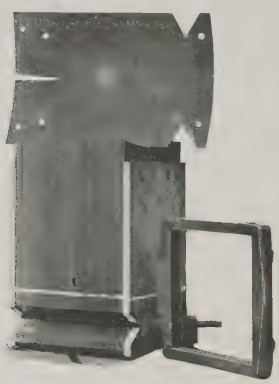


FIG. 1.

GENERATORS.

The Walker street railway generator utilizes the ring form of field magnet with inwardly pointed poles. The field frame is of cast iron, and the pole pieces consist of bunches of soft iron plates riveted together and cast welded into the frame. This makes an excellent magnetic circuit which requires very little power to excite to a high degree of intensity. The laminated construction of the pole pieces causes the magnetism to rapidly respond to changes of current in the field circuits, and as a consequence, the voltage follows the demand for current with great accuracy. An idea of this method of pole piece construction can be gained from Fig. 1, which shows a completed pole piece, a pole shoe and one of the component plates. The chalk mark defines the portion imbedded in the

FIG. 2.

field frame. By the use of a steel pole shoe, as shown in Fig. 1, the machine is enabled to run with a very short clearance, in fact, just enough for mechanical purposes, whereby the necessity for

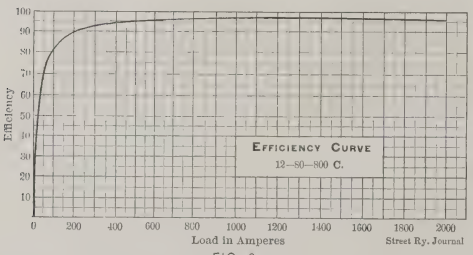


FIG. 3.

increasing the clearance to spread the flux over the armature is avoided, and the extra field current, that would be necessary under such circumstances, is saved.

The winding of the field coil is worthy of some description. The shunt coils are wound with scrupulous accuracy, with due regard to layers and turns, and are carefully insulated. The series coils are wound with conductor large enough to carry the full dynamo current. This requires very heavy ribbon as may be seen from Fig.

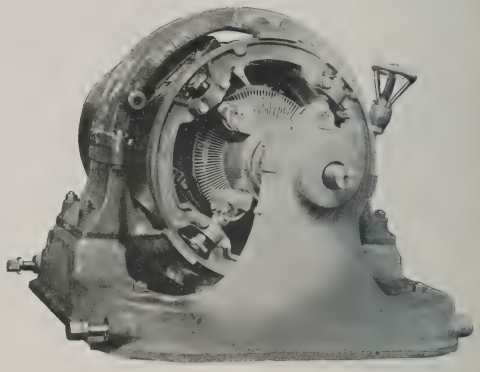
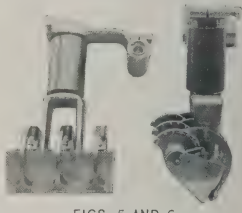


FIG. 4.

2, but it has the great advantage that the spools may then be series connected, and their turns being equal they will have equal magnetic strength. This is most important, for spools of unequal strength mean an unbalanced field, and an incurable sparking at one or more of the brushes. The use of smaller wire on the series coil, and connecting them in parallel, is responsible for much sparking due to unsymmetrical fields.

The frame is so built that the field magnet can be slid parallel to the shaft, so as to render the various parts of the machine readily accessible. Two men can easily do this without the aid of heavy hoisting apparatus, and it is a convenience that is very much appreciated.



FIGS. 5 AND 6.

The armature is as substantially made as the field. It is of the straight toothed type to enable the use of a formed coil—an enormous advantage both in insulation and repair. In the evolution of an armature coil, one or more copper ribbons are cut to a suitable length and bent double on edge while cold. It is worthy of note that none but the very best copper can stand so severe a bend as this, and thus it is that only copper of the highest malleability and conductivity finds its way into these armatures. The coils are then

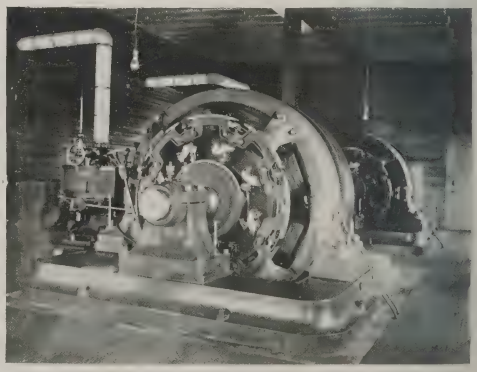


FIG. 7.

bent to their final shape and taped together. They are then fitted into their slots on the armature, which have previously been suitably insulated, and packed into place, so that each has plenty of room, but there is absolutely none to spare. The coils are alike in size, shape, weight and resistance in this armature, and thus it is

balanced both electrically and mechanically. This feature of electrical balance contributes largely to the sparkless running of generator machines, as well as the equal distribution of the work among the circuits of the armature. The completed winding is highly symmetrical and pleasing in appearance, and it is almost a pity that it should be covered with a canvas head, but this is absolutely necessary in order to exclude dirt and dust. The protection of the ends of

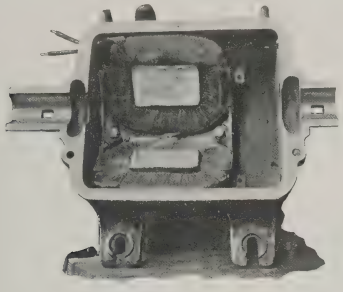


FIG. 8.

these windings is particularly worthy of note. They are far from the oily bearing, and rest securely in an iron pocket, which is an extension of the end disk of the core. This flared end disk has numerous advantages. It forms a continuous support for the ends of the coils so that they can be heavily banded down upon it, and it completely protects them from mechanical damage. Some manufacturers of large armatures—1000 k. w. capacity and upwards—are accustomed to ship them unwound and perform that part of their construction after they have been safely installed in place. The Walker armatures up to the largest sizes—1400 and 1600 k. w.—are shipped complete, and have always reached their destination in safety, which argues much for their durability and protection against mechanical damage.

All the parts of an armature coil are straight, and when they are assembled together, the ends form a concave surface, in which heavy bands secure the coils in place. This position is outside of the clearance, and therefore there is plenty of room to make the bands strong enough. Being clear of the pole pieces they do not generate eddy currents, which would tend to melt their soldered joints apart. The bands in the clearance, and on the edges thereof, are merely for the purpose of holding in place the canvas heads and wooden fillers in the tops of the armature slots. Band wires have always been looked upon with considerable suspicion because of their frequent failure in other armatures, but they have many undoubted advantages, and if they can be made secure they are much to be preferred. For instance, if bands were not used, the "T" shaped tooth would have to be employed, which would preclude the use of a formed coil, and would involve soldered joints in the winding, for the conductors would have to be introduced into

FIG. 10.

the slots from their ends. Moreover a "T" toothed armature is much more inclined to spark than a straight toothed one, and as each individual coil is separately secured, extensive repairs involve much labor.

The core plates of the Walker armature are set up under hydraulic pressure and thoroughly insulated from one another by a coat of asphaltic paint, which effectually interrupts eddy currents. The larger armatures are, of course, built up of segments, with joints staggered. The smaller ones are built of complete disks. Ventilating apertures are provided in the usual way and enable the machine to carry immense overloads. Fifty per cent overload is guaranteed for a short time to do no injury to the machine, and numerous instances are on record of generators carrying 100 per cent overload for several hours, without being injured.

The machine is supposed to get rid of its losses at full load by perfectly natural means, without the aid of extraneous ventilating devices. The high efficiency of these machines minimizes their losses to less than 5 per cent, as shown by the efficiency curve (Fig. 3), and a loss of 5 per cent can never overheat a machine that is built with reasonable care.

Very great care is given to the construction of the commutator. None but the very best cold rolled or drop forged copper is used. It is first assembled and then placed in a powerful clamp, where the insulation is thoroughly seasoned under high temperature and great pressure. The depth of the bars is liberal. It is a common thing for a machine to be guaranteed for a term of years, *with the exception of its commutator.* It is claimed for the Walker commutator that it will wear as long as the machine, and until the bars are completely worn out. There can be no danger of blow holes in the copper used in their construction, such as occur in cast bars, these necessitating frequent turning, which destroys a commutator much faster than the wear of the brushes.

The brush support consists of a ring suspended by a number of arms placed at points of equal magnetic potential on the field magnets, as may be seen in Fig. 4. The holders themselves are secured by clamps, and are of unique and ingenious construction. Views of the brush holders are shown in Figs. 5 and 6. A single finger holds the brush in place against the commutator, and the pressure of that

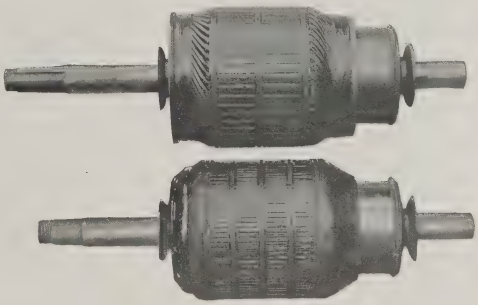


FIG. 9.

finger also holds the brush against the inclined surfaces of the holders. In fact, this finger drives the brush, like a wedge, in a triangular pocket, formed by the brush holder and the commutator. The holder is all one piece, from the carbon to the connecting stud, and, there being no joints, it does not overheat, nor does the current traverse the tension springs. The tension is easily and quickly varied by engaging a spring in the notches provided for that purpose.

The Walker generator is made in sizes from 25 to 1600 k. w. In Fig. 7 is shown one of the smallest sizes, and one of 1400 k. w. capacity, is now operating in Kansas City.

MOTORS.

The Walker motor is made in sizes from 25 to 200 h. p., which latter, it may be noted, is claimed to be the most powerful railway motor made to-day as a standard product. The principles of construction employed in the manufacture of the generator also enter into the construction of the motor, suitable modifications being made for its peculiar service. The casing is of cast steel, and the field coils are fastened in by means of castings, secured by screws, as shown in Fig. 8. The removal of four bolts frees four field coils. With one or two exceptions, the motors are of the four pole salient type, each pole carrying a coil. The bearings of the motor are entirely outside of the casing, and thus refuse lubricant falls on the ground and cannot enter the motor.

The armature is wound like a generator armature, the wave winding, of course, being employed. The coils are wound on the straight-out plan, and it would seem that such a method would

make an armature much too long for a street railway motor, but such is not the case. Careful designing has produced an armature no longer than its predecessor, which employed a system of coils passing over the ends. This may, perhaps, be better appreciated by consulting Fig. 9, which represents two 25 h. p. armatures, one of each type. The flange protection of the coil, while very useful in the generator, is of far greater value in a street railway motor, for it

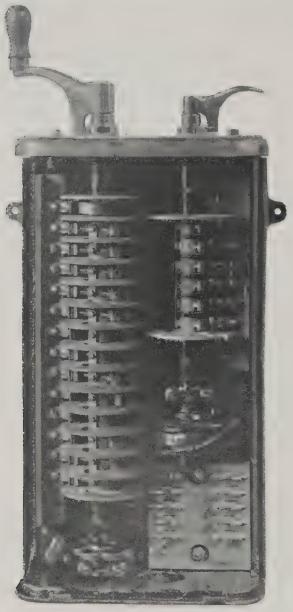


FIG. 11.

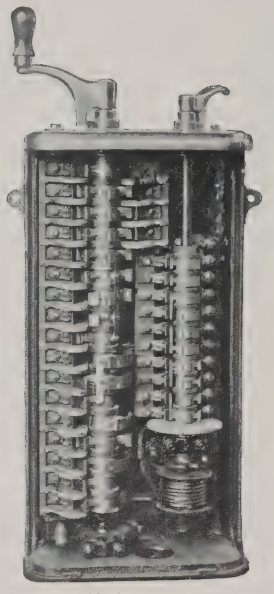


FIG. 12.

FIG 13

well resists the abuse to which the motors are subjected in the repair shop.

The commutator lugs of the Walker motors are extended until they equal the armature diameter. This has the effect of making the surfaces, adjacent to the brushes, of the same potential as the brushes themselves, so that when the latter flare, due to weak field, the armature head is not burnt full of holes, a frequent occurrence with some styles of motors.

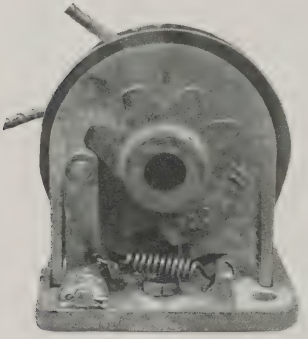


FIG. 14.

The brush holders of the motor are mounted on a vulcabeston board. The spring which feeds the brushes is very powerful, but it acts with so short a leverage on the brush finger that the tension of the latter is uniform throughout the life of the brush.

The peculiar suspension of the Walker motor is familiar to all street railway operators. It consists of a sleeve surrounding the car axle, from the ends of which project two arms which grasp the motor by the two sleeves which project from the casing shown in Fig. 8. Thus, either end of the motor is free to move up or down and the gears are rigidly held in mesh by the arms. One end of the motor is flexibly suspended from a cross bar in the usual way, and the other is supported on springs which are carried in cups cast in the sleeve already referred to. The ordinary way of suspending a railway motor is to rigidly connect one end to the car axle, thereby causing at least one-half of its weight to ride rigidly, and very much accentuate any pounding effect which the suspension of the truck or irregularities in the roadbed may produce.

FIG. 15.

The Walker Company has entered the field of heavy railroading only quite recently, but has already done excellent work. One of the roads which has been equipped is the Cleveland & Chagrin Falls Electric Railway, which does a general transportation business between the cities whose names it bears. One of its cars is shown in Fig. 10 which is comparable with steam railroad cars, and gives a very good idea of the class of railroad work which the company is prepared to handle. The power station of this road is shown in Fig. 7 and is also equipped with Walker apparatus.

CONTROLLERS.

Several of the controllers of the Walker Company are herewith illustrated, and are typical of others that it produces. The device for avoiding arcs is a system of series breaks on the last contact, which subdivide the arc into such small parts that each is harmless. Substantial vulcabeston fences prevent flashing from ring to ring on the cylinder. The smallest controller is the "D-2" which is intended for ordinary street car service (two 25 h. p. motors) and is shown in Fig. 11. The "K" (Fig. 12) is somewhat more elaborate and is intended for two 50 h. p. motors. In this controller the reversing cylinder is provided with several

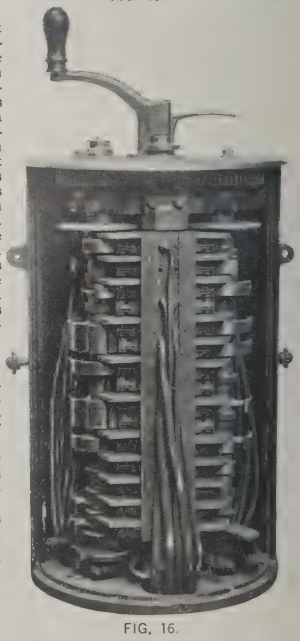


FIG. 16.

notches, which enable either motor to be cut out without opening the controller. The "D-2" and "K" controllers, as also the type "L," presently to be discussed, have a device which is undoubtedly a novelty and of great utility. It is an electrical interlocking device, and in simplicity is claimed to excel any mechanical equivalent. The motion of the reversing lever is accurately centered on its contacts by means of the usual roller and wheel, as shown in Fig. 14. If this roller is locked, the reversing lever is locked also. The arm on which this roller is mounted carries an extension shaped in the form of an eyelet, which, when the roller rests in a notch, coincides with a hole in the center of a solenoidal bobbin, which the controller current is made to traverse. A little plunger is placed in the solenoid, and when the latter carries current is drawn through the eyelet on the roller arm, thus securely locking it. It can be easily seen from this that the reversing lever cannot be manipulated while there is current in the motor circuit, but when the controller is on "off" the reversing lever is immediately released.

The "J-2" controller (Fig. 13) is designed for two 25 h. p. motors, and carries a system of contacts on its reversing spindle which turn the current from the motors, operating as dynamos, into a resistance. The back drag of the motors quickly brings them to rest.

For storage battery work, where large currents are used, the contact fingers require to be more liberal in dimensions, and for this purpose the fingers shown in Fig. 15 are employed. Besides giving a larger contact, the current is deflected out of the joints and springs of the finger by a flexible lead which connects the contact plate directly with a cap screw, securing the wire.

Fig. 16, depicts a locomotive controller known as type "L," which has been designed to meet the demand for heavy railroad work. It has two controlling cylinders which are run by gearing from the controlling handle, two revolutions of the handle making one of the gearing. The fingers and contact plates are adapted to

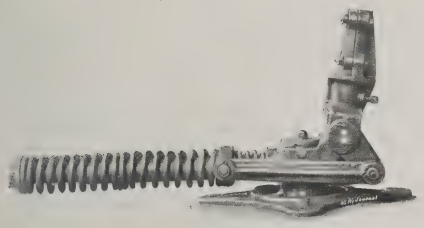


FIG. 17

to carry large currents. The reversing spindle cannot be seen on this photograph as it is in the rear and behind the two controlling spindles. The arcing is gotten rid of by an electro-magnetic switch in a separate box which is automatically cut into such circuits that if broken in the controller would cause an arc.

THE TROLLEY.

The omission of the latching device from its trolley stand converts the Walker trolley into one of a pivotal type, as is shown in Fig. 17. Its principles will be easily understood. The roller trolley is still manufactured, but a pivotal trolley is essential to meet the demands of the more conservative classes. The trolley stand designed by the Walker Company has two springs. One is a very powerful spring which is compressed as the pole is drawn downward, and gives the upward pressure on the wire. The other arrests the motion of the trolley, should it come off the wire, and has a lesser power.

The Walker Company has made a specialty of railroad work, to the exclusion of almost everything else. Its work in the lighting field, thus far, has been a mere modification of the machinery originally designed for railroad work. It has been customary to build railway generators in a much more rugged and substantial manner than those intended for lighting purposes and therefore a generator designed on railway lines, and wound for lighting, forms an exceptionally fine machine for such purposes.

Air Brakes During the Year.

The Standard Air-Brake Company, which is proud of the fact that it is the oldest street railway air brake company in the business, reports its sales during 1897 to have been greater than during any previous period of the same length. Starting as it did in 1891, the company has seen the remarkable changes which have occurred in street railway practice. E. J. Wessels, the managing director, has shown very keen foresight in preparing to meet problems which he felt were certain to arise as street railroading became more and more an exact science. With commendable prudence, several years ago he began the development of a motor compressor by means of which it would be possible to equip any electric car or train, without requiring any part of the car axle for mounting such apparatus. Since last convention the motor compressor has been installed in a large way on several roads. Various sizes are now furnished ranging from 1 h. p. to 5 h. p. The latest form of the compressor is illustrated in another connection.

The Standard Air-Brake Company's axle driven compressors have been making a phenomenal record and have given great satisfaction wherever installed. Since last convention the company has sold hundreds of these outfits, and repeat orders have come not only from the continent of Europe, but from Australia, where a large number of different types of standard outfits are in service. The single acting compressor type A furnishes sufficient air to supply enough pressure for heavy cars even though they are operated at slow speed. The duplex, double acting compressor, which was installed a number of years ago, is still in service, notably on the Buffalo Railway, where thirty outfits are completing their sixth year of hard service. Although the air braking apparatus has had to contend with slush, ice, dirt and changes in temperature, there has been little difficulty experienced in its operation. The interlocking controlling handle with which all the Standard outfits have been supplied since last convention, has proved a great success and in no instance has there been a failure to accomplish the end sought, i.e., the prevention of tampering with the apparatus on the part of careless or malicious parties. The company furnishes its own type of brake rigging and is prepared to equip a car with everything in the brake line down to the brake shoes. In fact, it prefers to do this so that all parts of the brake rigging may be properly adapted for use with the Standard system.

Within the past few months the company has greatly increased its capital stock and it is well known that all its purchases are made on a spot cash basis. By reason of its financial ability the company has always been able to buy to advantage and can therefore supply air brakes at reasonable prices. Associated with Managing Director Wessels are some of the most noted international bankers in the world, making a strong combination which gives railway managers a sure guarantee that whatever the company undertakes will be faithfully performed. E. H. Dewson, Jr., the company's chief engineer, is well known to the fraternity by his experience East and West. H. P. Merriam, one of the company's engineers, is at present in Europe supervising the installation of a large number of air brake equipments for which General Manager Wessels secured contracts. The company has been most fortunate in its selection of foreign representatives. They stand in the very front rank and include such names as Dick, Kerr & Company, Limited, London; Bergische Stahl-Industrie, Berlin, Germany; and Noyes Brothers, Sydney and Melbourne, Australia.

Test of a well Known Boiler.

The following is a brief extract of the data and results of a test on one of the 200 h. p. Cahall water tube boilers recently erected at Narragansett Mills, Fall River, Mass. This boiler was manufactured by the Cahall Sales Department. The boiler is one of the regular 200 h. p. size made by this company and set with an ordinary furnace and plain grates. The boiler contains 108 tubes 4 ins. outside diameter and 18 ft. in length. The diameter of the upper drum is 6 ft., 8 ins. and that of the internal flue 34 ins. The grate is 8 ft. wide and 5 ft. long with ½ in. bars and ½ in. air space. The area of the grate surface is 40 sq. ft. and of the water heating surface 2064 sq. ft., the ratio of the two being 1 to 51.6. There are 50 sq. ft. superheating surface at the average water line. The draught area through the flue is 6.3 sq. ft. or a trifle less than one-sixth of the grate surface and the space between the tubes of the draught area at the entrance is about twice this quantity. For the purpose of the test the boiler was supplied with feedwater by a small steam pump erected for the occasion, and the feed pipe was entirely disconnected from all other pipes. The water was supplied from the city service and fed cold. The test was of ten hours' duration, being started at 7:15 o'clock in the morning and ending at 5:15 P.M. The boiler was run continuously during this period and the test was made with a running start and finish. The kind of coal used was Pocohontas with 3.3 per cent moisture. The following are some of the details and results of the test: duration, ten hours; weight of dry coal consumed, 6507 lbs.; weight of ashes and clinkers, 391 lbs.; percentage of ashes and clinkers, 6 per cent; weight of water for the boiler, 64,722 lbs.; weight of water evaporated (corrected for superheating), 64,877 lbs. water evaporated per pound of dry coal (corrected for superheating), 9.97 lbs.; equivalent evaporation per pound of dry coal from and at 212 degs., 11.841 lbs.; equivalent evaporation per pound of combustible from and at 212 degs., 12.597 lbs.; efficiency based on combustible, 78.7 per cent.

The power developed on the test was 223.4 h. p. or about 10 per cent above the rated capacity of 200 h. p. This was obtained with an average draught of .14 in. water pressure which is below the maximum available draught. The boiler steamed freely during the run without undue exertion on the part of the firemen, and there was an entire absence of fluctuation in the water line as revealed in the gage glass.

THE Manchester (N. H.) Street Railway Company has recently added to its equipment a beautiful parlor car built at Amesbury, Mass., and destined for use by special parties. Gen. Charles Williams, the company's president, and N. H. Walker, its superintendent, are developing the Manchester system in every possible way and take great pride in the transformation which has been effected within the last two years.

The G. E. 57 Railway Motor.

In line with the G. E. 52 and G. E. 1000 railway motors, the General Electric Company announces a third, the G. E. 57. This is called forth by the success and popularity of the G. E. 1000, to which it is similar in design, but of greater capacity, while still as compact and simple. It is intended for heavy city and suburban work and is suitable for service of that class e ther as a two or four motor equipment.

The G. E. 57 has an output of 50 h. p. at 500 volts, rated according to standard General Electric basis a maximum rise of 75 degs. C.in the temperature of the windings after a run of one hour at rated load, the temperature of the surrounding air not exceeding 25 degs. C.

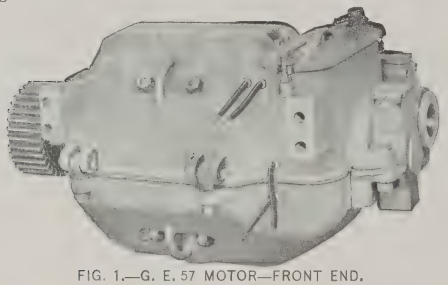


FIG. 1.—G. E. 57 MOTOR—FRONT END.

The frame is of similar construction to that of the G. E. 52 motor. It is of steel, cast in two bowl-shaped pieces, with a hand hole in the lower half directly beneath the commutator. This permits free access to the bottom of the motor for inspection or cleaning. The frame is both water and dustproof, the cover plate at the top half being provided with a felt gasket and clamping bolts as in the G. E. 1000 motor. The motor has four laminated poles, each having a separate coil held in place by the pole piece, which is bolted to the frame, the bolts projecting through the frame with nut and lock washer on the outside.

Knowing the amount of trouble that has been experienced by street railway companies from small motor bearings and their poor lubrication, the bearings of this motor have been designed with special reference to these points. The armature bearings are of the following dimensions: pinion end, 3¼ ins. × 8¾ ins.; commutator end, 2⅞ ins. × 6⅜ ins. They are designed and built on the "outboard" plan. The support for the upper half of the lining is cast as a part of the upper half of the frame, and between the inner end of the outboard bearing and the motor frame there is a large cored recess. This space is utilized for a combination thrust collar and oil guard, which is funnel shaped and extends through

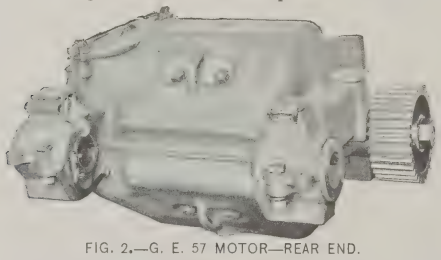


FIG. 2.—G. E. 57 MOTOR—REAR END.

the motor frame into the cored recess, where it acts as an oil guard, 8 ins. in diameter. The support for the lower half of the lining is a cap bolted to the upper half, but not enclosing the lower half of the oil guard. This allows free egress to the lubricant after it has passed through the bearing and makes it impossible for it to work through into the motor frame. Either oil or grease may be used in the bearings. The lower boxes, or oil wells, are fitted with felt wicks, which wipe the shaft through holes cut in the linings. For the armature bearings, there are two of these wicks on the pinion end and one on the commutator end. For each of the axle bearings there are two wicks.

The field coils are wound on cast spools thoroughly insulated with asbestos, mica and paper, and wound with copper ribbon insulated with asbestos. A covering of heavy duck, drawn together and sewed after the spool has been wound, forms a perfect mechanical protection for the winding. As in the G. E. 1000 motor, the upper and lower field connection is made on the outside of the motor, and all leads to the car are brought out on the front end. This has been found convenient in the car wiring and opening of the motors.

The armature is similar in construction to the G. E. 52 armature. It is small and compact, being 14 ins. in diameter, with a spread of 12 ins., and has thirty-three slots. It is ironclad, the core being built up of well annealed laminated disks, assembled directly on the armature shaft. In assembling the core, three sets of spacing blocks are used, providing three ventilating ducts. This form of construction is similar to that of the G. E. large generator armatures. There are thirty-three triple coils; each coil composed of three separate coils bound into a compact single unit. The separate coils are wound with either two or three turns per coil, as may be specified, the three turn winding being standard for ordinary service.

This method of winding is a distinct advantage in the matter of armature repairs, there being comparatively few coils to look after,

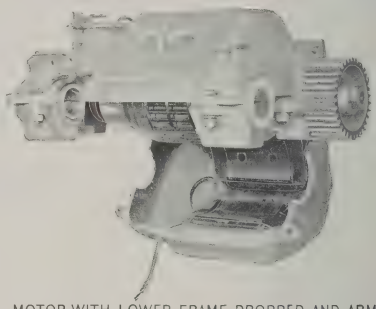


FIG. 3.—MOTOR WITH LOWER FRAME DROPPED AND ARMATURE IN POSITION.

while the construction admits of a substantial insulation of high quality, insuring immunity from repairs. A special effort has been made in the design of this motor to have the armature as light as possible without detracting from its electrical merit and efficiency, a light armature having small inertia presenting special advantages in starting and braking.

The standard gear ratio is 3.72, with a taper bore pinion having eighteen teeth, and a cast steel gear having sixty-seven teeth, and a face of 5 ins. A two motor equipment with this ratio will propel an 18 ton car about 26 miles per hour on level track. For heavy haulage work a lower speed gear ratio may be used, giving a slower speed and correspondingly increased tractive effort. A higher speed gear ratio may also be used, giving an increased speed and correspondingly decreased tractive effort.

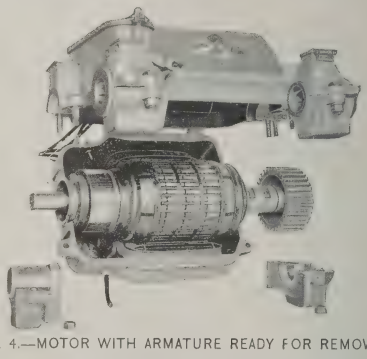


FIG. 4.—MOTOR WITH ARMATURE READY FOR REMOVAL.

The commutator is similar in construction to the G. E. 1000 and has ninety-nine segments. The segments are of hard drawn copper 2 ins. deep, allowing a wearing depth of 1 in. The brush holders are staggered to prevent the wearing of ridges in the commutator, and each holder contains two radial brushes 2¼ ins. long × 1¾ ins. wide × ⅝ in. thick.

The standard G. E. 57 motor is adapted to either the nose or the yoke suspension as in the G. E. 1000 or the G. E. 52 motor. The motor can be fitted for side bar suspension, but this necessitates a slight modification of the frame. The yoke suspension is recommended, as with this suspension the weight of the motor is carried on springs placed on the side frames of the car trucks. Lugs are cast on the upper half of the motor frame, to which the suspension bar is bolted. For inspection or repairs the lower half of the motor can be swung down into the pit without disturbing the upper half. When the motor is mounted on 33 in. wheels the clearance between the bottom of the motor and the top of the track rail is 3¼ ins. The clearance between the bottom of the gear case for 67 tooth axle gear and the top of the track rail is 4⅛ ins.

The G. E. 57 motor without gear or gear case weighs 2632 lbs. With 67 tooth gear and gear case the weight of the motor complete is 2972 lbs.

Origin of the "Mixed System" of Electric Traction in Europe.

Considerable discussion has recently taken place in Germany regarding the originator of the so-called mixed system of electric traction, whereby accumulators in the car are charged while it is in connection with the trolley line outside a city, and discharged within the city limits where the trolley line is not allowed. As this system has been used with apparent success in Dresden and Hanover, and has also been adopted for Berlin, the question as to who first publicly suggested this arrangement has naturally excited interest.

Dr. Sieg, in a paper on "Accumulator Railways," read in Cologne last February, mentioned that in the early days of electric traction the Union Electricitäts-Gesellschaft, the German representative of the General Electric Company asked his company if it could furnish light accumulators to be charged from the trolley wire outside the town. At that time the accumulator company was unable to fulfill this demand.

In the last yearly financial statement issued by O. L. Kummer & Company, of Dresden, they refer to themselves as the originators of the mixed system. In its issue of June 6, 1897, the *Electrotechnischer Anzeiger* editorially asks who is the inventor of the mixed accumulator system, and after referring to Dr. Sieg's paper and the statement of O. L. Kummer & Company, says: "The system is important enough for the name of the inventor to be handed down to posterity."

In answer to this the Patent Department of the Union Electricitäts-Gesellschaft wrote, June 21, to the *Electrotechnischer Anzeiger* as follows:

"The proposition for the introduction of the so-called mixed system was first made by J. L. Huber and Louis J. Magee, director of the Union Electricitäts-Gesellschaft (at that time representing the Thomson-Houston interests in Hamburg) in 1891. In the same year patents were taken out in various countries by Messrs. Huber and Magee for a switch arrangement, and in the introductory description of the invention the principle of the mixed system in question was distinctly described. We give below an exact copy of this paragraph of the patent application:

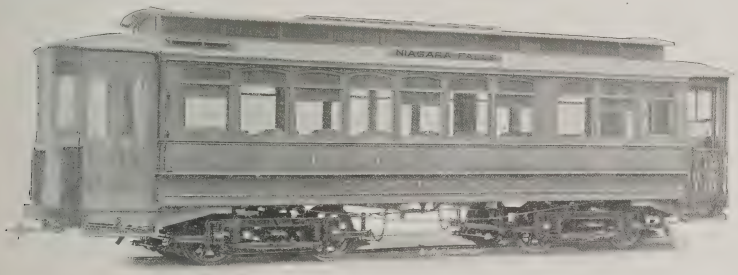
"This method of electric traction can be applied in all cases in which on some parts of the road, be it rail or waterway, but especially street railways, a direct current supply conducted by overhead or underground conductors is permissible whilst on the other parts of the road the same is not permissible. The method is as follows: the above mentioned direct current supply charges the accumulators (which can also be used as regulators) which are carried in the car, or other vehicle, and then uses the current thus stored up on those parts of the road on which direct current supply cannot be obtained. To effect this the accumulators referred to as being carried on the car, are, on the one hand, so connected by a switch that they can be switched in groups, parallel or in series; and on the other hand, the said accumulators are connected in such a manner by a second switch with the electric motor and a contact arrangement for the direct current supply from overhead or underground conductors, that the said electric motor driving the vehicle can be connected with the accumulators only or with the contact arrangement for the direct current supply. In the latter case the current from the generating station is partly carried to the accumulators which are switched preferably, parallel to the motor."

The *Electrotechnischer Anzeiger* closed the discussion, so far as it was concerned, July 4, 1897, by saying: "It appears to have been proved that the idea of the mixed accumulator system was first given to the world by J. L. Huber and Louis J. Magee and that O. L. Kummer & Company, or rather their chief engineer, Mr. Fischinger, the Accumulatoren-Fabrik in Berlin-Hagen, and Director Kruger, of Hanover, have the equal merit of having applied and perfected the system."

Brill Cars in Buffalo and Vicinity.

One of the most interesting features of a visit of a street railway manager or engineer to the city of Buffalo or to Niagara Falls is the opportunity afforded of inspecting the rolling stock of the different lines and of studying the results secured by cars of various patterns. The Niagara River region affords an excellent opportunity for this as it possesses good examples of a large city system, interurban systems and lines built for visiting scenic resorts. The rolling stock therefore varies in character, with the service and conditions presented. As stated elsewhere, a discussion of the cars in use in this territory is practically a discussion of the Brill cars in the territory, so generally are the cars of that manufacture used there. As the companies are not members of one system, but are fourteen in number each operating independent lines, it is the best evidence that could be adduced to the high character of construction which the J. G. Brill Company employs in its cars.

INTERIOR OF CLOSED CAR—NIAGARA FALLS & LEWISTON RAILWAY.



CLOSED CAR WITH SMOKING COMPARTMENT—BUFFALO & NIAGARA FALLS RAILWAY.

On page 607 of this issue views are given of seven types of cars used in Buffalo and Niagara Falls. On this and the following pages further engravings are given of the cars supplied by the Brill Company, from which an excellent idea can be obtained of the class of cars in use.

The largest contract received from this territory by the J. G. Brill Company was naturally from the largest road and consisted of an order placed about a year ago for 100 cars, seventy of which were closed cars, mounted on Eureka maximum traction pivotal trucks and thirty open cars of the nine bench pattern with enclosed ends. The former is shown on page 607. The car is 27 ft. long over end panels, 7 ft. 6ins. wide at belt rail and is finished inside in the Brill palace No. 2 style of solid cherry, with decorated veneer ceilings, spring cane seats covered with carpet, and cherry slat backs. The car is also fitted with the Brill patented portable vestibules which are used extensively on the Buffalo Railway. The nine seat open car referred to is illustrated on page 692. This was one of the first

TWELVE BENCH OPEN CAR—LEWISTON & YOUNGSTOWN RAILWAY

cars built having the Brill improved round corner seat end panels with curtains extending from the letter board to the sill. Since its introduction this improvement has met with great favor. The car has bronze metal trimmings, entrance guards, folding steps, gates and angle iron bumpers, which latter feature is also included in the

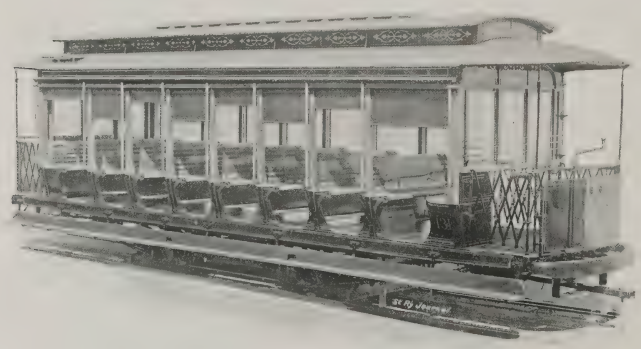
CLOSED CAR—NIAGARA FALLS & LEWISTON RAILWAY.

closed cars. All the cars are equipped with Dunning's patented drawbar and socket and Dunning's patented sand box.

The total equipment of cars and trucks on the line of the Buffalo & Niagara Falls Electric Railway, operating between Buffalo and Niagara Falls, is also of Brill manufacture. The exclusively passenger car used is shown on page 691 and the combination passenger and baggage car on page 607. The former is divided into two compartments, the smaller compartment arranged for smokers and a seating capacity for twelve passengers. The cars are 28 ft. long over end panels, 8 ft. 5 ins. wide at belt rail, are provided with transverse seats, spring upholstered, covered with cane and have reversible backs. The interior of the car is finished throughout in Palace No. 2 style. All these cars are mounted on the Brill No. 27 "Perfect passenger truck." It was on the line of this railway that the Brill Company first tried the No. 27 truck and with the remarkable conditions of operation this No. 27 truck has made a phenomenal record, never having been derailed through any cause.

The Buffalo, Bellevue & Lancaster Railway Company has some cars of the same general description as the 27 ft. cars on the line of the Buffalo Railway, which are described above. The company has also some very similar to those of the Buffalo & Niagara Falls Electric Railway Company except without vestibule ends. These cars are mounted on Eureka maximum traction trucks.

The Niagara Falls & Lewiston Railway Company, like the Buffalo & Niagara Falls Electric Railway Company, has its total equipment of Brill cars and trucks. The first installment of cars put in use were of the open excursion pattern, having twelve



NINE BENCH OPEN CAR—BUFFALO RAILWAY.

benches and with a seating capacity for sixty passengers. This type is illustrated at the center of the group on page 607. The cars have malleable iron seat end panels, stationary back seats and two sets of curtains, spring roller curtains to act in the capacity of sun shades, and storm curtains to roll up by hand outside of the side posts.

The closed cars operated on the Niagara Falls & Lewiston Railroad are shown on this page. They are almost duplicates of the closed cars in operation on the Buffalo & Niagara Falls road, having vestibule ends with doors, No. 2 palace finish and are provided with tables between the seats for picnic purposes. The car also has an ice chest or refrigerator at one corner. Like the other equipment of the Niagara Falls & Lewiston road, they are mounted on Brill Eureka maximum traction trucks.

The Lewiston & Youngstown Frontier Railway Company has quite a collection of different patterns of Brill cars. The first put in use were eight seat open cars, with enclosed ends and round corner seats and panels, and were mounted on Eureka maximum traction trucks. The same style of finish was used in these open cars as in the open cars for the Buffalo Railway. The closed car first put in operation by the Lewiston & Youngstown Railway Company has an 18 ft. car body with vestibule and platform at one end only, the controller and brake apparatus being mounted in the baggage compartment at the other end, as shown on page 607. The interior finish is palace No. 2, and the cars are all mounted on Eureka maximum traction trucks. The Lewiston & Youngstown Frontier Railway also purchased this year a twelve

200 H. P. ELECTRIC LOCOMOTIVE—LEWISTON & YOUNGSTOWN RAILWAY.

seat car It is of the same general description as those operated by the Niagara Falls & Lewiston Railroad, illustrated on this page, and is also mounted on Eureka maximum traction pivotal trucks. The company's freight locomotive, of which a description appears on page 608, is also of Brill manufacture, and is illustrated herewith. It is mounted on a Brill No. 21 E truck.

The Buffalo, Kenmore & Tonawanda Railway Company is another corporation which has purchased its total equipment from the Brill Company. These cars have 22 ft. bodies. The Niagara Falls & Suspension Bridge Railway has also Brill cars and trucks.

The last company organized, of those whose lines are built, the Buffalo Traction Company, has also placed an order for fifty cars with the Brill Company. These cars are 21 ft. long in body and are finished generally after the style used in the cars of the Buffalo Railway, that is, palace No. 2 finish, decorated veneer ceilings, spring cane seats covered with carpet, and cherry slat backs.

Large Fire in Washington.

During last month a disastrous fire occurred in the cable power station, at Pennsylvania Avenue and Thirteenth Street, of the Capital Traction Company, of Washington, D. C. The building, which was some six stories in height and contained a number of offices, was destroyed. The line operated from this station is the Pennsylvania Avenue line, extending to Georgetown, and the most important in the city. The directors of the company held a meeting immediately after the fire and voted to replace the cable with the underground electric system. In the meantime the line is being operated by horses.

A New Side Railing.

In the accompanying illustrations is shown the "Hanf automatic side railing" for open electric railway cars, which has been recently patented. Fig. 1 shows the railing as it appears when lowered, and Fig. 2 shows the method of lowering and raising the

FIG. 1.—SIDE RAILING IN POSITION.

FIG. 2.—RAISING SIDE RAILING.

rail. From these engravings it will be seen that the railing is fastened stationary to the rear uprights at each end of the car and has two joints equidistant from each end. The length of the joints depends upon the head room distance needed. The railing is held in place, when raised, by a spring at the top of the end post. When the railing is used on the outside of the car the grab handles are used for guiding it, and when used on the inside two guide rods are fastened to the inside of the upright side posts, the side railing running up and down between them. The device is handled by the conductor only, and he does not require the aid of the motorman in raising or lowering. This device has been used on the cars of the Hestonville, Mantua & Fairmount Passenger Railway Company, of Philadelphia, for some time, and seems to be giving entire satisfaction. A manufacturing company is being formed for the purpose of placing this device upon the market.

How to Heat Street Railway Cars.

The question as to the best method of heating street railway cars is a perplexing one, yet one which should be settled before the cold weather sets in. If the subject is put off till winter comes, passengers are often put to unnecessary inconvenience without any material saving in expense. Of course, the initial cost of a system and the expense of maintaining and operating it must be carefully considered. In these respects stoves are, no doubt, cheaper than electric heaters, but there are other important features besides the first cost, maintenance, etc., that are important factors. An illustration on this page shows the Columbia heater, which is manufactured by the McGuire Manufacturing Company. The manufacturers of this heater have this to say regarding heaters in general:

"The question of convenience is important. If stoves are used it should not be necessary to remove a section of the seat in order to put the stove in place. It spoils the seat to cut it. The stove should be convenient and easy of access. The grate and fire pot should be so constructed that they may be removable without tearing the stove to pieces. These parts burn out and need replenishing in the course of time. The ordinary stove at its best is a dirty and unsightly thing. It requires fire to be rekindled every morning and replenished several times during the day. The handling of coal and ashes while the car is in service, fills the eyes and clothes of the passengers with dust and dirt. This is certainly very objectionable.

"The stove should be large enough to heat the largest car in the coldest weather without replenishing the fuel. The tendency towards the use of larger cars necessitates the use of larger heaters. They should have sufficient magazine and ash capacity to last all day and to keep fire over night if necessary. Besides this, it is a well known fact that a large heater is more economical than a small one, because it radiates a greater percentage of its heat and requires less fuel to give a certain amount of warmth.

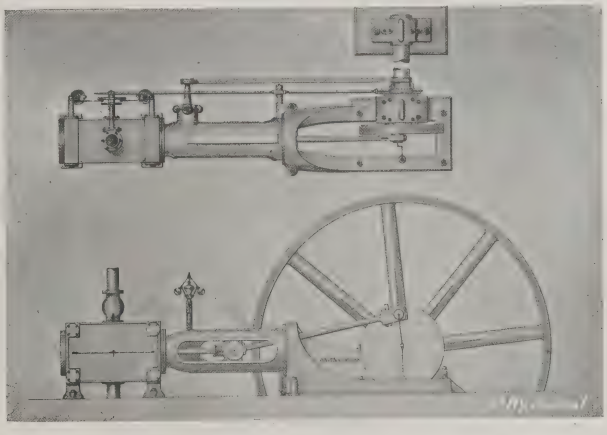
"A heater should by all means be artistic and ornamental. The average citizen has cultivated ideas on the subject of stove designs and architecture. He may have something artistic of his own at home. If he finds a dirty, ugly stove on entering an electric car—that embodiment of modern genius and development—his idea of progress and harmony, 'of the eternal fitness of things,' is rudely disturbed. The heater should not only be large, convenient, economical, clean and ornamental, it must be correct in design and handsome in appearance; a veritable example of high art in stove building."

The manufacturers of the "Columbia" heater claim that this heater meets all these requirements, and that its value has been demonstrated on a number of roads.

COLUMBIA HEATER.

A New Girder Frame Engine.

The Bates Machine Company believing that public opinion is largely in favor of a heavy duty girder frame engine, is building a Corliss of this class for direct connected work. The direct connected method of operating generators demands a heavier and more substantially built engine than the old system of belting from the line shaft or even direct from the engine. It is necessary in the direct connected type that the bearings throughout should be heavier, and realizing this the Bates Machine Company has brought out the type illustrated above, making it one of the heaviest and most substantially constructed girder frames on the market.

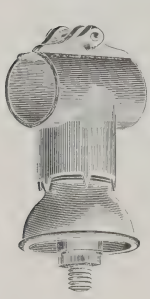


GIRDER FRAME ENGINE.

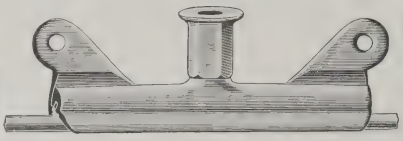
Hangers for Overhead Work.

The accompanying illustrations include three new hangers that have recently been placed upon the market by the Central Electric Company. These are the bracket arm hanger, the barn and bridge hanger and the mining hanger. The bracket hanger is arranged so that it will fit many types of bracket arms, as well as special angle iron brackets.

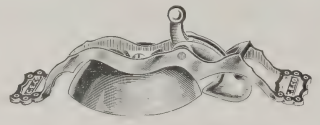
The barn and bridge hanger and the mining hangers are very similar, the mining hanger being made especially for places where the ceiling or the roof of the mine is very close to the ground or floor. This hanger is made very short, so that the wire is held very close to the ceiling. With most mining and bridge hangers, it is necessary when fastening the hanger to the wall or structure, if this happens to be masonry, coal or other similar substance, to drill holes into the masonry or coal and plug them so that the lag screws will thread into the wooden plugs, driven into the holes. If this is not done it has been found necessary to fasten timbers or planks to the roof of the mine, to which the hangers could be fastened. With the Central mining or bridge hangers, this is unnecessary, as the hanger is provided, when specified, with a special device which holds it rigidly in place, by simply drilling holes into the roof of the mine, the same as would be done in placing the hanger on wood. The devices used for holding the hangers to the ceiling are very simple, but fill a long felt want. These devices are termed the "Central" mining hanger clincher bolts.



PIPE BRACKET HANGER.

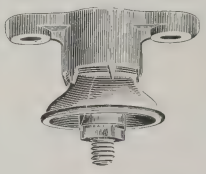


STRAIN EAR.



SIGNAL BELL.

MINING HANGER.



BARN AND BRIDGE HANGER.

The Central Electric Company has also adopted another appliance which is claimed to be entirely new. This can be applied to all of the "Central" overhead materials of the West End type. This device is a very small affair which fits the stud just above the ear, and absolutely prohibits the ear from working loose from the stud. Various other methods have been employed to overcome this difficulty, one of which the Central Electric Company has employed in all of its West End hangers for some time, viz., the self locking features of the cap, but this method of locking the stud to the ear is something radically new and it is claimed has never before been used in railway overhead materials.

The Central Electric Company is constantly engaged in developing new principles and improving upon old ideas. All of its materials are of its own special design, which have been originated in its own engineering department. Those who use these overhead products, speak in the highest terms of the "Central" self locking hangers, and the "Central" clincher ears.

The Central Electric Company, in addition to its new line of hangers, has just placed upon the market a mechanical strain ear which is very desirable on account of its strength and quick application. It is impossible to move it on the wire after it has been placed in position. These mechanical strain ears are made for No. 0, No. 00, or figure 8 wire. The company has also just brought out a line of conductor bells which are nicely finished, and are furnished complete with 6 in. gongs. These are used underneath the hoods of street railway and other cars or coaches.

The new power station of the New Orleans Traction Company is now about completed, and most of the track construction in the equipment of the lines of the company with electric power has been finished. Mr. Willard, who has had charge of this work, has consequently resigned to accept the position of assistant engineer with the General Electric Company, at Schenectady, N. Y. Messrs. Smith and Johhason have severed their connections with the company. Under the management of C. D. Wyman, the company's business has been growing rapidly during the past year, and the service constantly improving.

It is stated that a petition has been presented to the County Commissioners, at Hamilton, O., asking that the right of way be granted to the Hamilton, Venice & Okeana Street Railway Company for the construction of a single track line along Colerain pike.

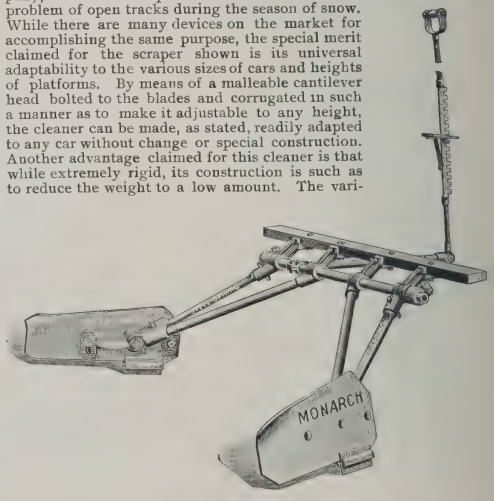
A Lifting Jack.

The accompanying engraving shows the Barrett lifting jack, No. 19, manufactured by the Duff Manufacturing Company. This jack has a number of improvements not found in the ordinary hydraulic jack for lifting lightly loaded and empty cars, etc., as it is more portable, more easily applied and less liable to derangement. The jack is staunch and tall and has a very high lift. It has a forged steel rack for reaching under car bodies and lifting them above obstructions, and is also provided with a side lug with which it can grapple low set loads with equal facility. It lifts and lowers on downward stroke of the lever only and the direction can be quickly reversed at the will of the operator. The height of the jack when the rack is down is 28 ins., rise of lifting rack 17½ ins., size of forged steel rack 2 ins. × 1¾ ins., weight 90 lbs. The Duff Manufacturing Company also manufactures a large number of different types of automatic jacks for street railway work.

AUTOMATIC LOWERING JACK.

A New Track Cleaner.

The accompanying illustration shows the Monarch track cleaner which is made by the Monarch Stove & Manufacturing Company, and which is presented as a solution to the problem of open tracks during the season of snow. While there are many devices on the market for accomplishing the same purpose, the special merit claimed for the scraper shown is its universal adaptability to the various sizes of cars and heights of platforms. By means of a malleable cantilever head bolted to the blades and corrugated in such a manner as to make it adjustable to any height, the cleaner can be made, as stated, readily adapted to any car without change or special construction. Another advantage claimed for this cleaner is that while extremely rigid, its construction is such as to reduce the weight to a low amount. The various crossbars and compression braces are made of gas pipe, which is extremely strong and very light. All the fittings are of malleable iron of the best quality, and the workmanship is of a very high order.



TRACK CLEANER.

On the heel of the blade is an adjustable shoe, which scrapes the track, and as it becomes worn can be readily replaced at a trifling expense.

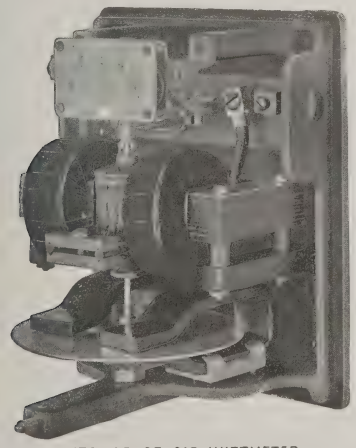
The cleaner will be on exhibition at the Niagara Convention in charge of representatives of the manufacturers, one of whom is the inventor of the device. The Monarch Company is having a very large line of inquiries for this scraper, and many roads are considering its adoption.

Recording Wattmeters for Street Cars.

The adoption of more careful and accurate methods in street railway work is typical of the universal struggle for economy. The advantage of exact measurement of station output has long been recognized, and the requisite meters provided, but to record the ever

EXTERIOR OF CAR WATTMETER.

varying energy used on a car traveling over all conditions of road, involves difficulties almost unsurmountable. In the Thomson recording wattmeter for street railway service, however, the General Electric Company claims to have overcome all the obstacles. The new meter which has been placed on the market after a number of years of experimental work, is intended for installation in the car, like a cash register. It records the actual energy used by the car. A few trials determine the proper energy consumption per car



INTERIOR OF CAR WATTMETER.

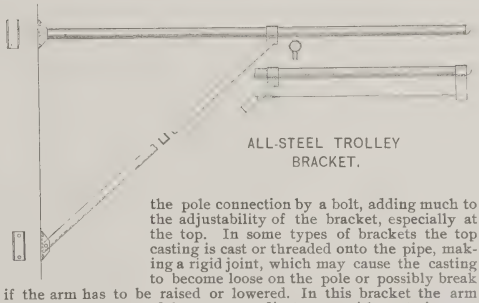
per trip under various conditions of track and traffic. Subsequent readings of the meter determine at once if energy is carelessly wasted, and thus serve as an effectual check on the motorman and condition of the motors.

Well authenticated data prove that meters on lighting circuits increase the lighting capacity of the station by nearly 30 per cent, that is, 30 per cent of the light used when the contract plan is followed, is generally wasted. Many railway managers agree that the average waste due to carelessness of the motorman, amounts to not less than 20 per cent of all the energy generated. The economy, therefore, which will be induced by the use of street car meters, will mean a saving of half the average waste or 10 per cent of the total energy generated. The profit from such economy is twofold. It saves, first, the cost of coal and water necessary to generate one-tenth of the total output of the station, and second, it increases the receipts by increasing the car capacity without enlarging the station, or in other words enables the station manager to operate 10 per cent more cars without increase in the station equipment.

The simple motor construction of the car meter, as shown in the accompanying illustration, is similar to that of the other forms of Thomson recording wattmeter, but new conditions imposed by the rough service have been met by the careful design of the rotating parts. Unavoidable vibration, due to rough tracks, demands a low drop in the armature in order that contacts may not be injured by sparking. High torque is also a requirement so that heavy brush pressure insuring perfect contact can be used. The sudden and wide variation of current requires a meter that will start quickly and slow down as soon as the current diminishes. The General Electric Company claims high accuracy for its new car meter and ability to withstand severe and continued use on the roughest tracks. The meter is now made for 500 volt circuits in sizes for 25 or 50 amps. with a liberal provision for overloading.

An All-Steel Trolley Bracket.

The bracket illustrated herewith is made of steel throughout. It is manufactured by the Young Lock Nut Company. The arm is 1½ in. steel pipe 7½ ft. long, while the brace is 1¾ in. steel channel 5½ ft. long. The pole connections are both made of steel and are fastened to the pole by ½ in. lag screws except at the top where a ½ in. bolt with washer is used. The brace and arm are joined to



ALL-STEEL TROLLEY BRACKET.

the pole connection by a bolt, adding much to the adjustability of the bracket, especially at the top. In some types of brackets the top casting is cast or threaded onto the pipe, making a rigid joint, which may cause the casting to become loose on the pole or possibly break if the arm has to be raised or lowered. In this bracket the arm turns on the bolt, and hence any adjustment neither strains nor loosens the pole connection. In place of the ordinary cast sleeve and set screw this design uses a clamp to join the brace to the arm. The clamp is of steel, open at the bottom as shown in cut, and washers give a full bearing between the legs of the clamp and flanges of channel; this clamp can be drawn absolutely tight by the ½ in. bolt.

This bracket can be made flexible by using a long clamp at the end of the arm, the top bolt being used to hold the clamp in position and the lower bolt to hold the wire which at the other end is attached to an eyebolt which in turn passes through a slotted hole in channel brace. It is claimed that this bracket is stronger than any other now sold not only because of the strength of the material, but by reason of the fact that the joints are all designed to get the best results from the material used.

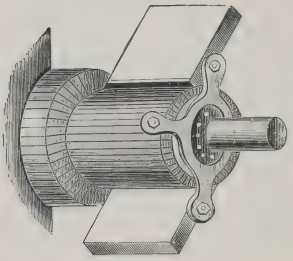
Trolley Wagon with Extension Platform and Tower.

The Trenton trolley wagon has been in general use for a number of years and seems to be giving perfect satisfaction wherever it is used. This wagon is built with an extension platform and tower, and is light, safe, strong and durable. Among the special features claimed for it are the following: all work can be done from the extended platform without interfering with the running of cars. The tower can be instantly set at any desired height. It can be easily operated by one man. It is not top heavy and is properly insulated. It has no overhang at rear. The wagon is low enough to be conveniently housed and is made to fit any gage, and having a platform gear it turns short. This wagon is fully provided with ample body space and lockers front and rear. The Trenton trolley wagon is not a collapsible wagon and is therefore free from the dangerous weakness sometimes found in wagons of that class. The wagon is manufactured by McCardell, West & Company.

THE Englewood & Chicago Electric Street Railway Company and the Calumet Electric Street Railway Company have issued orders to conductors to exercise their own discretion in allowing cyclists to carry their wheels on their cars. Only one fare is to be collected for wheel and rider.

A Self Lubricating Dynamo Brush.

The Le Valley vitæ dynamo brush, which is illustrated herewith, is manufactured by the Le Valley Vitæ Carbon Brush Company. This company employs the following method in the treatment of these brushes: it first extracts the gases from the carbon, leaving the pores of the carbon ready to receive a special treatment. The pores of the carbon are then filled by the company's patent process, making the carbon solid and uniform. After this treatment the carbon lubricates constantly and uniformly as it slowly wears away, preserving at all times an even, bright and polished surface.



VITÆ DYNAMO BRUSH.

Among the strong features claimed for this brush are the following: that its life is materially greater than that of any other brush used; that it is absolutely and positively a thorough self lubricator; that this brush when in use is 7 degs. to 10 degs. cooler than any other brush made; that the life of the commutator with the use of this brush is prolonged almost indefinitely; that it is a lower resistant brush and has greater conductivity than any other in use, insuring better contact and conveying the entire current without loss; that it wears smooth as velvet; never crumbles nor breaks and requires no attention as it constantly lubricates the commutator without gumming the segment tips

The manufacturers of this brush have received a number of strong testimonials from several of the leading street railway and electrical companies.

Substantial Suburban Construction.

The Suburban Electric Railroad, of Chicago, which was fully described in the September issue of the STREET RAILWAY JOURNAL, has been in operation for the past two months, and is an example of one of the finest and heaviest electric railways ever constructed in this country. The contractors for this entire system were Naugle, Holcomb & Company, and the contractors paid for the right of way

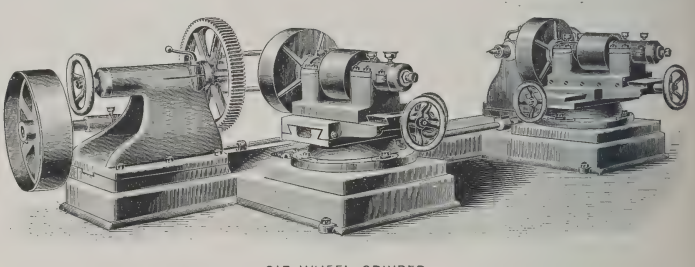
SECTION OF SUBURBAN RAILWAY DURING CONSTRUCTION.

themselves, furnishing all the material for the track, overhead work, etc., erecting all the buildings, furnishing all the machinery, and furnishing the entire equipment, taking in pay bonds and stock.

Naugle, Holcomb & Company built the entire road, and have operated it without having sold any of their bonds or stock, and their good judgment in undertaking this work under the conditions mentioned is illustrated by the success of the completed line. The patronage has exceeded expectations, and the excellent service and the good connections will continue to increase its popularity.

The roadbed and track are of heavier construction than those of many steam roads; 70 lb., 7 in., 60 ft. T rails are used and the line is paved throughout with cedar blocks. The cars are almost as heavy as the lighter coaches used on steam roads, and with the splendid track, which is fast being placed in a smooth condition, a very high rate of speed is made. The accompanying illustration gives a good idea of the kind of country that the main portion of the line passes through.

At the power house the contracting company installed a condensing system, the water being furnished from a deep well to a cemented pool holding condensing water sufficient for two months' use, as the water is used again and again by means of a cooling table capable of reducing the temperature of the condensing water from 30 degs. to 40 degs.



CAR WHEEL GRINDER.

Car Wheel Grinder.

The accompanying engraving shows a new type of car wheel grinder built by the Springfield Machine Company. As will be seen, the machine is designed to take the wheels after they have been removed from under the car, and the manufacturers claim that this is an essential of correct grinding in order to avoid any possibility of emery dust working into the motor or car bearings. The machine will grind wheels either on or off from the axles and one or two wheels at one time, and for the benefit of small corporations is also arranged with one emery wheel, making a cheaper machine.

The emery wheels or rims are held by a patent chuck which enables a very high speed with perfect safety. By these patent chucks the centrifugal strain is overcome and flying emery wheels are impossible. When desired, a journal with cone bushings is furnished and wheels may be ground off from the axle. The manufacturers claim for this machine, that by having tail stocks and wheel heads fastened to one bed, wheels may be ground perfectly round and that wheels ground in this manner will give far greater mileage and not become skidded so quickly, as when ground on their own bearings. The chuck spindles are 2¾ ins. in diameter with a bearing 10 ins. long; the boxes are lined with a special babbitt metal. The wheel heads are arranged with a cross and lateral feed, so that one operator can operate both wheels. The spindles in the tail stock are 3½ ins. in diameter. The floor space for the double end grinder is 12 ft. 7 ins. × 5 ft. 3 ins.; the weight of the machine is about 7000 lbs.

Cast Welded Joints.

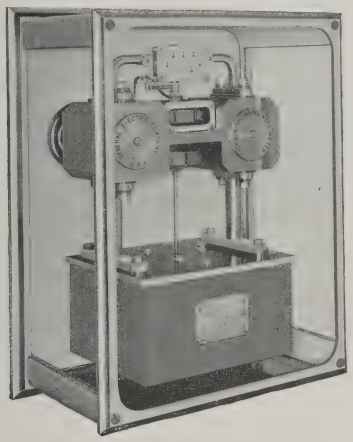
The American Improved Rail Joint Company has recently completed cast welding the joints on four lines of the Metropolitan Street Railway Company, of Kansas City, Mo. The portion of this work on Wyandotte Street was done in connection with the American Railway Construction Company. Nine inch, 103 lb. rails were laid upon concrete piers without ties, which with the cast welded joint insures a permanent roadway. This company is also at work in Chicago and St. Louis.

The American Improved Rail Joint Company is composed of a number of well known men in street railway circles. The president is A. S. Littlefield, of the American Railway Construction Company, who has represented the Johnson Company in the West for a number of years. The secretary and treasurer is D. J. Evans who was connected with the Baltimore & Ohio Railway Company in the motive power department for eight years, and afterwards with Ed. E. Ayer, the tie and pole contractor, and also for the last five years with the American Railway Construction Company. E. M. Fry, who has for ten years been actively engaged in street railway construction, having built many important Western lines, is general superintendent.

IT is stated that the Union Traction Company, Philadelphia, Pa., will extend its line now running to Glassport to Pollock, a distance of about 2 miles.

G 2 Astatic Recording Wattmeter.

The construction by the General Electric Company of a record ing wattmeter of sufficient capacity to measure and register the total output from the generators in central railway or lighting stations, met a demand, created by the new conditions of electric



ASTATIC RECORDING WATTMETER.

practice. The character of this demand may be gaged by the fact that a recording wattmeter which three years ago, would have been regarded as of enormous capacity is to-day considered small; meters of 10,000 amps. are now commonly called for, while inquiries have been made for sizes registering as high as 16,000 amps. Measurement of these heavy capacities precluded the use of any form of wound meter field, and the Thomson recording wattmeter had necessarily to be modified. Furthermore, the rapidly growing tendency to set the bus-bars closer together, and bring the switchboard into the least possible space has rendered it advisable that large meters of this character, where intended for boards of modern construction, should be astatic. While on the majority of switchboards an astatic wattmeter is not necessary, there exist cases in which the best metering results could not be obtained without one; and that total station output meters might be applicable alike to all switchboards whether within heavy protected fields or not, the G 2 meter has been designed and is manufactured in an absolutely astatic form.

In the G 2 meter, the field is a single straight bar of forged copper, above and below which are placed two armatures arranged astatically and having a common commutator. The damping device is also double and astatic—the polarities of the upper and lower group of damping magnets being opposite. The damping mechanism being enclosed within an iron shielding box, any stray leakage lines of an unbalancing character are prevented from entering. The G 2 meter is so independent of local or stray influences that it may be installed directly in front of the very heaviest busses without the introduction of any inaccuracy.

The entire meter is held in position upon the switchboard by two studs which form at once the electrical connections and the mechanical support of the instrument. These pass through the board and are bolted to the bus bar by binding nuts with large contact surfaces. The cover is of beveled glass set in a polished brass frame fastened to the board.

THE Texas Transportation Company, of San Antonio, Tex., has been incorporated by Otto Koehler, Otto Wahrmund and Oscar Bergstrom, to construct and operate a street railway for transportation of freight. Capital stock, $25,000.

A New Indemnity Company.

Another company has entered the street railway field and is competing for liability insurance covering street railway risks. The new concern is named the American Mutual Indemnity Company, of Scranton, Pa., and among its promoters are a number of wealthy bankers, coal operators and manufacturers of Scranton. It is claimed that the directory represents more wealth than any similar company in the United States. The concern will transact a general casualty insurance business.

The officers of the company are W. W. Watson, president; Elmer H. Lawall, vice-president; E. P. Kingsbury, treasurer; T. R. Brooks, secretary; F. W. Lange, medical director; Newton Jackson, general superintendent of agents. The directors are C. H. Zehnder, president Dickson Manufacturing Company; Charles Robinson, of E. Robinson's Sons, brewers; R. G. Brooks, vice-president West Side Bank and Dime Deposit Discount Bank, also coal operator; W.W. Watson, vice-president Traders' National Bank and attorney-at-law; Elmer H. Lawall, general superintendent Lehigh & Wilkesbarre Coal Company; E. P. Kingsbury, director Scranton Savings Bank & Trust Company, also secretary and treasurer Enterprise Powder Manufacturing Company; Alfred Harvey, silk manufacturer and coal operator; A. C. Fuller, vice-president and treasurer Scranton Stove Works; W. S. Diehl, of Watson, Diehl, Hand & Kemmerer, attorneys-at-law; F. W. Lange, medical director; T. R. Brooks, coal operator.

A Boltless Rail Joint.

The American standard rail joint is a new joint that has several new features not found in other joints, combining simplicity and durability with efficiency. These joints are made of high grade malleable iron or cast steel, in two pieces, one for each side of the rail, and are joined together with a tongue and groove below the base of the rail. This tongue and groove are on an angle with the line of the rail, the joint forming tie plate and brace as well as holding the rail ends in position.

The manner of placing these joints in position is very simple; the half of the joint which goes on the outside of the rail is placed in position first and driven up against the rail. The other half is placed along the inside of the rail just beyond the end of the outside half and lightly tapped till the tongue and groove are properly entered,

SECTION OF TRACK EQUIPPED WITH AMERICAN JOINTS.

when it is driven up with a heavy sledge hammer. The drawing angle is so slight, and the fit around the rail so close, that in driving up enormous force is exerted, drawing the two halves in under the head of the rail and up the bottom flange until it becomes one solid piece of metal from top of rail to tie.

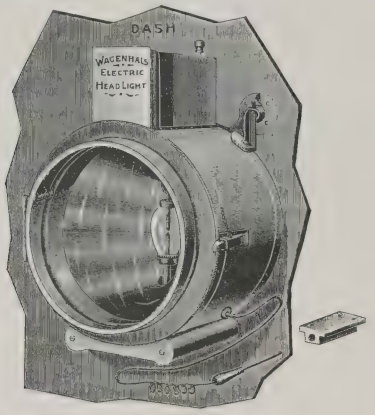
These joints are made to fit any style of rail and have been used very largely in the fixing up of broken down joints in old track with the best results, putting the track in good running condition and often saving a heavy expense.

These joints are made by the American Rail Joint & Manufacturing Company.

THE Tamaqua & Lansford Street Railway Company, of Tamaqua, Pa., will extend its lines soon.

Arc Electric Headlight for Electric Cars.

The headlight problem is an important one in electric railway operation, especially for high speed cars, as where the cars operate over city streets there is much more likelihood of collision with vehicles and pedestrians than in steam railroad service. It is natural to assume therefore that a much stronger headlight should be used than even on steam railroads. The arc light promptly suggests itself for this purpose, but the difficulties which have here-



ELECTRIC ARC HEADLIGHT.

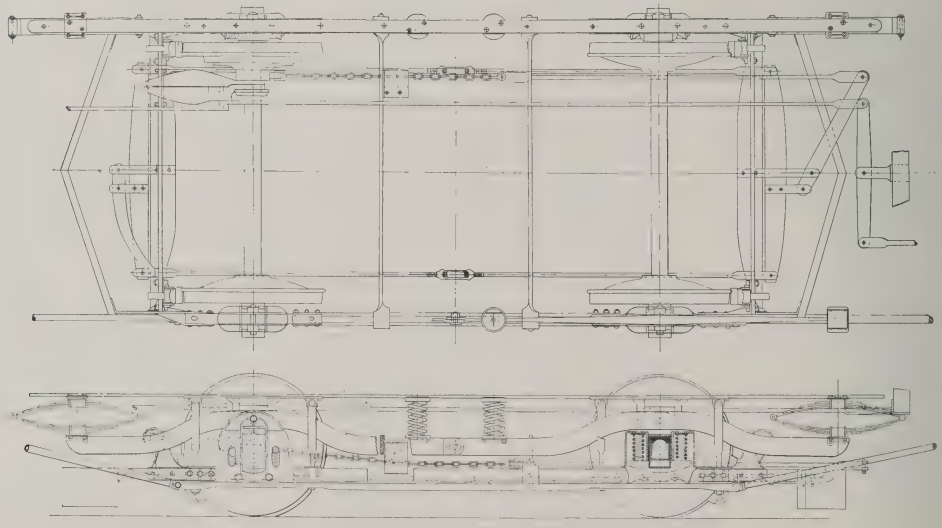
tofore been experienced in the connection of an arc light on a railway circuit have prevented its adoption. These difficulties, it is claimed, have now been overcome in the Wagenhals electric arc headlight built by the Dayton Manufacturing Company. It is the only headlight of its class in successful operation to-day, and was invented by a practical interurban manager who has found that a headlight giving more light than the best forms of oil headlight is most desirable. The headlight, which is shown in the engraving, throws its rays one-quarter to one-half mile ahead, giving the motorman time to stop his car no matter at what speed he is running, two or three times, before striking any obstruction which may be on the track.

The argument has sometimes been advanced that on account of its brightness a headlight of this character would frighten horses along a crowded highway. This has been found not to be the case, as a horse facing the light does not see the car, and there are few horses that have not seen an ordinary street arc light. To operate the lamp after it is hung in the dash castings, all that is required of the motorman is to make connection with the circuit by inserting a connecting plug into a receptacle under the platform of the car, touch the button on the top of the headlight, and the lamp is good for two hours' run without any attention. If the circuit breaker at the station should open, extinguishing the arc, the only attention required by the lamp is for the motorman to touch the button, which will start the arc. The Wagenhals lamp will burn on a consumption of from 3 amps. to 4 amps., giving between 3000 c. p. to 5000 c. p. The voltage is reduced through German silver resistance substantially built of porcelain with an iron case, which can be hung under the car out of the way, and requires no attention whatever as it will give a uniform amperage under all conditions. The lamp is in use on all the cars of the Dayton Traction Company, and is giving good satisfaction.

Street Car Momentum Brake.

The Price momentum street car brake, manufactured by the Wells & French Company, is arranged on the axle and is independent of the car body, truck frame and motor. It consists of a friction disk concentric with the axle, arranged so that it can be forced against a plane surface on the car wheel, and a leather or fibre washer is placed between these surfaces. The disk carries a hub which winds up the chain connected with the brake beam lever, the disk and hub revolving on a steel sleeve which is rigidly secured to the axle. This sleeve has a flange on the inner end whose diameter is equal to that of the hub of the disk. Between the flange and the hub are interposed two levers hinged together at their free ends. A screw is threaded through one lever close to the axle and abuts against the other lever. This screw is operated by the motorman's lever, and its action is to force the disk against the wheel, the friction causing it to revolve and wind up the chain to apply the brake. Although this brake is similar in its action to other momentum brakes, the bifurcated levers bend slightly so as to act as springs, which action causes the brake to work smoothly.

Last winter this brake was operated successfully under conditions which greatly reduced the efficiency of a staff brake. The Price brake would crowd off the snow that accumulated between the brake shoe and wheel, securing good contact between the two. These brakes are working satisfactorily on both single and double truck cars, and can be arranged to brake trailers, as they are now doing in Chicago.

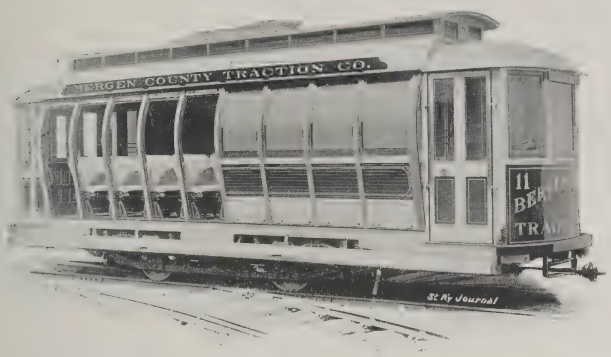


PLAN AND SIDE ELEVATION OF TRUCK WITH BRAKE.

THE Saddle River Traction Company, of Lodi, N. J., has applied for a franchise to construct a double track line in the town of Lodi.

The Duplex Car.

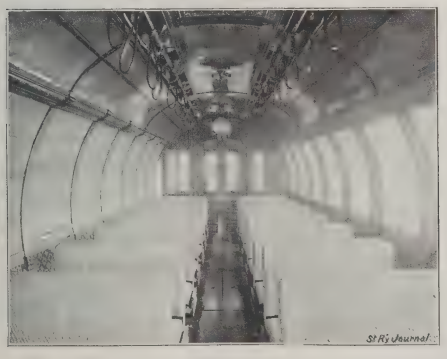
A new type of convertible summer and winter car has recently been built for the Bergen County TractionCompany,of Fort Lee,N.J., by the Jackson & Sharp Company,upon the patents of the Duplex Car Company. It has many points of merit which will be appreciated not only by railway officials, but by the traveling public. It will be seen at a glance from the "horseshoe" shape of the posts, as shown in the engravings, that the glass and side panels are raised and lowered and that when the car is "open" the sections are carried overhead and out of sight, but ever ready for service when



DUPLEX CAR PARTLY OPEN AND PARTLY CLOSED.

MOTORMAN'S PROTECTOR

sudden storms or cold weather or any other reason makes it desirable to have the car "closed." Furthermore, the change can be effected in a moment's time and each passenger can use the sashes at will and have them either up or down the same as in steam coaches. The whole section between posts may be operated together or the sash alone as necessity requires. It will therefore be seen that this is truly a summer or a winter car, for sunshine or storm, and is especially adapted for surburban or mountain lines where sudden changes of weather often prove of serious consequence to the passengers. It has been proven that this type of car can be just as substantially built, if not more securely, than the standard type of car, as the posts are in one piece curved from sill to sill; hence the joints



INTERIOR OF DUPLEX CAR—CLOSED.

connecting the roof to the body of the car are dispensed with. The first car of this type was used on a line in New Hampshire where it was given a severe test in all kinds of weather, and the manager testifies that the earnings of this one car were invariably greater than either his regular open cars in summer or closed cars in winter running over precisely the same route, proving that it was popular with the people.

The interior of the car is exceedingly pleasant and attractive and besides it is quite roomy. The curved lines in the construction seem to be more attractive than the straight lines with angular points. The reversible seats also add to its attractiveness, being of the Hale & Kilburn "Walkover" type and covered in rattan. The widest point of the car is just at the shoulder height of the average size person and thus gives more comfortable accommodation for two persons on each seat than in any other style of car.

Besides these points of advantage in the car itself, and others which might be enumerated, it has many claims from a railway standpoint which are worthy of consideration. It is a distinctive "all the year round" car and when once mounted upon its trucks and fitted with electric outfit never requires any change. It is just as good in the summer as in the winter and just as serviceable in the spring as in the fall. This saves to the railway company the expense of keeping up a double outfit. For summer service it affords all the advantages of an open car with better seats than are usually placed in such cars, and in case of a sudden shower which often comes up in the course of a summer afternoon,it can be readily closed and the passengers enabled to enjoy the security of a closed car, and thus be protected from wet curtains and rain that would otherwise be driven into the car and wet clothing occasioned thereby. A sample car will be sent to the Niagara Falls convention where it will be in service instead of on exhibition, and all railway officials who may be interested are cordially invited to inspect and criticise it. The builders, the Jackson & Sharp Company, have made arrangements for the manufacture of these cars.

A Motorman's Protector.

The question for vestibules for street cars is a serious one, so that the device illustrated herewith, entitled a Motorman's Protector, will be of interest. This invention embodies many of the functions of a vestibule without the expense, serious loss of room and weight on the end of the car, which the building of vestibules necessitates.

The protector is constructed of a waterproof strip provided with a sheet of glass, a self winding roller upon which the strip may be wound, and a frame in which the roller is journaled and means for attaching the frame to a car. The frame consists of side plates connected by cross rods and is fitted with hook shaped arms, adapted to engage the hood of a car, and set screws by which the protector is clamped in place. But one protector is required for each car, as it is adjustable and can be changed at the terminals from one end of the car to the other, as may be necessary, without delay. This protector has been put on the market by the Motormen's Protector Company.

The Electrical Exposition for 1898.

Ever since the electrical show held in New York City during May, 1896, there has been a feeling in the trade that it should not be the last. Its splendid success in the way of bringing trade to exhibitors has led to a very general demand that it be repeated.

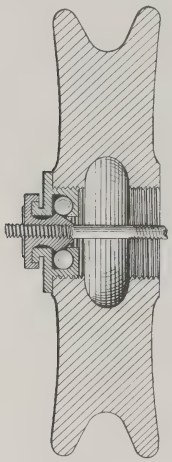
A company has been formed with $20,000 capital, and a live, up-to-date board of directors to conduct such an exhibition in 1898. Articles of incorporation were filed in Albany on Wednesday of last week, and these gentlemen were named as officers and directors. Cyrus O. Baker, Jr., president; Ferd. W. Roebling, vice-president and George F. Porter, secretary and treasurer. These officers, with Leonard F. Requa, Chas. A. Lieb, J. W. Godfrey, and H. H. Harrison, constitute the board of directors. Executive committee: C. O. Baker, Jr., Leonard F. Requa and H. H. Harrison. Martin Nathan has been selected as general manager.

This practically insures a first class exhibition. The new electrical inventions and improvements developed since the last show will be an important factor. The interest and co-operation of many manufacturers already assured will count for much towards making this a more complete demonstration of all the applications of electricity and its branches than was possible in the first exhibition in 1896.

THE West End Street Railway Company, of Boston, Mass., has petitioned for the right to extend its tracks in Brookline.

Improvements in the Works of a well Known Machine Company.

The Columbia Machine Works, manufacturers of electrical railway supplies of every description and specialties of various kinds, have recently made a large number of improvements in their factory, and have extended their business in a great many different lines. This business was established in 1893 by John C. Buehler, and has been carried on ever since by that gentleman, who has had associated with him different gentlemen at different times, and under various firm names, prior to his last and most important compact made about the first of this year. On that date Frank H. Platt became a member of the firm and considerable new capital was added to the business. With Mr. Platt's assistance the business has steadily improved, until now the firm carries on twelve entirely different lines of work, each a business in itself. The company, in addition to its factory at 2-18 Columbia Heights, Brooklyn, has now extended its business until it occupies all the buildings on Doughty Street from Columbia Heights to Furman Street, these buildings being numbered 18 Fulton Street, 9 Doughty Street and 15-17 Furman Street. The Columbia Machine Works pay particular attention to the following specialties in the electric railway field: commutators, new and refilled, drop forged copper bars, armature windings, trolley wheels, fuse boxes, bearings, car trimmings, canopy and power house switches, adjustable brake and controller handles, drop forgings, brass and iron castings, patterns and nickel plating. This firm also makes an excellent bicycle and a special nozzle for the New York Nozzle Company. The Columbia Machine Works is now placing upon the market a patented ball bearing, self oiling trolley wheel, which is illustrated herewith. This wheel has been in use for some time for the purpose of testing its running qualities, and seems to be giving entire satisfaction.

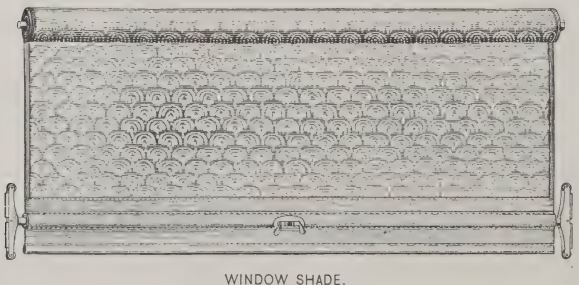


BALL BEARING TROLLEY WHEEL.

NEW BOND.

Window Shades.

During the fall of 1895 Forsyth Brothers & Company introduced to the trade their patent roller tip curtain fixtures. This curtain was entirely new, both in principle of operation and in form of construction, and was the first fixture to show a working or tilting head having friction surfaces of divers holding power, whereby the shade is made self righting. It had the ordinary tube with two spring actuated rods, these latter having at their outer ends tips provided with anti-friction rollers. This construction makes the fixture right itself and remain level and within the grooves. It can be operated either by grasping the finger pieces or the curtain anywhere along the bottom. The fixtures are exceedingly simple and very durable. While remaining in the grooves when in use, they can still be readily be removed therefrom for cleaning, repairing or washing of the curtain or window. These curtains met with immediate favor and have been adopted and extensively used by many of the leading railroads and street railway companies. Although the manufacturers have but recently sought after the latter trade, they are able to report that this department has grown rapidly, and they have been forced to work at night to fill orders. They have lately filled orders for the Metropolitan Street Railway Company, of Washington, the second order from that company, the third order from the Fort Pitt Traction Company, of Pittsburgh, the Detroit Citizens' Street Railway Company, the new cars for the Chicago City Railway Company, etc.



WINDOW SHADE.

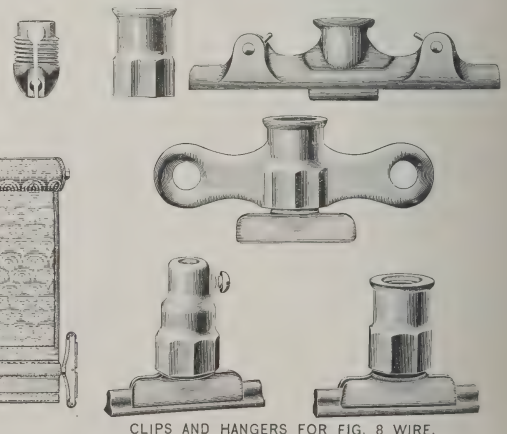
New Type of Rail Bond.

The accompanying engraving shows a new type of rail bond which has been giving such good results on the Union Railway Company, of New York, that it has been adopted exclusively for bonding rails on that line as well as on the Westchester Avenue Electric Railway and Jerome Avenue Railway, both leased lines of the Union Railway Company, of New York. The chief feature of the bond is the extremely broad surface of contact provided between the rail and the bond terminal, This surface contact is 1.95 sq. ins. for a 334,000 c. m. bond, and 1.65 sq. ins. for a 131,000 c. m. bond. No alloy is used as a solder in any part of the bond or in connecting the bond to the rail. A ¾ in. hole is drilled at an acute angle at the base of the rail, and this is afterwards reamed out to the exact taper of the bond terminal. The latter is of drawn copper rolled with the wires, forming the connection into a homogeneous mass. The bond terminal is driven into the rail hole by a sledge and follower, and is afterwards driven home by a prick punch. The union is so perfect that experience has shown that it takes a force of 2950 lbs., to pull the bond out.

The conductivity of the metal used, which is hard drawn copper throughout, is 93 per cent that of silver, the best conductor known, as compared with spelter which is about 21 per cent, and iron which is about 15 per cent. To secure accuracy of drilling a special drill is used, driven by an electric motor. The drills, of which four are used at once, are anchored to the rail by a special device, and the speed of bonding is such that it is possible to drill, ream and install two bonds in less than two minutes' time, thereby preventing any delay to traffic. The bond is manufactured by the Bridgeport Brass Company and installed by the Harrington Rail Bonding Company.

Clip for Figure 8 Trolley Wire.

The comparatively recent adoption of multiplex trolley wires in the figure 8, tri-foil and other special shapes, has necessitated the design of ears or clips for the mechanical attachment of the wire to its insulated trolley hanger or other support. The Luscomb clip claims special attention as one of the simplest and most practical forms of clamping ear for this purpose. It consists of two parts, simple in design and construction; the clamping jaws and retaining nut. The clamp or ear proper is split, the two parts being held together by a thin web of the metal, as shown in the cut. The ear is attached to the wire by slightly spreading the jaws of the clamp and springing them over the wire, then drawing them together with the hexagonal nut, as illustrated. This nut also forms the socket



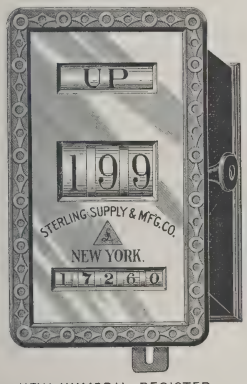
CLIPS AND HANGERS FOR FIG. 8 WIRE.

for attachment to the screw stud in the hanger. Illustrations are given of the straight line, strain, feed-in and splicing clips. By means of dogs in the latter, the ends of the wires to be spliced are securely retained in position automatically and furnish a smooth and unbroken runway for the trolley wheel. The strength of the Luscomb clip is evident, and the design is such that the trolley wheel cannot strike the jaws of the clamp, thus assuring a uniform track for the wheel at any speed. The H. W. Johns Manufacturing Company is placing this ear upon the market and anticipates its extensive use.

A Growing Manufacturing and Supply House.

The Sterling Supply & Manufacturing Company, which has engaged for some time in the manufacture and sale of general electric railway supplies, has recently made a number of important extensions to its business and is manufacturing and carrying a number of new appliances. Its works are on the third floor of the Lexington Avenue cable station, 141 to 155 East Twenty-fifth Street, New York, the upper floors of which were especially designed for manufacturing purposes. The floor space occupied by the company is 26,000 sq. ft., and is fully equipped with a large number of special tools of improved design. Here the company carries on the manufacture of its electrical appliances, street car fenders, car brakes, sand boxes, fare registers, etc. Being close to the center of New York City, shipments can be easily made to all parts of the country, while its facilities for supplying apparatus in the city itself and the neighborhood are unequaled by any manufacturer in this line. The work rooms are well lighted and ventilated and make a very pleasant place to visit for a stranger in the metropolis.

One of the most important of the new lines recently taken up by the company is that of overhead line insulators. These will be made in all of the several different forms which have become recognized as most desirable. The material used as an insulator is a special compound which promises to give very satisfactory results. Before placing this on the market the managers of the company adopted the conservative course of thoroughly testing its durability and insulating qualities under all conditions to which it might be subjected in service. They also requested Stone & Webster, the well known electrical experts, to make an independent test on the insulators. These tests are outlined as follows: the three strain insulators were selected and one was baked four hours at 150 degs. F. and dried with calcium chloride twenty hours. The insulation resistance was then measured, and again, after allowing the insulators to soak for twenty-four hours in cold water and to dry in one-half hour. The other two strain insulators were placed in a special machine by which they were subjected to 2000 lbs. strain for twenty-four hours while continually immersed in cold water. The stress was first removed, then the water drawn off, the stress put on again and the insulators allowed to dry one-half hour. The insulation resistance was again measured. The insulators were then baked at a temperature of about 125 degs. F. for five hours, the stress being maintained at 2000 lbs. throughout, and allowed to cool one-half hour. The insulation resistance was then measured. This process of alternate soaking and baking under stress was repeated several times. At the last baking the temperature was raised to about 150 degs. F. The results of the tests show very high wearing qualities and insulation resistance for the insulators, and, as compared with others of well known make when subjected to the same tests, a better result which averaged about 25 per cent. The material is now being offered to the trade with the full confidence of the managers of the Sterling Supply & Manufacturing Company, that in quality it will be equal to the other apparatus manufactured by it. The company has already supplied a large quantity of material to the Western Electric Company, and several of the principal electric railway companies which have heard of the material have expressed a desire to give it a thorough trial on their lines. The material can easily be recognized by the trade mark adopted for it by the manufacturers, viz., a triangle with the mark ℒ signifying the "sterling" character of the insulation.



NEW NUMERAL REGISTER.

In its other departments the company is doing a large business. There is, of course, a constant demand for the Sterling registers, of which ever 2500 are in use in New York City alone. In this line the company is about to put on the market a new type shown on this page. This register is designed to supply a large demand for a handsome, durable and perfectly reliable machine which would be within reach of all companies. It is attractive with handsome bronze casing, enameled dial and large figures, and should meet with an extensive use. The face of the register is a rectangle with rounded corners and the figures are large enough to be read easily from any point in the car. The direction sign is above the trip numerals and the totalizer below. The fact that the company also manufactures a large number of cash register machines under special contract with the Metropolitan Cash Register Company enables it to employ a large force of expert mechanics and machinery in this special line of business and to turn out registers at the minimum cost and of the highest grade of efficiency.

The fender, brake and sand box departments are working with the full number of employes. These appliances have been before the public so long that no extended description of them is required. They have been adopted as standard by the Metropolitan Street Railway Company, of New York—a good indication of their value.

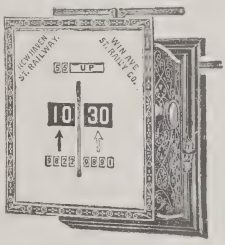
In addition to these well known specialties the company has recently extended its business to take in other railroad supplies, and now claims to be the largest dealer in the country of miscellaneous supplies of this character. Among the other appliances recently added to its list of materials are piping, gas fittings, rattan for snow sweepers, etc. In a recent interview the energetic manager of the company, J. H. Carson, stated that he intended to make the company headquarters for all kinds of miscellaneous supplies for both steam and electric railways so that it would be possible for a railway manager when coming to New York to secure at that place all of the repair parts and miscellaneous equipment for his rolling stock and line which he might require, and that what the company did not itself manufacture it would act as agent for. The value of this to the visiting manager is apparent as the ability to secure all of his needed apparatus at one place would be a great economy of time and labor.

Mr. Carson has associated with him in the management of the company, Perry Tiffany as vice-president, and William Tiffany secretary and treasurer. In the selling department the company has as representatives in the electric railway branches Louis E. Robert and F. A. Morrell, and in the general steam and railway supplies J. A. Macdonald, formerly of John Simmonds Company.

Double Fare Register.

One of the new features at the coming Niagara Falls convention will be a new double fare register adapted expressly for use on cars operated by two connecting roads.

Heretofore on such roads the usual method employed for keeping an accurate account of the fares collected on each line has been the use of two single registers, one provided by each road, with the necessary cord or rod fixtures for ringing each machine. The New Haven Car Register Company has just produced a double register, arranged expressly for use on such cars, which is complete in every d tail. Each side of the register is complete, and both sides are operated by only one set of rod or cord fixtures. Each side is also provided with a special lock, so that the conductor on leaving the car can lock his side of the register, thereby preventing fares being rung against him during his absence. The superiority of this system of operation over the use of two different registers in a car will be appreciated by all railway managers. Where a company desires to keep a separate record of cash fares and transfers, one side can be used to record the one kind of fare and the other the other kind. A view of one of these registers is shown herewith. It is a register built by the New Haven Company for one of the New Haven street railway companies desiring to keep record of two sets of fares. The full operation of the machines will be explained by the representatives of the company at its exhibit in space 47 at the Niagara Falls convention.



DOUBLE REGISTER.

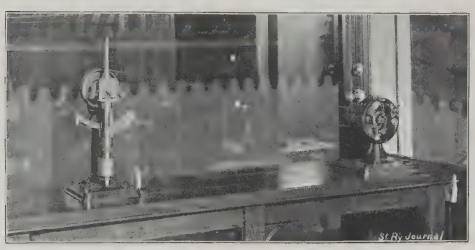
The enviable reputation of the New Haven fare registers will be enhanced by this new machine, which, as it fully meets the requirements of the large class of roads for which it is intended, is undoubtedly destined to have a very large sale. The features of these machines are fully protected by patents.

A Recent Patent Decision.

Judge Putnam, of the United States Circuit Court for the District of Massachusetts, has rendered a decision in favor of the complainant, with an order for an injunction and accounting, in the suit of the Consolidated Car Heating Company, of Albany, N. Y., against the American Electric Heating Corporation and the West End Street Railway Company, of Boston, Mass. This is the suit for the infringement of the patent to James F. McElroy, covering the Consolidated Car Heating Company's spiral coil construction of electric heaters, which is now used in a large number of street cars operating electric heaters.

Boiler Compounds and Lubricants.

To the man who has but tasted the water of different localities, it must appear axiomatic that a boiler compound prescribed for removing the incrustation from the water surface of a boiler in one locality must fail in any instance where the feedwater holds different salts in solution. The Dearborn Drug & Chemical Works realizing that no one compound can be placed upon the market which



INSTRUMENT FOR TESTING LUBRICATING OILS

will apply to the varying conditions of different localities, have established and equipped one of the largest laboratories in the world for analyzing feedwaters. Here they make preparations to overcome the different deleterious actions taking place in a boiler by analyzing the feedwater and prescribing according to the needs of each particular case. This prescription is sent to the works, where it is filled, filed, recorded and numbered, and can be refilled when

SECTION OF LABORATORY.

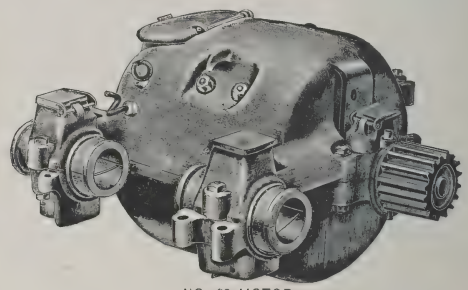
wanted, the same as a prescription is handled by a dispensing pharmacist in a drug store. The company has also in its laboratory a complete equipment for the testing of lubricating oils, a matter which must of necessity be of interest to the street railway purchasing agent. By means of the instrument illustrated above, the comparative lubricating value of any oil is precisely determined from which value the commercial value is easily deduced.

Description of a well Known Type of Street Railway Motor.

The following is a description of the standard type of motors manufactured by the Steel Motor Company. A number of new features and improvements have been added to these motors, and the Steel Motor Company claims that its designs now represent the highest attainment yet reached in the reduction of operating and maintenance expenses. The standard motors manufactured by this company are of three different sizes, numbered 20, 22 and 34, and are of 25 h. p., 35 h. p. and 50 h. p. respectively.

The frame of the Steel motor is cylindrical in shape, the exterior presenting rounded surfaces giving strong box sections with no exterior pockets or flat places to collect grease or dirt. The suspension lugs and axle bearing brackets are part of the top half of the motor frame, thus making the motor convenient for pit handling. The nose suspension is adapted to straight bar or bar having its end brought around to join the truck frame as near as may be in a line with its armature shaft, the latter arrangement having the advantage of taking the weight of the motor off the axle. The side bar suspension, however, is recommended as in this case the motor is supported back of its center of gravity sufficiently to take both the weight and the inertia blow off the axle and track. The armature bearings are cast integral with the frames, and are therefore held in place by the same bolts which hold the frames together.

On taking out the bolts which hold the top and bottom halves of frame together, the lower half is free to swing down by link suspension from lugs on the upper half. It swings away from the axle leaving the interior of the motor readily accessible from the end of the car. If desired the lower half can be lowered straight downward, the armature meanwhile being supported either in the upper half or held in lower half as it swings down. This is accomplished by a double shanked eye bolt encircling the armature shaft at each end. One shank extends through a lug, in the upper half of the frame, and is secured by a cotter through it on top of the lug. The other shank passes through a lug on the lower half and is held there by a nut. By taking off the nut below, the armature is left suspended in the lower frame and is swung away or lowered with it. The arma-

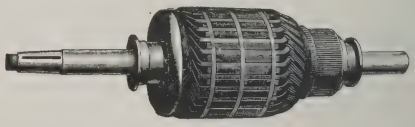


NO. 20 MOTOR.

ture shaft cannot be scored by the eye bolt, and no space is lost on the shaft as the eye takes its bearing on the box lining which projects beyond the frame casting.

There are four poles symmetrically located, each having its own field coil. This has the advantage of preventing the motor from being injuriously affected by distortion of the field by the armature current. The poles are laminated wrought iron with serrated faces, riveted together between substantial end plates and bolted in place in the motor frames. By making the laminations of substantial iron, a mechanical pole piece is secured having at the same time the advantage of a serrated face, reducing the heating and also the sparking of the motor.

The field coil of these motors is wound and insulated separately and is clamped in place by the act of bolting in the pole piece. A

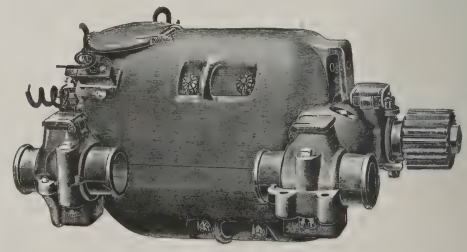


NO. 20 MOTOR ARMATURE.

coil holder having a spring plate is introduced between the coil and the tips of the pole piece. This plate distributes the clamping pressure well over the surface of the spool, and by means of its spring insures the firm holding of the coil without either injuring the insulation or preventing the pole piece from coming to its seat.

The brush holders are independent of each other, but are identical, requiring no right or left parts. Each brush holder consists of a wood block bolted in babbitted seat inside of the top frame, and carrying on its end the brush holder casting proper.

The bearings on both armature shaft and axle are of generous proportions, and are provided with grease boxes of ample capacity. Instead of one slot on top of the bearings, two are provided. These are located 30 degs. each side of the top which is an advantage in exposing twice the area of grease to shaft, and also introducing



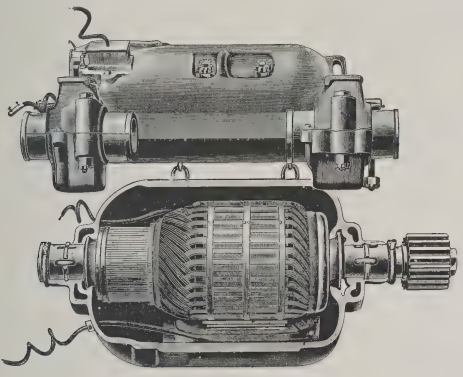
NO. 34 MOTOR CLOSED.

grease at points not directly under pressure. The axle linings are symmetrical and interchangeable. The thrust is taken by large dowel pins, two in each bearing. The two armature bearings are also made interchangeable, and can be used in either end except when motor is used on a road of narrow (1 meter) gage. In such

cases a special bearing will have to be used on the commutator end to clear the flanges of the wheels. This fits the same bearing seat and causes no other change in the motor than this one bearing.

Oil cellars supplement the grease cups on the axle bearings. These are packed with wool waste, and the oil is introduced at bottom of the cellar under the waste, so that foreign substances carried in with the oil may be caught by the waste and kept from the shaft. The thrust on the armature is taken in both directions by the pinion end lining. This lining is secured for the purpose by dowels similarly to the axle linings. This limits to a single bearing the accurate work required for locating the armature, rather than necessitating accurate measure across the length of the motor frame. As the bearings project outside of the frame at each end a ready means of slinging the armature is provided, a great convenience in taking out or putting in an armature. Bearings are all cast iron, lined with babbitt, giving a bearing cheaply renewable by the owner.

The armature is light and small in diameter, both of which features make braking the car easier, as the flywheel action of a heavy armature of great diameter is done away with. The power wasted in accelerating two large flywheel armatures, in frequent stop service is no small item. The armature construction is simplified by placing three coils in one slot, requiring only one insulation for the



NO. 34 MOTOR WITH CASE OPEN.

three coils. Also, by the latter arrangement the armature is given large, substantial teeth not easily injured or bent by rough usage. The armature is hollowed out sufficiently to cut down the distorting effect of armature on the field of the motor, and also the self induction of the commutating coil, both acting to reduce sparking of the motor, particularly at the higher loads. Hollowing out the armature has also an important ventilating and cooling effect, a result more thoroughly taken advantage of by the style of the winding and winding support adopted. The winding support also protects the ends of the coils from injury in handling the armature.

The armature core is wholly without insulation, the coils themselves being adequately insulated. The coil, where it passes through the slots and for a sufficient distance beyond the slot at each end, is covered with paper of high and lasting insulating qaality, and protected on the outside by an armor of red fibre. These coverings are put on the coil at a temperature above the running temperature of motor and are therefore not subject to deterioration in any ordinary use. The above construction also gives an armature in which an injured coil can be replaced with a minimum of harm to the remainder of the winding.

These motors are compact and of very light weight; the exterior dimensions being such as to allow their use on narrow gage down to the limit of 1 meter. Motor No. 20 is particularly designed to fill the requirements of the many roads of the lighter service character, which, by reason of lighter cars, or easier gradients, or both, have no need of carrying around a large motor, which in comparison to the demands of the service furnishes, by reason of its own weight, a large part of the work done. Motor No. 22 is designed for regular service in large cities, and No. 34 is designed for heavy city and interurban work.

The success of these motors has led the Steel Motor Company to design motors of larger capacity, ranging from 75 h. p. upwards for elevated railway and locomotive service. These larger motors are being constructed on the same general lines as the standard motors described above.

A New Principle in Dynamo Design.

Prof. S. H. Short, who enjoys the distinction of building one of the first, if not the first, commercial electric roads in this country, at the early date of 1885, and whose name is identified with gearless electric motors, such as are used in the Baltimore & Ohio Tunnel and the City & South London Railway, has just developed a new principle in the design of direct current dynamos, which is very valuable and reduces the cost of construction. The substance of his investigations is herewith presented in condensed form, and will interest everyone using machines of this character.

The term "bucking" as applied to direct current dynamos was formerly employed to designate any sudden and violent pyrotechnic display at the brushes that could not be conveniently accounted for. The term has, however, a definite meaning, and may be briefly described as the local interchange of current between parallel connected dynamos or motors, such interchange being entirely independent of the line that feeds, or is fed in the system. Thus, two railway motors connected in parallel may buck each other, one acting as a dynamo and driving the other as a motor.

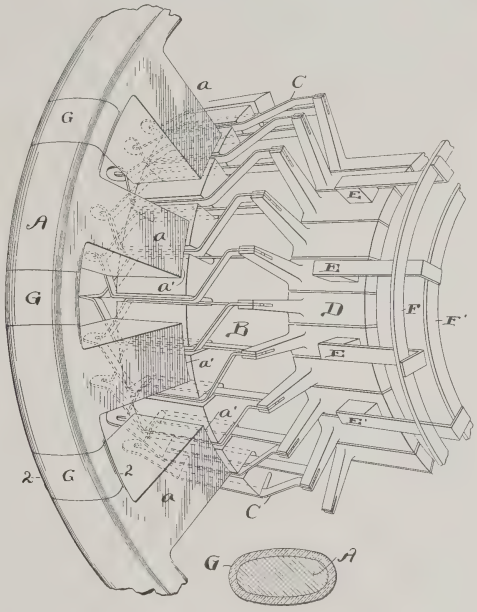


DIAGRAM SHOWING METHOD OF WINDING.

The motoring of power or lighting generators that work in parallel is a form of bucking.

A multipolar generator, the armature winding of which consists of a number of sections which are connected in parallel by the brushes, will sometimes buck of itself, for it really consists of a number of relatively small bipolar dynamos connected in parallel. Such a winding is called a parallel or lap winding, and by consulting the diagram it is seen to be a very popular and familiar one. We may consider the two upper poles and the windings between the two upper brushes to constitute one dynamo, and the two lower poles and the corresponding portion of the winding to constitute another machine, which, it will be seen, is connected by the brushes in parallel with the first. Now, if the poles over one winding are, for any reason, weaker than the adjacent set, the e. m. f. that they generate in the armature winding will be less than that produced in another portion, and the former will feed current to the latter and drive it as a motor. It will be remembered that the armature reaction of a motor strengthens its field, and the field of a dynamo is weakened by the armature reaction, for an analagous but inverse cause. So it is in this case, and the effect is to presently cause the dynamo and motor part of the armature to exchange functions and then to re-exchange them. This process begins slowly, but increases in rapidity till some part of the machine gives way, or is brought to a standstill.

The practical results of this action are very destructive. The enormous currents often heat the brushes white hot and the powerful magnetic forces often displace the frame or even spring it till the pole pieces are struck by the revolving armature and the latter is injured. Bucking is particularly liable to occur while the machine is building up, but often continues after full voltage is reached. It is obviously a phenomenon the elimination of which is imperative. Hitherto the cause of this trouble was not generally known, though the results were very familiar. It was experimentally found that increasing the air gap and highly saturating the fields or the teeth of the armature would reduce bucking for the now obvious reasons that the armature ampere turns found it harder to disturb the magnetic induction in a highly saturated section of the magnetic circuit. Every dynamo designer knows that highly saturated fields and large air gaps are very expensive both in field current and in copper, but

until Professor Short's invention there appears to have been no other feasible method of accomplishing the result. In investigating the phenomenon, Professor Short early realized that it was essential to the production of bucking that the armature should rapidly vary the strength of induction in the magnetic circuits, and his invention simply consists of a damper to prevent this action.

A heavy, closed circuit of low electrical resistance is made to inclose the magnetic field at some place outside the armature. The instant that a rapid change takes place in the strength of the field magnet, it is checked by the counter magnetic effect of this band in which the disturbing flux induces heavy currents. This band only operates when quick changes in flux density are attempted and does not interfere with the relatively slow ones caused by regulating devices.

This simple means effectually stops bucking and enables the machine to successfully operate with just enough clearance for mechanical purposes and with magnetic circuits of very low magnetic reluctance.

Professor Short's preferred form is a heavy copper band through which the frame is cast so that the band occupies a recess and is flush with the frame, but it can be easily seen that the device can be applied in scores of convenient ways.

A Great Leather Belt.

The interest which was universally manifested in the great belt furnished by the Chicago Belting Company to the Louisiana Electric Light Company, of New Orleans, La., has been renewed by a recent test to which the belt has been put. Some time ago one of the engines of this plant was shut down for repairs and this belt carried for several days the load of the entire station, transmitting by actual test a load of 2200 h. p. The belt was designed to transmit 1800 h. p., but the extra load was borne without the slightest sign of failure.

LARGE LEATHER BELT.

This belt is probably the largest ever made; it weighs 3300 lbs. and the hides of 550 steers were consumed in its manufacture. This was partly due to the fact that nothing but the centers of the hides were used. The belt has now been in use about a year; it has never required any alteration, runs true and straight and so far has given not a moment's trouble. It is made witnout rivets or pegs, depending entirely upon cement to hold the sections together. The belt cost $2100.

A Curious Patent Case.

Certain odd and interesting facts have just come to light in connection with Patent No. 588,391, issued Aug. 17, 1897, to George Martin Brill and John A. Brill, of Philadelphia, for an electric motor car truck, a brief reference to which patent was made in the September issue of the STREET RAILWAY JOURNAL. As the issuing of this patent illustrates the injustice which the present rules of the Patent Office, and the "law of the land" make possible under certain circumstances, it is worth while, perhaps, to briefly review the facts in this particular case in the hope that in this way the inevitable reform in Patent Office legislation and procedure may be expedited, if only but slightly.

The invention claimed by the Messrs. Brill had relation "to railway car trucks having electrical equipment of the form wherein the motor at one end is sleeved or hinged to one of the truck axles and its other or free end was supported so as not to be subject to the action of the system of springs supporting the car body or truck frame." The original application on which the patent just issued was based was filed June 25, 1888, and a portion of the drawings accompanying the application are produced herewith. In Fig. 4, is shown a method of suspending the armature end of the motor on the cross bar supported on the truck frame, but *nowhere in the original application is this particular method of support claimed*, as is shown by inspection of the Patent Office records in the case.

On Mar. 25, 1890, the original application was divided, and the first divisional application was granted, resulting in the issuance, on Apr. 15, 1890, of patent No. 425,653. The second divisional application was held in the Patent Office without progress for about four years. In neither of the divisional applications was Fig. 4 described or claimed, though left in the drawings of both.

On Dec. 9, 1890, Sidney H. Short, of Cleveland, O., made application for a patent covering substantially the same invention as that shown in Fig. 4 of the Brill patent, and on May 12, 1891, patent No. 452,036, was issued to Mr. Short. This patent appears to have come to the attention of the Messrs. Brill some time later. By the rules of the Patent Office, the validity of which have been established by a decree of the Supreme Court in the Berliner Telephone Case, an invention can be kept alive in the Patent Office indefinitely without progress, but subject to change of claims at any time, and, fortified in their position by this ruling, the Messrs. Brill, with the Short patent before them, injected into their second divisional application which had been lying in the Patent Office unacted upon, claims for the suspension shown in Fig. 4. Apparently in order to make sure of being able to institute interference proceedings with the Short patent, the exact phraseology of certain claims of the latter were followed in the revised Brill application and in other claims the changes are merely verbal and of no consequence. An interference between the two patents was then declared by the Patent Office, and as a final result, a patent was granted to the Brill Company on Aug. 17, 1897, as before stated. This patent is substantially identical in its claims with the Short patent, but the Brill patent being based on an application nominally antedating the latter by nearly eighteen months, may be presumed to be the stronger one in the light of the Berliner decision, though it is not impossible that the courts will have to decide the matter. The importance of the matter lies in the fact that both patents claim broadly the nose suspension of motors upon a cross bar carried on the axle box frame —a device in almost universal use to-day—together with the "composite" feature of independent trucks.

Fig. 2.

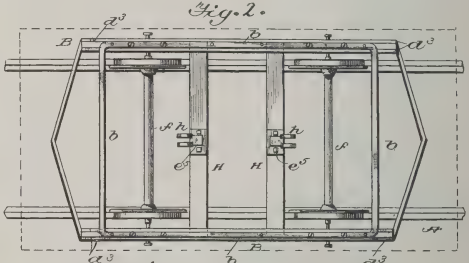


Fig. 4.

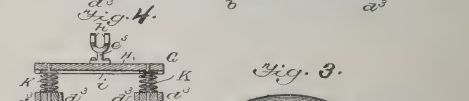
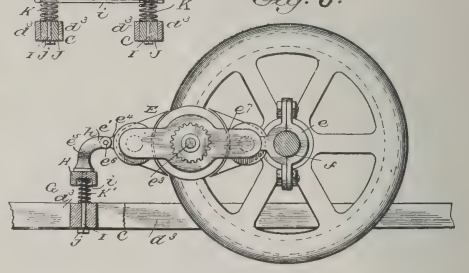


Fig. 3.



PATENT DRAWING, NO. 588,391.

A LITTLE "Pocket Manual of the (Boston) Stock Market" compiled and printed every six months by Joseph G. Martin, of Boston, is a very convenient résumé of market conditions existing during the previous six months, giving low and high quotations in each month for Boston national banks, railroad companies, manufacturing stocks, railroad and other bonds, mining and miscellaneous securities.

THE Union Railway Company, of New York, N. Y., intends to extend its Fifth Avenue line from Mount Vernon city line to Bartow and City Island as soon as possible, and it is believed that the company also has under consideration the construction of a road over the abandoned route of the North Mount Vernon Railway Company through Chester Hill to the county seat at White Plains.

· · PERSONAL · AND · BIOGRAPHICAL · ·

The Prominent Street Railway Men of Buffalo and Vicinity.

Not less interesting than a description of the magnificent system of electric railways and transmission lines radiating from Buffalo and Niagara Falls, is a sketch of the lives of the men to whose mechanical ingenuity, skill and perseverance the construction and maintenance of this extensive system is due. The following biographical sketches of the prominent street railway men of Buffalo and vicinity will, therefore, be read with pleasure by all those who are in any way interested in the development of the science of electric railways and power transmission.

H. H. Littell, vice-president and general manager of the Buffalo Railway Company, has for the last six years been very closely identified with the development of the street railway system within the city limits of Buffalo. Mr. Littell was born in Corydon, Harrison County, Ind., in 1845, and in 1861 removed to Louisville, Ky. Mr. Littell comes from an old Kentucky family, and traces his ancestry back through a long line of famous Kentuckians. The present generation has furnished two very prominent representatives to the street railway industry in H. H. Littell and his brother, H. M. Littell, of Brooklyn and New York. H. H. Littell engaged in business in Louisville from 1861 to Nov. 24, 1864, when the Louisville Railway Company commenced operations and Mr. Littell accepted the position of receiving clerk for this company.

H. H. LITTELL.

H. M. WATSON.

W. CARYL ELY.

From that time all his energies have been devoted to street railway work. Mr. Littell made rapid strides in his profession, displaying rare adaptability to the business. In two years he was appointed to fill the office of superintendent of the road, and afterward became its general manager. Under Mr. Littell's management the Louisville Railway system was rapidly extended and improved, and in 1888 all the lines in the city were consolidated into one company, with Mr. Littell as general manager. Mr. Littell's record at Louisville for good judgment and careful management has placed him among the foremost street railway managers in this country. In April, 1891, Mr. Littell was elected president of the Crosstown Street Railway Company, of Buffalo, and vice-president and general manager of the Buffalo Railway Company, and in that year he removed his home from Louisville to Buffalo. Under Mr. Littell's direction the street railway system in Buffalo has been thoroughly improved, and has been extended into nearly every portion of the city and for some distance into the suburbs. This has been a gigantic achievement, and the Buffalo Railway stands, to-day, as one of the best equipped and best managed street railway properties in the United States. Mr. Littell has always taken an active interest in the affairs of the American Street Railway Association. He was one of its organizers, issued the call for the first meeting, and was elected its first president. He is, of course, thoroughly in sympathy with the aims and purposes of the association, and has done all in his power to broaden the field of its work and to make it of greater practical value to its members.

Henry M. Watson, president of the Buffalo Railway Company, has also been prominently identified with the extension and improvement of the Buffalo Railway system. Mr. Watson was born in Otsego County, N. Y., and went to Albany in 1857. He engaged in the banking business in that city until 1867, and during the last two years of this decade he was likewise general passenger agent of the Albany & Susquehanna Railroad. In 1868 he removed to Buffalo and was elected secretary and treasurer of the Buffalo Railway Company. In 1871 he was elected secretary and treasurer of the Buffalo East Side Street Railway. Upon the death of S. V. R. Watson in 1881 he became president of the Buffalo Railway Company, and in 1890 he was likewise elected to the presidency of the East Side Street Railway Company, now consolidated with the Buffalo Railway Company. Mr. Watson is a trustee and director in a number of prominent banks and insurance companies in Buffalo, and has also been president of the Bell Telephone Company in Buffalo. While a resident of Albany he became, in 1862, a member and one of the volunteers of the Tenth Regiment, N. G. S. N. Y. He was promoted to the office of second lieutenant in 1865, and is still an honorary member of the company. He received the appointment of aide-de-camp on the staff of Governor Alonzo Cornell, Jan. 1, 1880, with the rank of colonel. Mr. Watson has always taken great interest in the affairs of the American Street Railway Association, and was chairman of the local committee when the association met in Buffalo, in 1890.

W. Caryl Ely, president of the Buffalo & Niagara Falls Electric Railway Company has been the projector, organizer and promoter of a number of important undertakings in the electrical field and has succeeded in the face of great discouragements. He has had the faith and the energy that, united, overcome all obstacles. Mr. Ely was born at Middlefield, N. Y., Feb. 25, 1856, and was educated at Cooperstown (N. Y.) Union School, Girard (Pa.) Academy, Delaware Literary Institute, Franklin, N Y., and Cornell University. He was admitted to the bar in 1882. He was a member of the State Assembly in 1883-85, and has practiced law at Niagara Falls since 1885. To speak of Mr. Ely as a business lawyer seems natural, yet he is something more than that, for he is a successful advocate. He has the valuable gift known in the profession as a "judicial mind." His work in connection with such corporations as the Niagara Falls Power Company and the Buffalo & Niagara Falls Electric Railway Company exemplifies and emphasizes the practical side of Mr. Ely's character. He was one of the five original promoters and incorporators of the Niagara Falls Power Company and prepared and had charge of the legislation of its original charter, and assisted in preparing and had charge of all subsequent legislation. He has been a trustee and legal counsel of the company since its organization. He was the principal promoter of the Buffalo & Niagara Falls Railway Company and carried this enterprise to a successful end despite the panic of 1893-95 which threatened at one time to block the project. Mr. Ely is a member of the firm of Ely, Dudley & Cohn, and his career as a lawyer has been unusually successful and brilliant. In social life Mr. Ely holds a high position and has hosts of friends. He is a member of the Masonic Order, the Manhattan Club, Reform Club and other social and political organizations.

E. G. S. Miller, president of the Buffalo Traction Company, was born in Buffalo, and has spent his entire life in that city. After a common school education, Mr. Miller took up the occupation of bookkeeper and became an employe in the office of George Urban & Son, proprietors of the Roller Flour Mills. His capacity for business and his genuine worth to the firm were soon recognized, and in 1874 he was admitted into partnership. He then extended

his business relations, and in 1884 became manager of the Gerhard Lang Brewery. His management of this establishment has been highly successful. In financial circles Mr. Miller is an active and yet conservative investor, seeking lines of investment and development that have a permanent future. He is a director in the People's Bank, the German American Bank, the Buffalo Loan, Trust & Safe Deposit Company and the Buffalo Savings Bank. When a movement for increased street car facilities in Buffalo was set on foot and capital began seriously to examine the field, Mr. Miller was among the foremost in giving his influence and support to the scheme, and when finally the Buffalo Traction Company was organized to build a new railway line, Mr. Miller was elected president.

E. G. S. MILLER.

J. T. JONES.

J. M. BRINKER.

John M. Brinker, president of the Niagara Falls & Lewiston Railway Company, is one of the leading capitalists in Buffalo, and has been closely identified with a large number of railroad and manufacturing enterprises. When the project of an electric railway along the base of the Niagara Cañon was first suggested, it was deemed visionary and impracticable by a large number of people and many predicted that if built it would be a financial failure. Captain Brinker, however, after a careful survey of the line, became convinced of both its possibility and advisability, and the correctness of his opinions has been amply proved by the unqualified success of the road. Among other enterprises in which Captain Brinker is at present engaged is that of the Pan-American Exposition to be held near Buffalo in 1899. He is president of the company which is undertaking this exposition and which is composed of prominent capitalists of Buffalo and New York, and is taking an active interest in the work.

Joseph T. Jones was born in Philadelphia, Pa., June 11, 1842, and attended school until the outbreak of the Rebellion, entering the army at the age of nineteen as a private and retiring three years later as captain of his company and commander of a battalion. During his service he received wounds from which he has never entirely recovered. After his discharge he entered actively into the business of producing oil in Pennsylvania, and has since become the most extensive individual oil producer in the United States. He resided in Bradford, Pa., until 1891, when he removed to Buffalo, N. Y., where he now resides. Mr. Jones is president of the First National Bank, of Sistersville, W. Va., and of the Gulf & Ship Island Railroad, which operates an extensive system in Mississippi, a director of the Buffalo General Electric Company, the People's Bank of Buffalo and the Buffalo Commercial Bank. After his removal to Buffalo Mr. Jones' attention was attracted to the promising future of Niagara Falls, and he became largely interested in various enterprises in that city, being president of the Niagara Falls & Suspension Bridge Railway Company and the Pettebone-Cataract Paper Company, a director in the Buffalo & Niagara Falls Electric Railway, and a stockholder in the Niagara Falls & Lewiston Railway, the Niagara Falls Power Company and other institutions which are engaged in the upbuilding of the city; he is also a large owner of real estate in the city of Niagara Falls and its vicinity. Mr. Jones is a public spirited man and a liberal supporter of all measures of benefit to the various communities in which he is interested.

Burt Van Horn was born in Niagara County, N. Y. He prepared for college in the Lockport Union School, and entered Yale in 1871, being graduated from the academic department in 1874. He was also graduated from Columbia Law School in 1878 and was admitted to the bar in the same year. After practising law in New York City for several years he returned to Lockport, N. Y., on account of ill health, and purchased the old homestead, consisting of 350 acres (the greater portion of it being devoted to fruit culture), which he still owns and manages. When the Buffalo & Niagara Falls Railway was projected, the president of that company sought his help in getting the franchises and consents, and during the construction of the road Mr. Van Horn looked after the interests of the company as vice-president and general manager. When the road opened for business he was made secretary, treasurer and general manager of the company, and has continued ever since in these positions, giving his undivided attention to the management of the road.

Herbert P. Bissell, secretary of the Buffalo Traction Company, was born Aug. 30, 1856, at New London, Oneida County, N. Y., and moved to Lockport, N. Y., in 1864, where he attended the public schools. In 1869, he entered De Veaux College, at Niagara Falls, from which he was graduated at the age of sixteen. He then visited Germany and attended the public schools there for two years, when he returned and entered Harvard College from which he was graduated with the degree of A. B., in 1880. In this same year he went to Buffalo and began the study of law with the firm of Laning, McMillan & Gluck. He was admitted to the bar in 1883 and began practice for himself in 1885. In 1887, he became a member of the firm of Bissell, Sicard, Brundage & Bissell, afterwards Bissell, Sicard, Bissell & Carey, with which firm he was associated for ten years. In 1897, he formed a partnership with Hon. J. Henry Metcalf, ex-judge of Ontario County, under the firm name of Bissell & Metcalf. Mr. Bissell was a nominee of the Democratic party for State Senator in 1885, and for District Attorney of Erie County in 1892. He is a director and counsel for the Niagara Falls & Lewiston Railway Company, and attended to its legal business during its organization and construction. He is also a director and counsel for the Buffalo Traction Company, as well as its secretary, and has assisted in its legal work from the time of its organization. Mr. Bissell is also a director and counsel for the Pan American Exposition Company organized to hold an exposition in 1899. He is also counsel for the Buffalo & Depew Railway Company, and is a trustee and treasurer of DeVeaux College.

B. VAN HORN.

H. P. BISSELL.

G. A. RICKER.

George Alfred Ricker, is a prominent engineer who has had charge of the construction and has held the position of chief engineer of the Niagara Falls & Lewiston Railway Company, Buffalo Traction Company and the Buffalo & Depew Railway Company. Mr. Ricker was born June 30, 1863, in Portsmouth, N. H. He attended school at Portsmouth and at Newmarket, N. H., at Liverpool, England, and studied at the Massachusetts Institute of Technology. Mr. Ricker has been connected with a number of steam railroads, having filled the position of second assistant to road-

C. B. HILL.

W. B. RANKINE.

master for the Buffalo & Rochester division of the Erie Railroad, from 1885–1886, assistant engineer Helena & Red Mountain Railroad, a branch of the Northern Pacific Railroad in 1886, and first assistant to roadmaster of the Buffalo division of the Erie Railroad in 1886 to 1887. He opened an office for private practice, Feb. 7, 1887. Mr. Ricker is an associate member of the American Society of Civil Engineers, and is president of the Engineers' Society of Western New York.

William B. Rankine was born in Owego, N. Y., Jan. 4, 1858. He was educated at Hobart College, Geneva, N. Y., and Union College, Schenectady, N. Y., and was admitted to the bar in 1880. Beginning the practice of his profession in the city of New York, he was in active general practice until 1890, when in company with New York associates he organized the Cataract Construction Company, which undertook the work of developing water power at Niagara Falls, and under whose direction about $6,000,000 has been expended in the plants of the Niagara Falls Power Company and its allied companies. In the same year Mr. Rankine became associated with the development and extension of the local street railroad at Niagara Falls, the Niagara Falls & Suspension Bridge Railway Company, of which he is now vice-president. He is secretary and treasurer of the Cataract Construction Company, the Niagara Junction Railway Company, the Niagara Development Company, and the Canadian Niagara Power Company; president of the Niagara Falls Water Works, and an officer and director of other corporations in New York and at Niagara Falls.

Charles B. Hill was born at Albany, N. Y., Mar. 1, 1857, and from early boyhood has resided at Buffalo, N. Y., receiving his education in the public schools of that city. He was admitted to the

C. K. MARSHALL.

P. C. DEMING.

bar in 1881, and has ever since practiced law, confining himself to real estate and corporation practice. Observing the phenomenal growth of his native city, Mr. Hill became interested in real estate transactions on a large scale, being one of the pioneers in the development of Buffalo's famous Elmwood Avenue district. In 1887 Mr. Hill was active in the organization of the Citizens' Electric Railway Company of Buffalo, which sought to build 15 miles of road in that city, but was denied a franchise by the Common Council. In 1890 he became interested in the developments at Niagara Falls, invested largely in land in that city and became one of the purchasers of the Niagara Falls & Suspension Bridge Railway, being elected secretary and treasurer, which office he has ever since continued to hold.

C. K. Marshall was born at Niagara Falls, N. Y., May 24, 1858, and was educated at Otsego University, Otsego, N. Y. He was employed in the city engineer's office, Buffalo, for two years, and during the following three years was on the engineer corps of the Atchison, Topeka & Santa Fe extensions, and returning to Buffalo in 1878 went into electrical work in connection with the Thomson-Houston Electric Company, of Boston, in the construction department of central station work. He continued in this position until 1880, when he entered the railway department of the same company. At this time electric railways were in their experimental stages. He continued in this department, remaining with the General Electric Company when the consolidation was made and did not sever his connection with that company until he took the position of superintendent of the Buffalo & Niagara Falls Electric Railway Company, the position he now holds.

P. C. Deming, superintendent of the Buffalo Railway Company, was born at Buffalo on May 13, 1864. He was educated at Heathcote and the Buffalo State Normal Schools, and in 1883 accepted the position of secretary and treasurer of the Ten Eyck Edge Tool Company, of Cattaraugus, N. Y., remaining in this position until 1885. He returned to Buffalo in 1885, and was engaged with the Barber Asphalt Paving Company uutil 1889, at which time he left this position to enter the city and county treasurer's office at Buffalo. He remained in this office until 1893, when he entered the employ of the Buffalo Railway Company as clerk in the office of the superintendent. He continued in this capacity until Dec. 24, 1892, when he was appointed assistant superintendent. On Nov. 1, 1895, he was made superintendent of both the Buffalo Railway and the Crosstown Street Railway. Mr. Deming is a well known Mason, and has also been a prominent member of the National Guard, State of New York. He resigned his commission in this organization in May, 1896, on account of business reasons.

Joseph B. Mayer is treasurer and one of the prominent promoters of the Buffalo Traction Company. Mr. Mayer was born in

J. B. MAYER.

J. K. BROOKS.

Baden, Germany, but came to the United States before he had attained his majority. He received a thorough elementary education in Germany, and graduated in 1866 from the Freiburg Gymnasium, an institution of the same relative rank as the American high school or academy. Mr. Mayer settled in Buffalo in 1868 and for many years was engaged there in the business of importing diamonds. He continued this line of business until 1891, when the possibilities for making a fortune in the advance of real estate in and near Buffalo impressed itself upon him, and he became a real estate dealer. In this field of enterprise his operations have been on a large scale, and his sagacity, perseverance and tact have enabled him to conduct to favorable results the many important projects in which he has figured. Mr. Mayer is president of the Temple Beth Zion, the leading Jewish congregation in Buffalo, and is a member of the Masonic fraternity and of the Ellicott and Liberal Clubs.

J. K. Brooks has been superintendent of the Niagara Falls & Lewiston Railway Company since it commenced operation in April, 1895. The peculiar conditions under which the line operates have produced novel and difficult problems to solve, but he has proved equal to the emergency, and much of the credit for the successful operation of the line is due to him. He is genial, popular and a hard worker. Mr. Brooks was born in Canada, is thirty-eight years of age, and the Niagara Falls & Lewiston Railway is the first railway with which he has been associated. Before his connection with this company he was associated in the construction of the Niagara Falls tower, and was previously in the milling business.

Richard E. Danforth, superintendent of the Buffalo, Bellevue & Lancaster Railway Company, was born in Buffalo, N. Y., Oct. 5, 1868, and was educated in the Buffalo public schools and at Cornell University, from which he was graduated in 1891 with the degree of M.E. Mr. Danforth entered the employ of the Buffalo Railway Company in September 1891, as lineman's helper, and was made regular lineman during the construction of several east side lines. In February 1892, he was promoted to the position of assistant chief engineer of power house, and assisted in the erec-

tion of engines, boilers, etc. Upon the death of the chief engineer in April, he assumed full charge of the power station. In October he was appointed superintendent of the Buffalo, Bellevue & Lancaster Railway and was instructed to thoroughly overhaul and extend that road. While holding this position he has constructed 6 miles of extensions, and remodeled the entire line. Mr. Danforth has also been engaged in general engineering practice during the past three years, numbering among his clients the owners of many isolated plants and suburban lines.

John C. Brewster superintendent of the Niagara Falls & Suspension Bridge Railway Company, is a native of Niagara Falls,

R. E. DANFORTH.

J. C. BREWSTER.

having been born there Feb. 7, 1862. He received his education in the public schools of that city, and at the age of nineteen entered the service of the New York Central & Hudson River Railroad Company as telegraph operator. He continued with that company for ten years, when in 1891 he was tendered the position of the Niagara Falls & Suspension Bridge Railway Company which he accepted and has held ever since. During his incumbency of this position the road has been entirely rebuilt and largely extended and the traffic has continually increased.

Thomas H. Fearey, treasurer of the Buffalo, North Main Street & Tonawanda Railway Company, has been identified with electric railways in the Buffalo and Niagara Falls district since 1891, when he removed from Louisville, Ky., to Buffalo, to represent the Thomson-Houston Company as railway agent for New York State. He has been successful in selling the electrical equipment of the General Electric Company to all the railways in this district and was one of the promoters of the Buffalo & Niagara Falls Electric Railway. Mr. Fearey was graduated from Union College, Schenectady, in 1863, and during the war was an official in the U. S. Signal Corps. He is a member of the Royal Legion, Grand Army, Ellicott and University Clubs, of Buffalo, and the United Service Club of New York, and American Association for the Advancement of Science. In 1880 he was elected trustee of Union College by the Alumni Association of

T. H. FEAREY.

G. MORGAN.

that institution, and during the recent reunion of the G. A. R., in Buffalo, was chosen president of the U. S. Veteran Signal Corps Association.

Godfrey Morgan, superintendent of the Buffalo, North Main Street & Tonawanda Railway Company, is a son of the late George W. Morgan, a well known organist. He was born in New York City and educated in the public schools and in the College of the City of New York. After his graduation from college he accepted a position as dynamo tender at the Twenty-sixth Street station of the Edison Electric Illuminating Company in New York City. He afterwards entered the students' course at the General Electric Company's shops at Schenectady, and after graduating was put in charge of the stationary and railway motor testing department. Desiring to become acquainted with practical railway work, Mr. Morgan left the General Electric Company, and after a short experience in the South entered the employ of the Amsterdam (N. Y.) Street Railway Company, as a helper at the car house. Within a year Mr. Morgan was appointed general manager of this entire plant. Resigning the management to return to his home in New York City, he entered the employ of the New York Electrical Equipment Company, and subsequently was employed in the business department of the *Electrical World*. Mr. Morgan left this position to assume his present one as superintendent of the Buffalo, North Main Street & Tonawanda Railway Company.

Foreign Visitors and Contracts.

During the month of September there came to America from various foreign countries a number of delegations and individual managers and engineers connected with tramway enterprises in different parts of the world, and by several of them contracts, aggregating in value nearly or quite $1,000,000, were placed with American manufacturers. Some account of these most welcome visitors and friends will be interesting, not only because of their prominence in engineering, financial and railroad circles abroad, but also because their visits are illustrative of the great interest which is being taken in American street railroading by those who have transportation problems of their own to solve on the other side.

About two years ago several of the prominent directors of the Dublin (Ireland) United Tramways Company—Messrs. Murphy, Carte, Anderson and Wigham—came to this country in order to determine upon the best method of electrical equipment for their initial experiment in electric traction to be undertaken in the suburbs of Dublin. Not long after their return, contracts were placed with the British Thomson-Houston Company for this equipment, and its completion and successful operation in every respect is a matter of recent history. A short time ago the proprietors of the Dublin United Tramways entered into a new contract with the city of Dublin, by virtue of which they have obtained forty year franchises and the right to equip their entire system by electricity upon payment of considerable sums annually to the different municipalities served by their lines. Again the company sent its manager and members of its board of directors to America, this time to place contracts for all the required apparatus. The new delegation consisted of William M. Murphy, J. B. Concannon and William Anderson. Mr. Murphy is an ex-member of Parliament and proprietor of a prominent newspaper in Dublin, and for several years has been interested in tramway enterprises in the British Isles. He has recently secured a valuable concession for tramways in Cork, and is associated with the British Thomson-Houston Company in the construction and operation of the tramways to be built under this concession. J. B. Concannon is a member of the London Stock Exchange, and for nearly twenty years has been director in several tramway properties in Great Britain and other countries, among them the Dublin United Tramways, the Barcelona Tramways, the Madrid Tramways and the Rouen Electric Tramways. His interests in Rouen have recently been sold to French capitalists, but he is still managing director of the Barcelona and Madrid Tramways. William Anderson is well known as the genial and able manager of the Dublin United Tramways Company, and his judgment and good sense in the many matters large and small to be passed upon in so important a work as that of converting the entire system from one motive power to another are highly appreciated by his associates in the enterprise. Mr. Anderson and Mr. Murphy were accompanied by their sons on this American trip.

H. F. Parshall, consulting engineer to the Dublin United Tramways Company, arrived in America a short time before the Dublin delegation. For many years Mr. Parshall had been identified with the development of street railway generators and motors in the United States, having been originally connected with the Sprague Company, later engineer of the Wenstrom Company, and still later, with the Edison and General Electric Companies at Schenectady, where he had much to do with designing the company's large generators. About three years ago Mr. Parshall went over to England and opened an office as consulting electrical engineer, since which time he has built up a very large engineering practice. He is now consulting engineer of the British Thomson-Houston Company and of a number of the tramway companies of Great Britain, among them, as before stated, the Dublin company. It is understood that Mr. Parshall's plans for the equipment of the Central London Underground Railway were accepted by its directors practically without change, and it was largely through the skill and ability shown in the preparation of these plans that the British Thomson-Houston Company, for whom they were made and in whose name they were presented, was successful in securing the contract.

The contract for the entire construction and equipment of the Barcelona and Madrid tramways was recently placed by Mr. Concannon in London with Dick, Kerr & Company, Ltd., who have recently perfected their organization for the building of electric railways under contract and have entered upon this branch of work with great energy. George Flett, managing director of Dick, Kerr & Company, together with W. Rutherford, their electrical engineer and Mr. Beaton of their engineering staff, accompanied the Dublin delegation, Mr. Flett's principal object being to decide upon and place contracts for the apparatus to be used in Madrid and Barcelona. As an indication of the extensive contract work that Dick, Kerr & Company, Ltd., have undertaken, it may be mentioned that they have contracts for the entire reconstruction of the Edinburgh tramways from horse traction to cable, supplying all materi-

als, including engines, rails, etc.; the contract for constructing the Blackpool & Fleetwood Railway, about 8 miles of double track, including generating stations; contracts for Barcelona and Madrid as above stated; the contract for the construction of the West Hartlepool Electric Railway; and contracts for several other roads of various sizes, the approximate amount of work now on hand being between $3,500,000 and $4,000,000 in value.

Alfred Dickinson, consulting engineer for Mr. Concannon, and engineer of the Madrid and Barcelona tramways was also of this party. Mr. Dickinson has been a prominent figure in tramway matters in Great Britain for a number of years and is the inventor of the Dickinson trolley, which is used quite largely abroad.

Shortly after the arrival of the Dublin delegation, A. K. Baylor, manager of the railway department of the British Thomson-Houston Company, Ltd., came to America, prepared to bid on the electrical equipment for Dublin, Barcelona and Madrid. Mr. Baylor is well known in America from his former connection with the General Electric Company's railway department, and he has been particularly successful with the work of the British Thomson-Houston Company since he went to London about eighteen months ago.

Tenders for electrical apparatus, engines, trucks and miscellaneous supplies were at once invited by Messrs. Anderson and Flett, and decisions on the major contracts were made just prior to their return to England on Oct. 2. A large number of American firms were represented in the competition. The British Thomson-Houston Company was successful in securing contracts for all the electrical apparatus required in the three places named, together with a bulk contract for nearly all the remaining apparatus and material called for to equip the Dublin lines. The Dublin order was for 150 complete double motor equipments with series parallel controllers, and six 500 k. w. multipolar generators. The Barcelona and Madrid order was for 140 double motor equipments with series parallel controllers, five 400 k. w. multipolar generators, and three 75 k. w. multipolar generators. The total orders thus secured by the British Thomson-Houston Company amounted to about 7000 h. p. in generators and 14,500 h. p. in motors. The Peckham Motor Truck & Wheel Company secured the order for 150 cantilever trucks for the equipment of the Dublin road, while the J. G. Brill Company secured the order from Dick, Kerr & Company for 140 trucks for Barcelona and Madrid. The Edw. P. Allis Company secured the entire engine order for all three cities, consisting of six 500 h. p. engines for Dublin, five 400 h. p. and three 75 h. p. engines for Madrid and Barcelona. The complete order for cars has not yet been placed, but one sample car has been ordered from each of five American manufacturers.

Robert W. Blackwell who represents in London, as is well known, a large number of American manufacturers, is another of our "foreign" visitors arriving in September and is still in this country. Mr. Blackwell is an American and is well remembered by the older men in the electric lighting and railway industries of America. In 1881-83, he was secretary and treasurer of the Gramme Electrical Company which represented the first attempt to pool the electric lighting interests of the country and at the same time he was secretary of two general committees of the United States, one on the reform of patent legislation and the other on underground electrical communication. In 1883 he was secretary of the syndicate formed by the Gramme Electrical Company, the United States Electric Lighting Company and the Brush Electric Company to investigate the possibilities of electricity as a motive power. From 1884 to 1889 Mr. Blackwell was president of the Bentley-Knight Electric Railway Company which did brilliant work in the field of electric traction, opening for passenger traffic in Cleveland, O., in August, 1884, what is claimed to be the first electric railway ever operated in a city street with continuous conductors. In 1889, on the consolidation of the Bentley-Knight Company with the Thomson-Houston Company, Mr. Blackwell settled in London, where he has developed a large business as contractor for complete electric railway equipment and installation and dealer in supplies of all kinds. He now has bulk or detail contracts on hand in Dublin, Cork, Clontarf, Coventry, Brighton, Bristol, Dover, Isle of Man, Guernsey, in the British Isles; and Cape Town, Port Elizabeth, and Brisbane in the Colonies. The principal object of Mr. Blackwell's visit to America at this time is to revise his agency arrangements with American manufacturers, and to undertake new ones. He was also incidentally interested in the award of contracts for Dublin.

R. M. Macdonald, manager of the Christchurch, New Zealand, tramway system was another arrival on our shores in September. The Christchurch system is at present operated by steam dummies, and one of his principal reasons for visiting this country is to investigate the improved motive powers in use in this country with a view to the equipment of his lines upon his return. The system at Christchurch comprises about 20 miles of track. Mr. Macdonald expressed himself as much interested in the developments in electric traction which he has so far seen.

Gustave Fischer, assistant chief engineer of the New South Wales Government Railways, has been making a tour of inspection of the leading electric railway systems of America during the past month. The New South Wales Government has recently decided upon the complete equipment with the overhead trolley of the tramway system of Sidney, which it owns, and of which a description appears elsewhere. The main features of the installation were decided upon before Mr. Fischer left Sydney, but the determination of many of the details will not be made until his return from America.

Perhaps the most distinguished visitor of the many who have come to America this year is Lord Kelvin (formerly Sir William Thompson), whose contributions to theoretical and practical science during the last forty years have been of immense value to the world. Lord Kelvin first attended the meeting of the British Association at Toronto, and upon its close he took occasion to visit a large number of electrical installations and works in the United States and Canada, among them the works of the General Electric Company, at Schenectady, where he was the guest of honor at a large party of prominent American scientists and railroad men on Sept. 23. Included in the party were Count di Brazza-Savorgnan. Spencer Trask, Alanson Trask, R. R. Bowker, Prof. Elihu Thomson, W. F. Merrill, Dr. Louis Duncan, Frank J. Sprague, Dr. Cary T. Hutchinson and representatives of the technical press. The party was entertained by Capt. Eugene Griffin, Joseph P. Ord and E. W. Rice, Jr., the three vice-presidents of the company, and S. Dana Greene, manager of the lighting department; W. B. Potter, chief engineer of the railway department; C. P. Steinmetz, in charge of the company's alternating work, and W. J. Clark, general manager of the railway department.

Acceleration Tests Before Illinois Central Officials.

A series of acceleration tests on the experimental track in the works of the General Electric Company at Schenectady, were carried on on Oct. 7, in the presence of A. W. Sullivan, general superintendent, Renshaw, superintendent of machinery, John Lundie, consulting engineer of the Illinois Central Railroad, and E. C. Carter, principal assistant engineer of the Chicago, Northwestern Railroad. The tests were carried out in connection with the recent decision of the Illinois Central Railroad to equip its suburban tracks running south from Van Buren Street with electric traction in lieu of steam. The need of a very rapid acceleration to cope with the crowded condition of the suburban service of this railroad has been the point upon which the greatest insistence has been laid by the engineers of the Illinois Central Railroad, and especially by John Lundie, and it is to satisfy this point that a series of acceleration experiments under different conditions have been carried on for some time past at Schenectady. The car used in these tests is one of the standard cars sent by the South Side Elevated Railroad of Chicago for equipment to the works. For this occasion it was equipped with four G. E. 57 50 h. p. motors, series parallel controllers, and the usual equipment. In order that the officials might verify for themselves the power consumption, speed, etc., during the tests, a Boyer speed recorder was attached to one axle and readings were made at two second intervals, the time being sounded from a chronograph. Attached to the sides of the car were also a voltmeter, ammeter and wattmeter. The tests were made under bad weather conditions, but the results showed that this car, weighing 25 tons, and carrying eighteen people, could be brought up to a speed of 41 miles an hour in a space of twenty seconds. According to the calculations of W. B. Potter, the chief engineer, such an acceleration as this on leaving stations is equivalent to starting a train on a grade of 15 per cent.

After the tests were completed, a number of runs were made in a car fitted with the electric brake.

The General Electric Company at the Street Railway Convention.

The General Electric Company will make a representative exhibit at the sixteenth convention of the Street Railway Association. The space selected by it is immediately to the left of the entrance on Walnut Street, and the exhibit will occupy 1100 sq. ft. The moving part will consist of motors mounted on trucks. On a pair of McGuire double trucks, an axle of one will carry a G. E. 53 45 h. p. motor, while on the other axle a 22 in. electric brake will be mounted. On the other truck, one axle will carry a G. E. 51 80 h. p. motor, while on the other axle will be a 26 in. electric brake. This type of brake is designed for trailer car use or for application to the unoccupied axle of a car with a single equipment only, the stationary part of the brake being held in position by an iron bar attached to the truck frame. On a set of Brill double trucks will be mounted four G. E. 50 h. p. motors with electric brakes. This equipment is similar to that used on the Cleveland & Lorain road where a high speed service of 50 miles an hour is carried on. To secure the necessary space on the axle for motor and brake, the wheels on these trucks are dished. A Peckham cantilever truck will carry a standard G. E. 52 27 h. p. motor and all will be equipped with series parallel controllers.

The controller used on the McGuire truck equipment will be of the new B 7 type, that on the Brill truck of the B 8 type. The G. E. 51 and G. E. 53 equipment will be handled from one controller, either as a double equipment operating both motors, or, by cutting out either motor, as a single equipment. The wheels between the motor and the axle carrying the electric brake, will be geared together by means of bevel gears beneath the platform on which the truck will rest. A G. E. 55 175 h. p. motor will also be shown, but not in operation.

In the Barney & Smith Car Company's exhibit, two G. E. 1000 motors will be shown on a part of that company's Class H trucks; while in the Peckham Truck & Wheel Company's exhibit two of the G. E. 52 27 h. p. motors will be shown by that company on

one of its trucks. The General Electric Company has also equipped a car for the Duplex Company, of Boston, constructed by the Jackson & Sharp Company, of Wilmington, on Peckham cantilever truck, with two G. E. 1000 motors, electric brakes and the new B 13 controller. This will be shown in active service on the tracks of the Buffalo & Niagara Falls Electric Railway.

The apparatus showing the operation of the magnetic blow-out will comprise four types of automatic circuit breakers, K, L, M and Q, arranged to be shown breaking currents up to 200 amps. The M. D. lightning arrester, also fitted with the magnetic blow-out device will be shown discharging under high potential current obtained from a Thomson X-ray inductorium to represent lightning, the discharge to be followed by current from the 500 volt circuit. This will enable visiting delegates to appreciate the method by which lightning discharges are safely handled in these arresters. The same panel will carry another lightning arrester and a voltmeter. The voltage of the current used will be increased to 2000 volts at which potential the lightning arrester will discharge. This is exhibited to show that in cases in which wires carrying high potential current should fall across trolley wires with one end grounded, the current will not pass through the motors, but will take the path through the lightning arresters. Ten of the new General Electric railway arc lamps will illuminate the space. The wattmeter exhibit showing the street car meter and station output meter especially, will probably be made at the International Hotel.

The headquarters of the General Electric Company will be at the International Hotel, where its interests will be cared for by the following representatives: railway department, W. J. Clark, W. B. Potter, Ralph H. Beach, L. D. Tandy; supply department, J. R. Lovejoy, H. C. Wirt, J. H. Aitken; meter department, C. D. Haskins; convention committee, F. M. Kimball, T. Beran, A. D. Page. The sales offices will be represented as follows: New York, W. G. Bushnell, A. B. Shepard; Chicago. T. P. Bailey; Philadelphia, E. D. Mullen, H. J. Crowley; Boston, C. C. Pierce; Cincinnati, W. F. Hays, F. H. Strieby or H. H. Corson; Atlanta, S. W. Trawick; San Francisco, F. F. Barbour.

Notes From England.

(*By our London Correspondent.*)

The results of the purchase of tramway undertakings in England by town councils are now being made manifest on a considerable scale. The Leeds Corporation electric lines have started running. Sheffield's Town Council is about to begin electric traction. The Blackburn Corporation has by agreement bought out the local tramway company at a price which is about £1 per share over the present market value. The total sum is £77,210. Electric traction will be introduced.

An analysis of the accounts of the Liverpool Elevated Electric Railway for the past half-year shows that the relation of expenses to receipts remains almost stationary. The expenses per train mile were 30.06 cents, against 31.34 cents in the preceding six months, and 30.2 cents in the first half of 1896. The receipts were 47.58 cents per train mile against 49.02 cents and 47.9 cents in the two preceding periods. The percentage of expenses to receipts was 63.18 against 63.93 and 63.05. Owing to the opening of a short extension, about 42,000 train miles more than had ever been run in any previous half-year were covered, so that the profits of the company have gone up considerably.

For the same period the City & South London Electric Railway has done better than ever before, but the improvement does not arise from any diminution in the working expenses. It comes wholly from a large increase in the receipts. The expenses per train mile were 32.44 cents against 30.96 cents and 31.92 cents in the two preceding half years. But the receipts stood at no less than 58.3 cents against 54.5 cents and 53 cents in the former periods. The relation of expenses to receipts was thus 55.64 per cent against 56.81 and 60.23. The mileage run also showed a slight increase, so that there was a substantial addition to the net profits.

Arrangements for buying up tramways are also progressing in Scotland. Terms are fixed by which the Dundee Town Council will purchase the local lines, and at length there is a prospect of the deadlock between Edinburgh and Leith being removed. It is probable that the Leith Town Council will buy up the lines in that burgh and have them worked by cable traction in conjunction with the big cable system of Edinburgh.

Just at the time of writing a report has been published of a speech by the Lord Provost of Glasgow, in which he proposes to the Town Council that the tramway and electric lighting departments should be consolidated, so that in future the supply of electricity for all purposes should be under a single control. He thinks that in this way great economy will be possible. Perhaps so, but the scheme is absolutely fatal to exact knowledge of the working expenses of electric traction in the city. The subject has not been discussed by the Town Council.

Personals.

Mr. J. S. Watters has been appointed superintendent of Wilmington (N. C.) Street Railway to succeed Mr. H. Hues.

Mr. A. B. Skelding has been appointed general manager of the Wilmington (N. C.) Street Railway Company in place of Mr. M. F. H. Gouverneur, recently resigned.

Mr. F. H. Chamberlain has been appointed electrician of the Metropolitan Railroad Company, Washington, D. C., in the place of Mr. W. A. Heindle, who has resigned.

Mr. M. F. H. Gouverneur, formerly general manager of the Wilmington (N. C.) Street Railway Company, has resigned that position to take charge of the Yonkers (N. Y.) Street Railway Company as general manager.

Mr. E. Tremlett Carter, joint editor of the *Electrician* of London, was a visitor to this country last month. Before his return, on Sept. 15, he visited a number of American cities and inspected their electric lighting and railway systems.

Mr. W. Nelson Smith, chief electrician of the New Orleans Traction Company, and Mr. Ben. Johson, assistant superintendent and claim adjuster of the New Orleans Traction Company, have severed their connections with that corporation.

Mr. C. G. Adney, formerly electrician of the Northeast Electric Railway Company, of Kansas City, Mo., has been promoted to the position of superintendent and purchasing agent of that company, to fill the vacancy made by the resignation of Mr. W. O. Hands.

Mr. H. G. Madden, well known to many of the readers of the Street Railway Journal, has recently resigned his position with the Ansonia Brass & Copper Company, and has taken a position with the Bridgeport Brass Company. Mr. Madden's many friends in the street railway field wish him every success in his new position.

Mr. B. Willard has resigned his position as general superintendent of the New Orleans Traction Company to accept that of assistant engineer with the General Electric Company, at Schenectady, N. Y. Mr. Willard has been connected with the New Orleans Traction Company for a long time, and under his supervision the greater part of the system was changed to electric power.

Mr. G. E. Pratt, who for two years has been general manager of the Hunt Air Brake Company, resigned from that corporation Oct. 1, and has associated himself with the Standard Air-Brake Company. Mr. Pratt is well known and popular in the street railway fraternity and is an authority on rolling stock and its problems. He has had a long railway experience, and Manager Wessels, of the Standard Air-Brake Company, is to be congratulated on having secured his services. He will represent the latter company at the Niagara Falls Convention.

Mr. E. C. Baggs, for the past six years claim agent of the Denver City Railroad Company (cable) was last month selected by the board of directors to succeed Colonel Randolph as general manager, whose resignation was announced recently. Mr. Baggs is about thirty years of age, is a native of Philadelphia, and has made a thorough study of cable railways and all subjects connected with the same. He was warmly recommended by Colonel Randolph for the position. The new general manager will also attend to the duties he has heretofore had in charge.

Mr. John Clark, electrician of the People's Railway, of Dayton, O., is known as one of the best electricians in the middle West. Mr. Clark has full charge of the track and overhead construction of the People's Railway. He is a hard worker, takes great pride in his work, and in consequence the construction that is performed under his management, is usually of the very best. Mr. Clark has recently been engaged in equipping the old Wayne Avenue & Fifth Street line with electricity, in building an extension to Fairmount Park and in renewing a great part of the overhead work of the People's Railway.

Mr. W. C. Gotshall, formerly chief engineer of the Union Depot Railroad Company, of St. Louis, Mo., has recently taken two important steps—one highly personal in character, and the other a business one. On Sept. 15 Mr. Gotshall was married to the Countess von Rathgen, originally of Hamburg, Germany, but for many years a resident of the United States. The ceremony took place at the residence of Dr. Heidenfeldt, at Griffin's Corners, in the Catskill Mountains. Not long ago Mr. Gotshall resigned his position with the Union Depot Railroad Company, and is now connected with the Metropolttan Street Railway Company, of New York City, having direct charge of the construction of its Second Avenue line, work upon which is now fairly started.

W. C. GOTSHALL.

Mr. W. O. Hands, until recently superintendent and purchasing agent of the Northeast Electric Railway Company, of Kansas City, Mo., has resigned this position to become construction engineer for the East Side Electric Company, of Kansas City, Mo., a new road just about to be constructed. Mr. Hands began his career in the electrical business in the "Brush Electric" shops

of Cleveland, O. Working through all the various departments, including the machine shop, lamp winding, construction and testing departments. In February, 1890, he engaged with the Short Electric Construction Company, of Cleveland, O., and while with this company he assisted in or had charge of the following work: in March, 1890, he assisted in installing the equipment for the Muskegon Railway Company, of Muskegon, Mich.; in July, 1890, he assisted in installing the electrical equipment for the Rochester Railway Company, of Rochester, N. Y., then said to be the best in the United States; in May, 1892, he installed the equipment for the Pimlico and Pikesville Railway Company, at Baltimore, Md.; in September, 1892, he reconstructed the Georgetown & Tenalleytown Railroad, of Washington, D. C.; in November, 1892, he became electrician and assistant superintendent of the Braddock Railway Company, of Braddock, Pa. From Braddock he went to Beaver Falls, Pa., to become chief electrician and assistant manager of the Beaver Valley Traction Company.

In March, 1894, Mr. Hands left Beaver Falls to become superintendent and purchasing agent of the Northeast Electric Street Railway Company, of Kansas City, Mo. About two weeks before it went into receiver's hands. While in the receiver's hands this property was thoroughly improved. In all these changes Mr. Hands has left with the good will of his superiors, and has letters from every one of them, of which anyone would be justly proud. Mr. C. G. Adney, the present electrician, will be appointed superintendent and purchasing agent.

AMONG THE MANUFACTURERS.

The E. T. Burrowes Company, of Portland, Me., has recently secured the services of W. S. Calhoun, who is well known in the railway trade.

Dick, Kerr & Company, Ltd., of London, England, announce that the company's offices have been removed from 101 Leadenhall Street, to 110 Cannon Street.

The Barney & Smith Car Company, of Dayton, O., reports its business as improving and its shops busy with orders. The management of the company writes us that the prospects are that it will be very busy during the fall and winter.

The Jewell Belting Company, of Hartford, Conn., has changed the name of its brand of belting formerly called "Diamond" to "Hartford." The quality of the leather, workmanship, and finish is exactly the same in every way, the only difference being in the name.

The American Electrical Works, of Providence, R. I., has recently issued a very fine photo-lithograph of the group of attendants at the nineteenth annual clambake given to the electrical fraternity by that corporation. A printed list of the names accompanies the group.

The A. & J. M. Anderson Manufacturing Company, of Boston, Mass., received recently a high testimonial to the value of its electric railway material in being awarded the highest honors at the recent convention at Brussels. Anderson material was placed "Hors Concours."

The Globe Electric Heating Company, of Philadelphia, Pa., reports an increasing demand for its electric heaters. During a comparative test made last winter on the Consolidated Traction Company of New Jersey, of these heaters with those of other makes, the Globe heaters showed very good results.

The Johnson Company, of Lorain, O., has received a large order for rails last month from the Buffalo Railway Company. The order was closed by Major H. C. Evans, the company's Eastern representative. The company was also the manufacturer of the special work for the Charleston (S. C.) Electric Railway, mentioned in our last issue, and not another manufacturer.

Mayer & Englund, of Philadelphia, have secured the contract for all of the overhead material required for the 12½ miles of the Bucks County Railway, running from Doylestown to Willow Grove, Pa. The contract includes all of the weatherproof copper wire and hard drawn trolley wire, together with the overhead fixtures, flexible horseshoe rail bonds and International fare registers.

The Taunton Locomotive Manufacturing Company, of Taunton, Mass., has recently received an order from the West End Street Railway Company, of Boston, for eight double track snow plows for use on that line. The company reports that its snow plow business is most satisfactory and that its orders for plows at present aggregate more than those during the whole of last season.

The Fiberite Company, of Mechanicville, N. Y., supplied the Medbery insulation and overhead equipment for the City of Leeds Electric Tramways. This equipment was purchased through Laing, Wharton & Down, Limited, of London, who represent this material in Great Britain. The number of sales that have been made of this material by these people, indicates its superiority and great popularity.

F. W. McGurk, of New York, has recently invented an automatic fire extinguisher which upon being inverted throws a blast or spray of dry carbonic acid gas against the fire. The device is particularly applicable for station switchboards, cars, marine use, and elsewhere where a stream of water would prove destructive or undesirable. Mr. McGurk will exhibit the extinguisher at the convention, assisted by W. H. Delaney.

The Westinghouse Machine Company, of Pittsburgh, Pa., has recently installed for the Allegheny County Light Company, of Pittsburgh, Pa., four very large Westinghouse engines of the vertical compound marine type, each driving Westinghouse two-phase 1500 k. w. generators. It is claimed that these are the largest steam driven alternating current machines ever built, and that the engines are the largest to which alternating current machines have ever been direct connected.

The Dearborn Drug & Chemical Works, of Chicago, numbers among its customers the North and West Chicago Street Railway Companies, the South Chicago Street Railway Company, the Cleveland Street Railway Company, the Toledo Traction Company, the Milwaukee Street Railway Company, the Smith Street Railway Company, San Francisco; the Los Angeles Street Railway Company, the San Diego Street Railway Company and some one hundred smaller street railway companies.

Eugene Munsell & Company, miners and importers of mica, of New York and Chicago, will exhibit at the convention at Niagara Falls. The exhibit will be in connection with that of the Mica Insulator Company and will consist of both India and amber mica in the sheet, as it comes from the mines, mica segments, and a variety of cut sizes as used by the electrical trade generally. Franklin Brooks, of the New York house, and Chas. E. Coleman, manager of the Chicago branch, will both be in attendance.

Charles A. Chapman has resigned his position with Naugle, Holcomb & Company and opened a consulting engineer's office at 1020 Monadnock Block, Chicago, his specialty being reports on power plants and construction of same. Mr. Chapman is a graduate of Ohio State University, and although still a young man has had a wide experience. During his connection with the firm of Naugle, Holcomb & Company, he had charge of the design and construction of the power plant of the Suburban Railroad.

Henry R. Worthington, of Brooklyn, N. Y., manufacturer of pumping engines, steam pumps, hydraulic machinery, etc., has opened a branch office in New Orleans, La., at 713–717 Perdido Street. Mr. Worthington has also opened a branch office in the Century Building, 317 North 9th Street, St. Louis, Mo. Mr. Worthington has recently issued a very neat catalogue fully illustrated, giving a number of valuable statistics concerning the appliances that he manufactures. This catalogue will be of great interest to all users of pumps or hydraulic machinery.

The Fiberite Company, manufacturer of Medbery insulation and overhead trolley equipment, also manufacturer of the Medbery knife switches, has moved its offices to 1114 Marquette Building, Chicago, Ill. This company will be represented in Chicago by George W. Patterson, who is well known in the street railway field. Mr. Patterson will be pleased to hear from any of the company's old customers and any others in need of first class equipment. The Medbery insulation was used throughout upon the lines of the Leeds Electric Tramways, Leeds, England, which were recently opened to the public.

Wandruszka & Company is the title of a new firm recently organized by Victor O. Wandruszka, with offices at Askanischer Platz, No. 4, Berlin, Germany. The firm will engage in general contracting and engineering business for electric railways and tramways in Germany and Austria. Mr. Wandruszka is at present general European agent for the Steel Motor Company, of Johnstown, Pa., and is well known in electrical and engineering circles in Europe, having been one of the pioneers in electric tramway development in Germany and France. He has the best wishes of his many friends in his present enterprise.

The Gisholt Machine Company, of Madison, Wis., has issued a handsomely illustrated catalogue describing the Gisholt tools. The illustrations show the various types of lathes which this company manufactures and samples of work which these lathes have performed. This company's shops are equipped with the most approved machinery including a large number of machines of its own design, and the company will make special effort to give entire satisfaction to all its customers. Changes and improvements are being continually made in the shops in order that the company's capacity may be kept fully up to all requirements.

George W. Patterson has recently been appointed Chicago and Western representative for the Gordon-Burnham primary battery and the Fiberite Company's Medbery switches and overhead railway appliances, with an office at No. 1114 Marquette Building, Chicago. Mr. Patterson is well known to the electrical fraternity through his past connections as "the busy man in Morse's office," and also by his very ingenious electrical Indian clubs (first famous at the Trocadero in 1893) with which he often entertains friends and the public. Mr. Patterson is a bright and industrious young man, and with two such agencies he should attain unusual success.

L. K. Hirsch, of Chicago, reports good business on new steel rails, splice bars, bolts and spikes, and has constantly on hand a large amount of relaying rails varying in weight from 35 lbs. to 60 lbs. He also has in stock cars, engines and boilers, and is always in the market for old railway material, iron and steel scrap. A recent purchase is a large stock of "Pullman Car" lamps, consisting of one, two and four light and bracket lamps. Most of these are as good as new and will be sold at less than one-half their net cost.

The Western Gear Company, of Milwaukee, Wis., reports a very satisfactory business in gears and pinions. This company's gears are not only used in every part of the United States and Canada, but it also reports orders from European countries. This company makes very strong claims for its method of making gears, which consists of forming the teeth in the casting before cutting, instead of cutting from the solid blank rim. In employing this method the company claims to secure very much closer and more uniform metal in the teeth, and, as a consequence, greater strength and longer life. The cutting is done in special machines, which are fully covered by patents.

Laing, Wharton & Down, Limited, of 82a New Bond Street, W. London, England, is the foreign representative of the Okonite Company, Walker Company, J. G. Brill Company, Fiberite Company, Garton-Daniels Electric Company, and the Creaghead Engineering Company. Laing, Wharton & Down, Limited, report a number of recent orders for these companies, among them being an order for a considerable number of trucks for the Barcelona and Madrid tramway companies, for the J. G. Brill Company; an order for the entire overhead equipment for the tramways at Leeds for the Fiberite Company; and a large order for lightning arresters for the Garton-Daniels Electric Company.

The Miller-Knoblock Company, of South Bend, Ind., advises us that it keeps on hand and is prepared to ship at any time commutators in assembled form for all standard street railway motors. The company, by using the very best Lake Superior copper, the best quality of light amber mica and an improved process, claims a decided advantage over other makers, enabling it to build a more perfect and longer lived commutator at lower price than any on the market. The work is under the supervision of A. W. Morrell, the well known electrical and mechanical expert. The company has recently placed upon the market the Miller electric wide spray sprinkling car which sprinkles all of the street from curb to curb, the water being forced out under pressure.

The Standard Underground Cable Company, of Pittsburgh, Pa., announces that it has opened an office in rooms 1225 and 1226, Betz Building, Philadelphia. This office will be in charge of T. E. Hughes, formerly manager of the company's wire department in New York City. Mr. Hughes will give his entire attention to the trade in the Southern Atlantic States. The Standard Underground Cable Company assures its friends and patrons that all business will receive careful and prompt attention at Mr. Hughes' hands, and with the special facilities of long distance telephone connection between the Philadelphia office and the company's factory at Pittsburgh, the company feels confident of executing all orders with promptness and satisfaction to customers.

The Western Electric Company, of Chicago and New York, has recently issued one of the most dainty and attractive advertising cards that has ever been received at the office of the STREET RAILWAY JOURNAL. The card is of heavy paper, 14 ins. long by 11 ins. wide, and on the card is painted, in all the natural colors and tints, a representation of a box of strawberries from which the stawberries have been partially poured upon a table. Under the picture is printed the company's motto, "Full measure and good quality," and on the back of the card is shown a number of Western Electric enclosed arc lamps. The whole design makes an extremely suggestive and delicate reminder that the Westean Electric Company is prepared to furnish a complete line of electrical supplies with the best possible satisfaction to its customers.

H. F. J. Porter, general sales agent of The Bethlehem Iron Company, with headquarters at 1433 Marquette Building, Chicago, Ill., has during the past six months been located at the works in South Bethlehem, Pa., during the absence in Europe of R. W. Davenport, second vice-president. Mr. Porter is spending a few days at his office in Chicago, and reports that there is a decided improvement in the steel forging business in the East, and that there are evidences that business will pick up rapidly in the West. He will return to the works and have his headquarters there during the winter. His Western office will be in charge of his assistant, Erwin Nelson, who will be glad to answer all correspondence and give information on matters relating to steel forgings of all descriptions.

The Miller-Knoblock Company, of South Bend, Ind., by using an improved process, which is the invention of A. W. Morrell, the well known electrical and mechanical expert, is making assembled motor commutators for all standard railway motors. The appliances and tools for doing the work turn out, it is claimed, an especially fine commutator and one with a very long life. The fact that Mr. Morrell has charge of making the commutators, will in itself be a recommendation. The company states that commutators can be ordered and received by return freight, as a sufficient stock will be carried so that they can be forwarded immediately. The company will also carry in stock ready for prompt shipment armature coils for all standard motors and will either ship full or broken sets. The company's appliances for rewinding armatures and field coils are exceedingly good.

The Phœnix Manufacturing Company, of Meadville, Pa., which recently supplied one of its engines to the Yokkaichi Electric Light Company, of Japan, is just in receipt of a communication from its Japan agent, Lamar Lyndon, of Kobe, Japan, in which he encloses a letter which reads as follows: "We have the pleasure to inform you hereby that in the first part of this month we got through with the setting up of the engine which we bought of you, and same was inspected yesterday by the government officials, and the result was so satisfactory that we thank you for same, and are glad to give you hereby testimonial for the strongness and perfectness of the engine which you are selling. (Signed) The Yokkaichi Electric Light Company, Limited." This is a 75 h. p., tandem compound, condensing engine, 7½ and 13½ ins. cylinder, 12 in. stroke.

The Pierce & Miller Engineering Company reports a strongly marked increase along all its lines of business, following the return of its president, F. M. Pierce, from his tour around the world, during which he made many valuable connections. From observations which he made while abroad, he decided that America would do a large European business in furnishing equipments for electric tramways, a d to accommodate this, and the rapidly increasing home trade, a large increase in this company's engineering and selling force has been drawn from England and Ireland. Mr. Pierce has made strong financial connections in London and New York, which enables his company to "finance" electric railway, and other first class enterprises. This company reports work in hand as follows: one 3000, three 1200, three 300 h. p. and several hundred horse power in small engines, and one complete railway power plant.

F. W. Bunts, formerly assistant secretary and treasurer of the Walker Company, of Cleveland, O., has bought out the Cuyahoga Supply Company, dealer in electric street railway and lighting supplies, and general selling agent for Eugene Munsell & Company and the Mica Insulator Company, in Cleveland, and northern Ohio. Mr. Bunts will continue the business under the same title as formerly, occupying the offices at 102 Superior Street. Mr. Bunts is a young man who has a large acquaintance in the city of Cleveland and vicinity, and his association with the electrical trade will, no doubt, bring to his company a large business. His leading lines, to which he will devote his special attention, will be the "micanite" specialties as manufactured by The Mica Insulator Company, of New York, Chicago and London, and Eugene Munsell & Company's India and amber mica in all of its various forms.

The Mica Insulator Company, of New York, Chicago and London, will exhibit at Niagara Falls a full line of its insulating specialties. Since the convention at St. Louis, one year ago, the company has added many new insulating materials to its already extensive line, two of the most important being the flexible micanite plate and the "M. I. C." insulating compound. "Micanite" and "Empire" cloths and papers, together with the micanite plates for commutator segments, will be attractively displayed, also several sets of commutator rings and segments for railway generators and motors. This exhibit promises to be one of the most attractive the company has yet made, and will be of special interest to both the electricians and railway managers present. Franklin Brooks, vice-president of the company, and Chas. E. Coleman, manager of the Chicago branch, will be in attendance.

Wendell & MacDuffie, 26 Cortlandt Street, New York City, report the following sales of snow plows, manufactured by the Taunton Locomotive Manufacturing Company, of Taunton, Mass., viz,: Brockton, Bridgewater & Taunton Street Railway three plows, Brockton & East Bridgewater Railway, one plow; Bridgewater, Whitman & Rockland Street Railway, two plows; Worcester Construction Company, three plows; West End Street Railway, of Boston, eight plows; New London Street Railway, one plow; Hingham Street Railway, one plow; Norwich Street Railway, one plow; Buffalo Traction Company, two plows; Rockland & Abington Railway Company, one plow; Exeter Railway Company, one plow. These orders are evidence of the good standing which the Taunton plow enjoys among street railway men, and before the time that snow flies, it is not unlikely that this firm will double the list of orders.

The Ohio Brass Company, of Mansfield, O., is led to believe from the present indications that this season's sales of the adjustable track brush holders will far exceed all previous ones. During the past month several large foreign shipments of holders and brooms were made, one consignment alone being for forty-five sets, and in addition numerous orders have been received from roads operating in this countay for both initial and additional equipment of these. Several important changes have been made in the detailed way of manufacturing the holders since they were first placed upon the market two years ago, although their method of operating and the manner in which they are handled remains very much the same. These modifications have increased very greatly both the efficiency and durability of the holders as well as of the brooms themselves, making them not only more economical, but far more satisfactory to use than any other similar appliance.

The Wagner Electric Manufacturing Company, with general offices and factory at St. Louis, Mo., carries on a very extensive business in different street railway supplies. This company makes a specialty of high potential switchboards for lighting and power transmission stations, street railway, 500 volt, direct current switchboards, isolated plant switchboards, high grade knife switches, ammeters, voltmeters, wattmeters, etc. The Wagner Electric Manufacturing Company is prepared to furnish standard feeder panels for installation, either in connection with generators or feeder panels of any other standard manufacture, or for independent board service. These panels are of a variety of forms, the aim being to furnish a sufficient number of panel arrangements to meet practically every station requirement that is likely to arise. The mate-

rial used throughout the factory of this company is of the very best, and workmanship and finish all that could be asked for.

The Berlin Iron Bridge Company, of East Berlin, Conn., has recently received a large contract from the Philadelphia Gas Improvement Company, of Philadelphia, Pa., for increasing that company's plant by erecting a new fireproof pipe shop, constructed entirely of iron. The building has steel framework and a corrugated iron covering. The Berlin Iron Bridge Company has also received a contract for the construction of a new building for Maris Brothers, manufacturers of traveling cranes, of Philadelphia, Pa , who are erecting a new machine shop to meet the demands of their increased business. The new building will be modern and designed to meet all the requirements of a handy and serviceable machine working establishment. It will be 55 ft. × 75 ft. Running the full length of the building will be a ten ton power crane having a span of 30 ft. One side of the building will be arranged with a gallery on which will be placed the lighter machinery. The framework of the building is of steel, and the covering of the sides and roof will be corrugated iron.

The Jewett Car Works, of Jewett, Harrison County, O., have recently been bought by new parties. This business will hereafter be carried on under the name of the Jewett Car & Planing Mill Company, and the plant which is a large two story building will still be located at Jewett. This plant is on the lines of the Pittsburgh, Cincinnati, Chicago & St. Louis Railroad and the Wheeling & Lake Erie Railway, giving it shipping facilities of the very best. The plant is being thoroughly overhauled, equipped and stocked with modern machinery and the best material to be obtained, and will have a capacity of 300 cars per annum, besides planing mill work in all its branches. The new firm consists of A. H. Sisson, W. H. Lorentz and C. E. Krebs, all of Wheeling, W. Va. Mr. Sisson, manager of the firm, is a man of business ability, enterprise and experience and is well known in business circles. The other members of the firm are hustling young men well fitted to do their part, while the firm as a whole forms a combination which undoubtedly will stand in the front rank in its line of business.

The Hoppes Manufacturing Company, of Springfield, O., reports quite an improvement in business, within the past few weeks having received orders from the following: the Union Traction Company, of Philadelphia, three large exhaust steam feedwater heaters, aggregating 8000 h. p., for the Mt. Vernon station of this company, that was recently destroyed by fire; Henry R. Worthington, for the Ridgewood Pumping Station, Brooklyn, N. Y., 500 h. p. live steam feedwater purifier; Westinghouse, Church, Kerr & Company, for Flushing, L. I., N. Y., 400 h. p. purifier and 400 h. p. heater; East St. Louis (Ill.) Ice & Cold Storage Company, 500 h. p. heater; Kirkhoff Brothers, Indianapolis, Ind., 400 h. p. heater; Live Oak (Fla.) Manufacturing Company, 100 h. p. purifier; Argentine (Kan.) Water & Light Company, 150 h. p. heater; Ames Estate Building, St. Louis, Mo., 150 h. p. heater; Miami Valley Railway, Piqua, O., 200 h. p. heater; Bettendorf Metal Wheel Company, Springfield, O., 100 h. p. heater; Excelsior Milling Company, Yankton, S. D., 100 h. p. heater; Taggart & Son, Knoxville, Ia., 75 h. p. heater.

The Hunter Illuminated Car Sign Company, of Cincinnati, O., reports during the month of August that it has sold full equipment signs to a number of roads. Of these the following principal roads gave this sign a critical test before placing the order for the full equipment: Staten Island Midland Railroad Company, Staten Island, N. Y.; United Traction Company, of Pittsburgh, Pa.; and The Lindell Railway Company, of St. Louis, Mo. This sign seems to have attracted the attention of street railway managers as the company reports that it has eighty-seven different roads in the United States now testing the sign. It claims that the first cost of this sign is somewhat in excess of the ordinary signs now in use, but in the end will prove very much cheaper. It is possible with this sign to incorporate as many as twenty-seven different terminals in the one sign and a car installed with the same can be run over all divisions of any system. The motorman by operating a small dial can change the name of one terminal to any other desired. The success of this sign since its introduction seems to predict a very bright future for the company.

Mr. Robert Graham-Woodward, who is a Fellow of the American Association of Public Accountants and author of the "Safety Duplicate System of Banking" and the "Economic Check System of Street Railway Accountancy" has opened an office as professional street railway accountant at 26 Cortlandt Street, New York. Mr. Woodward will make a specialty of street railway accounts, having been auditor for street railway companies on the Pacific Coast for over three years, and connected with street railways in their operating departments for five years, besides following the profession of public accountant and corporation auditor for the same length of time. He will advise street railway companies upon the division of their accounts during construction and arrange them systematically for economic operation, take charge of special, periodic, consolidation or receivership accounting, make special examination of street railways proposing to issue bonds for trust companies, banks and prospective investors, etc. For regular daily operation he has devised a perfect check and record of the working of each department showing disposition of stock and labor and cost of operation daily, with a minimum of clerical effort.

Warren Webster & Company, of Camden, N. J., have recently received two large contracts, one to install the Webster system of steam heating in connection with the large new Hudson Building, New York City, and the other to install the system in the works of Rand Drill Company, Tarrytown, N. Y. The firm's works are running to their full capacity, and there are a number of large prospective orders in sight, which proves the appreciation of the merit of the Webster system of steam heating and allied specialties. Warren Webster & Company have also received contracts for installing the Webster system of steam heating from the following: Gale Shoe Manufacturing Company, Haverill, Mass.; New Britain High School, New Britain, Conn.; Parker Block, Lowell, Mass.; Simon Silk Mills, Easton, Pa.; Minnesota State Prison, Stillwater, Minn.; South Boston Buildings, Wormwood and Binford Streets, South Boston, Mass. This company has also secured through its New York office a contract for changing the present steam heating system in the New York Life Insurance Building to the Webster system. This building contains over 5,000,000 cu. ft. of space and is one of the largest buildings in the city of New York.

The Goubert Manufacturing Company, of New York, reports its business as excellent, and among the orders for heaters now in the company's shops, numbers the following: 3500 h. p. for the St. John (N. B.) Street Railway Company; 4000 h. p. for the United Electric Light & Power Company of New York City, making the second of that size ordered from the Goubert Company; 3600 h. p. for the Third Avenue Railroad Company, of New York City; 1200 h. p. for the Metropolitan Street Railway Company, of New York City, and 1200 h. p. for the United States Government for installation in the Navy Yard at Mare Island, San Francisco. The company is also doing a large business in combination receivers and Stratton separators, and mentions the following among its recent orders for this apparatus: for the Allegheny County Light & Power Company, four 10 ins. two 6 ins. and one 5 ins; for the United Electric Light & Power Company, of New York City, two 10 ins. and one 5 ins.; for the Cape Town (South Africa) Tramway Company, three 6 ins. and one 8 ins.; for the Knoxville (Ky.) Woolen mills one 7 ins.; for the Third Avenue Railroad Company, of New York City, one 6 ins. one 7 ins. and one 8 ins. The sales of standard separators are also very large.

The Ohio Brass Company, of Mansfield, O., recently secured through its new Canadian agents, the Northern Electric & Manufacturing Company, Limited, of Montreal, an order for the entire track bonding, and overhead construction material which will be used in the electrical equipment of the Sherbrooke (Quebec) Street Railway Company. As this order was secured very shortly after the Northern Electric & Manufacturing Company, Limited, had accepted the Canadian agency it gives every indication that the arrangement between the two companies will be of mutual advantage. C. K. King, secretary of the Ohio Brass Company has just received official notice from the Patent Office that a patent has been allowed him on a new and improved method of attaching hangers and ears to the trolley wire by the use of rivets or similar means; also on a specific form of a trolley wire splicer. This patent relates particularly to the devices that are adapted for use with figure 8 and similar designs of conductors. The Ohio Brass Company has manufactured and sold under this patent to electric railway companies in the United States since the first of the year a sufficient quantity of overhead construction devices for figure 8 trolley wire to build 300 miles of single track line.

The Murphy Manufacturing Company, of Pittsburgh, Pa., reports an increasing interest in its car wheel grinder. A representative of this paper recently paid a visit to the Glenwood shops of the United Traction Company, of Pittsburgh, for the purpose of seeing the Murphy wheel grinder in operation. A car was selected, having four badly flatted wheels under it, the flat places being fully 8 ins. in length and about ¾ in. in depth. From the time the car was placed in position on the machine to the time after grinding the wheels to a perfect true, occupied only twenty-seven minutes. It has been claimed that in grinding a wheel by this method the temper is drawn by the heat caused by friction. This was easily discovered to be absolutely without foundation, because at no time was the wheel hot enough to even warm the hand while in actual operation. The machine is very simple in construction, and after being perfectly installed does not require expert machinists to keep it doing good work. It is well designed and should last a lifetime. One of them will be placed in practical operation in the Exposition Hall during the convention at Niagara Falls. Mr. Murphy, the inventor, is a practical street railroad man, and fully knows the requirements necessary to get the full mileage of a wheel.

The McGuire Manufacturing Company, of Chicago, Ill., is having a season of unusual activity, and its sweeper and truck departments are running to their fullest capacity. Its truck department is especially busy and the company reports enough orders in this department to keep it busy until the holidays. The first shipment of trucks for the South Side Elevated Railway of Chicago, has been made, and they are the object of much favorable comment. This company's new "Columbia" heater, which is described in another column, has apparently decided a great many railway men who had wavered between the different styles of car heating, and the number of orders already received for these heaters is very large, considering the season. The sweeper department is also very busy and the company has received orders for eighteen sweepers in the past three weeks. The McGuire Manufacturing Company will make an extensive display at the coming convention of the American Street Railway Association, and will also show a pair of the South Side Elevated trucks in the General Electric exhibit. The McGuire Manufacturing Company, has also closed a contract

through Elmer P. Morris, its New York agent, for five combination snow plows and sweepers, for the North Hudson County Railway Company, of Hoboken, N. J., also one with the Atlantic Highlands, Red Bank & Long Branch Electric Railway Company of Red Bank, N. J.

The New York Switch & Crossing Company, of Hoboken, N. J., is doing a good business in the manufacture of special work, and recently completed an elaborate installation at the corner of Smith and Ninth Streets, Brooklyn. This is a double track crossing with double track curve. It has hardened steel centers and is bound together with cast iron. The company is also having excellent success with its automatic electric track switch which has been described in previous issues. This is a tongue switch which is operated from the platform of the car without the employment on the platform of any auxiliary apparatus whatever and is extremely simple and reliable. The switch has been in successful operation for more than two years on the North Hudson County Railway, of Hoboken, N. J., on whose system seven of these switches are now in use. The Brooklyn Heights Railroad Company has also seven of these switches, the Brooklyn City & Newtown Railroad Company has three of these switches, and others have been installed elsewhere. A good idea of the merits of the switch can be obtained from a letter recently received by W. C. Wood, president of the New York Switch & Crossing Company, from John N. Partridge, president of the Brooklyn City & Newtown Railroad Company. Mr. Partridge says: "In reply to your inquiry about the electric switches you furnished us, the first one was put in in October, 1896, at a point where about 700 cars pass over it daily. We have had no trouble with it at all. It has worked equally well when there were heavy falls of snow. All that we had to do was to keep the snow clear from it with brooms or salt or both. It is because we were so well pleased with it that we ordered a second one at a similar point this spring."

The Clonbrock Steam Boiler Company, of Brooklyn, has a large number of orders ahead for prompt delivery, and many of these are from old customers who are enlarging their plants. This company is highly pleased with the business outlook, all indications pointing to a busy future. It has secured the entire power plant required by the Trans-Mississippi & International Exposition Company, Omaha, Neb., which is a great trimuph for the Climax boiler. In addition to these orders, the company has recent sales as follows: The Salt Lake County Light, Heat, Power & Cold Storage Company, Salt Lake City, Utah, four 250 h. p. boilers; Queen Dyeing Company, Providence, R. I., one 400 h. p. boiler; the United Electric Light & Power Company, New York City, three 600 h. p. boilers; the Providence Gas Company, Providence, R. I., one 250 h. p. boiler, second order; the Converse Building, Boston, Mass., two 125 h. p. boilers; the Roxbury Gas Company, Roxbury, Mass., two 50 h. p. boilers; the Economy, Light, Heat & Power Company, Scranton, Pa., two 300 h. p. boilers; People's Light & Power Company, Jersey City, N. J., one 600 h. p. boiler, fourth order; Whitney Factory, North Attleboro, Mass., one 80 h. p. boiler; Brazer Building, Boston, Mass., two 90 h. p. boilers; New Jersey & Pennsylvania Construction Works, Edison, N. J., two 350 h. p. boilers, third order; Riverside Iron Works, Wheeling, W. Va., two 550 h.p. boilers, twelfth order; Tennessee Centennial Exposition Company, Nashville, Tenn., 2500 h. p.; Providence Gas Company, Providence, R. I., one 200 h.p. boiler; the Crescent Insulated Wire & Cable Company, Trenton, N. J., one 200 h. p. boiler; Jacksonville Electric Light Company, Jacksonville, Fla., one 200 h. p. boiler; the Jersey City, Hoboken & Rutherford Electric Railway Company, Rutherford, N. J., one 350 h p. boiler, second order; Geo. Watkinson & Company, Rubber Works, Philadelphia, Pa., one 300 h. p. boiler, second order; People's Light & Power Company, Orange, N. J., two 600 h. p. boilers; New York Steam Company, East Sixtieth Street, New York City, two 1000 h. p. boilers; Hazelton Manufacturing Company, Hazelton, Pa., two 200 h. p. boilers; The American Manufacturing Company, Brooklyn, N. Y., one 500 h. p. boiler, second order; Mathieson Alkali Works, Saltville, Va., one 500 h. p. boiler, second order; Latimer & Fernandez St. John, Porto Rico, one 250 h. p. boiler; Edison Electric Light Company, York, Pa., one 350 h. p. boiler.

New Publications.

SOME PHENOMENA OF HIGH SPEED ROTATION. By James F. McElroy, A.M.

This is a reprint of an interesting paper read before the Albany Institute, Feb. 2, 1897, on the action of bodies under high rotative speed, particularly steam turbines.

SOME FUNDAMENTAL PROPOSITIONS RELATING TO THE DESIGN OF FRAMEWORKS. By Frank B. Cilley, S. B. Paper. Twenty-five pages. Reprinted from the *Technology Quarterly*.

In this article, which is reprinted from the *Technology Quarterly* for June, 1897, Mr. Cilley upholds the American method of statically determined truss construction as opposed to the European indeterminate method and aims to prove that the former is more economical and exact. His arguments, which are accompanied by an example, are pointed and should be read with interest by bridge engineers.

GAS, GASOLENE AND AIR VAPOR ENGINES. By Gardner D. Hiscox, M. E. Published by Norman W. Henley & Company, of New York City. 206 handsome engravings, 280 pages. Price, $2.50.

This book is designed for the general information of everyone interested in gas or gasolene as a motive power, and its adaptation to the increasing demand for a cheap and easily managed motor requiring no licensed engineer. The book treats of the theory and practice of gas, gasolene and air engines, and is designed and manufactured in the United States. It also contains chapters on horseless vehicles, electric lighting, marine propulsion, etc.

RAILWAY TRACK AND TRACK WORK. By E. E. Russell Tratman. Published by the Engineering News Publishing Company. 418 pages. Illustrated. Price $3.

This is a comprehensive and carefully written treatise upon a subject of great importance and on which a book of this character was much needed. It takes up in detail the roadbed construction and ordinary track material (rails, wooden and steel ties, rail joints and fastenings, switches, frogs, fences, cattle guards, track tools, etc.), and also includes such allied subjects as bridge floors, coal and water stations, turntables, section houses and track signs. The different methods and practices are not only described, but are treated critically, the author pointing out, where possible, which of several forms used he considers most desirable. There are over 200 illustrations and an index.

ELECTRIC RAILWAYS & TRAMWAYS: THEIR CONSTRUCTION AND OPERATION. By Philip Dawson, C. E. Published by John Wiley & Sons, London and New York. 677 pages. Illustrated. Price, $12.50.

This is the most elaborate book ever published devoted exclusively to the subject treated. The work is based upon a series of articles by the author which has appeared during the last two years in London *Engineering*, but the matter as published there has been entirely revised, enlarged and brought up to date. Naturally Mr. Dawson devotes a great deal of attention to American practice, a subject with which his visits to this country have made him familiar, and in a number of instances special installations are described with much detail and care. The scope of the book is wide, including not only a technical description of the machinery and apparatus used, methods of construction, and descriptions of important installations, but the operating side as well, one chapter being devoted to accounts and their classifications, another to the management of electric lines, another to organization, discipline and rules, another to statistics, etc. As a whole, the book will be found very interesting, and while the price appears somewhat high, there should be a good demand for it on both sides of the Atlantic.

A Card to the Public.

As a protection to my business and the large interests of others connected therewith, I have been strongly urged by my customers throughout the country to give the public a plain statement of facts, which I trust will serve to refute the malicious statements which have been made in reference to my business, and scattered broadcast by those who, through self interest, have sought to destroy a competitor. In June, 1896, previous to starting upon a tour around the world, it was found that for the best interests of my business, the services of J. D. Miller would no longer be required, and I then became sole owner of the stock of the Pierce & Miller Engineering Company through the purchase of his small interest. E. A. Merrill, at that time in my employ, was placed by me as acting president in my place, to represent and protect the company's interests in my absence.

During six years of most friendly and satisfactory business relations, the Pierce & Miller Engineering Company paid a certain firm, known as McIntosh, Seymour & Company, about $1,100,000 for some 90,000 h. p. of its engines, which we largely introduced in the market under great difficulties. On my return from abroad, this firm demanded that I should sever my connection with an organization which resembles Free Masonry in that its purpose is unsectarian humanitarian work.

Holding the position that independent thought and action is one's sacred right, so long as it does not interfere with the rights of others, I immediately severed my company's connection with this firm, and have since proved to my own satisfaction that I pursued the right course. To make further misrepresentations impossible, I am now taking steps to change the name of my company from the Pierce & Miller Engineering Company to "F. M. Pierce Engineering Company." Mr. Merrill is no longer in the employ of this company.

Still holding to the fact that "the best is the cheapest," we have made new arrangements on this basis, and now offer to our friends and the public the "Rice-Sargent" engine in sizes from 300 h. p. to 3000 h. p., also the "Standard" Ball engine, built in Pennsylvania, in sizes from 20 h. p. to 500 h. p.—either machine of any type desired.

Using these engines, we are now prepared to contract for power plants exceeding in efficiency and economy the numerous high grade plants we have installed in the past.

Strong financial connections we have made in London and New York now enable us to "finance" electric railways and other first class enterprises; this in addition to the enlargement of our old established business of contracting engineers, through European connections. I take this opportunity to thank our friends for their liberal patronage.

F. M. PIERCE, President,
Pierce & Miller Engineering Company.

DIGEST OF CONTENTS.—OCTOBER, 1897.

Abkürzung des Inhalts—Oktober 1897.

Die Elektrischen Bahnen der Niagara Falls Gegend [Seite 585.]

Dies ist eine Uebersicht der Entwickelung und der gegenwärtigen Lage der Gegend in der Umgebung von Buffalo und der Niagara Fällen, so wie derer Verkehrssystems. Dieses letztere bestehen aus ungefähr vierzehn verschiedenen elektrischen Bahnen, unter welchen sich ein gutes Beispiel von einer modernen städtliche Strassenbahn in einer Stadt von nahezu 350,000 Einwohner befindet; ferner gibt es eine Vorortbahn von einer Länge von ungefähr 40 Kilometer, und eine scenische elektrische Bahn welche durch die ganze Strecke des Niagara-Canyons fährt, in einer Entfernung von 12 Kilometer unterhalb der Fällen. Der Bau dieser letzteren Linie war besonders schwierig, und mit manchen technischen Problemen verbunden. Wasserkraft, von den Niagara-Fällen entnommen, wird für die Erzeugung des durch die meisten dieser Linien erforderlichen Stromes benutzt.

Dampfmaschinen für elektrischen Strassenbahn-Kraftstationen, von Charles E. Emery, Ph. D. . . . . [Seite 612.]

Dies ist der erste einer Reihe von Artikeln welche in den Internationalnummern des STREET RAILWAY JOURNALS erscheinen werden. Deren Verfasser ist einer der bedeutendsten Dampfmaschinen-Ingenieuren von Amerika, welcher während den letzten dreissig Jahren oder mehr in fortwährender Praxis war, und sich letzthin besonders mit den Verhältnissen des elektrischen Betriebs für Eisenbahnen beschäftigt hat. Etliche der in diesem ersten Artikel erläuterten Themen sind die folgende:

Bedürfnisse für Maschinen die auf dem elektrischen Betrieb verwendet werden; schwächere Punkte in Dynamos; massives Aussehen; oekonomische Gestaltung; allgemeine Regeln für die Proportionirung der Maschinen; Vergleich zwischen senkrechten und horizontalen Maschinen; Klappen und selbstbewegliches Klappenverfahren; Zwischenraum für compound Maschinen.

Zum Schlusse werden sechs der hervorragendsten amerikanischen Maschinen von dem "cross compound" Typus mit Corliss-Klappen beschrieben, und in gewissen derer hauptsächlichen Theilen verglichen, auch werden verschiedenen Abbildungen der Werkstätten der Fabrikanten jener Maschinen in vollem Betriebe gegeben.

Der nächste Artikel wird sich mit anderen Gattungen von Maschinen beschäftigen, welche in derselben Weise beschrieben und illustrirt werden.

Bericht über die Versammlung in Hamburg . . [Seite 632.]

Ausführlicher Bericht über die am 5. August stattgefundene Versammlung des Deutchen Strassenbahnvereins, nebst Photographieen einiger der ausgestellten Artikeln.

Versammlung des Vereins der Strassenbahnen des Staates New York [Seite 633.]

Die Versammlung fand den 14–16 September statt, und die folgenden Mittheilungen wurden gelesen;

"Wie können wir die Fähigkeit unserer Angestellten erhöhen?" "Ein Jahrzehnt der Strassenbahnen-Entwickelung"; "Der Einfluss von Messungen über ein ökonomischer Betrieb"; "Meilenstrecke von Strassenbahnen"; "Vortheile eines modernen Srassenbahnen-Betriebs"; "Elektrische Strassenbahnen-Reparaturwerkstätten"; "Städtlicher Eigenthum und Betrieb von Strassenbahnen;" "Das beste Verfahren um Unfälle zu vermeiden"; "Niedrige Schienenstösse—wie sie vermeiden werden können;" "Wagenräder—sollen sie schwerer gebaut werden?" "Reparatur von Wagenkasten."

Versammlung des Pennsylvanien Strassenbahn-Vereins [Seite 649.]

Der Kampf der Triebkräften . . . . . [Seite 650.]

Dies ist ein Auszug der Herausgebern des STREET RAILWAY JOURNALS über die eigenschaftlichen Vor- und Nachtheilen der verschiedenen Systemen von Triebkraft welche gegenwärtig von den Dampf- und Strassenbahn verwaltungen in jedem Welttheile studirt werden.

Es ist die Meinung der Herausgebern dass eine ausführliche Erörterung dieses Themas gerade jetzt zeitgemäss ist, wo jede Strassenbahnverwaltung ihr Augenmerk auf die in dieser Beziehung bestehenden Einrichtungen lenken, und die gemachten Erfahrungen anzuwenden trachten.

Verwaltungsrath und Exekutiv-Komitee des Amerikanischen Strassenbahnvereins . . . . . [Seite 654.]

Die Niagara Falls Convention . . . . . Seite 658.]

Ausführlicher Bericht über die sämmtliche Erörterungen welche bei der kommenden Versammlung des Amerikanischen Strassenbahnvereins und des Vereins der Strassenbahn-Rechenmeister von Amerika stattfinden wird. Die Convention wird im Niagara Falls vom 19. bis inclusiv 22. Oktober gehalten.

Das Strassenbahnsystem der Stadt Sydney, Australien. [Seite 661.]

Dieses System ist der Eigenthum der Regierung, und beträgt eine Länge von 130 Kilometer, wovon 103 k. m. gegenwärtig vermittelst Dampf, 15 km. durch Kabel, 5½ km. elektrisch und 1½ km. durch Pferde betrieb werden. Die Regierung entschied sich letzthin die durch Dampf betriebene Linien mit elektrischer Traktion zu versehen, und werden die vorgenommenen Pläne ausführlich beschrieben. Vier direkt verbundene, 650 kw. starke Maschinen sowie vier Akkumulatoren-Hilfstationen werden so fort eingerichtet.

Die Strassenbahnfrage in Wien, von E. A. Ziffer . [Seite 663.]

Beschreibung, durch einen österreichischer Ingenieur, der Aenderungen welche letzthin in der Wiener Strassenbahnfrage stattfanden. Nach dem Verfasser wird die Stadtverwaltung wahrscheinlich einen wesentlicheren Einfluss über den Betrieb der Strassenbahnen als bisher üben, während dem Privatkapital Gelegenheit gegeben wird, das Netz bedeutend zu erstrecken.

Vertheilung der Meilenlänge und der Kapitalisirung der Strassenbahnen in Amerika . . . . . [Seite 665.]

Dies ist eine statistische Analyse der Vertheilung und Entwickelung der Meilenlänge und Kapitalisirung von Strassenbahnen in verschiedenen Staaten und Theilen der Vereinigten Staaten und Canada, in Verhältniss auf derer Bevölkerung.

Ein Kapitel über Unfällen, von W. J. Clark . . [Seite 667.]

In diesem Artikel werden Daten über Unfällen aller Art gegeben, inclusiv solche, die durch den Betrieb von Pferde-, elektrischen und Drahtseilbahnen während den letzten fünfundzwanzig Jahren in der Stadt New-York stattfanden; jene Daten sind von dem Verfasser in solcher Weise dargestellt und analysirt, das eine Menge für Strassenbahnverwaltungen höchst bedeutende Thatsachen vorgebracht werden. Herr Clark beweist durch von offiziellen Quellen erhaltenen und höchst zuverlässichen Ziffern dass die Einführung der verbesserten Triebkräften einen kaum merkbaren Einfluss über die durchschnittliche Anzahl von Unfällen aller Art in der Stadt New-York übten, und dass die Zeitungen in derer Äusserungen, wonach der eletrische und Drahtseilbetrieb von grossem Gefahr für die Fussgängern wären, gänzlich im Unrecht sind.

Beschleunigung und Bremsung der Züge, von W. B. Potter. [Seite 670.]

In seiner Eigenschaft als Direktor der Eisenbahn-Abtheilung der General Electric Company, die bedeutendste elektrische Constructionsfirma der Welt, befindet sich Mr. Potter in einer besonderer Lage um Versuchen vorzunehmen und Daten zu erhalten, die ihm die Gelegenheit geben, mit Autorität über die Frage der elektrischen Bahnen zu schreiben. In diesem Artikel gibt er die Erfolge mehrerer Versuchen über Beschleunigung und Bremsung welche auf den drei elektrisch ausgestatteten Hochbahnen in Chicago stattfanden, und vergleicht sie mit den auf der Illinois Central Dampfbahn und der New Yorker Hoch- (Dampf) Bahn stattgefundenen Versuche. Die Erfolge sind erstaunlich, und beweisen eine weit grössere Beschleunigungsfähigkeit seitens der Elektricität als des Dampfes.

Die Elektricität als Triebkraft für den Vorortbetrieb in Neu England, von Sidney H. Short . . . . [Seite 673.]

Herr Short ist ein weltbekannter Gelehrter, und ein Fachmann von höchster Erfahrung in Strassenbahn-Angelegenheit, der einer der ersten Werker auf dem Gebiete des elektrischen Betriebs war. Seine Analyse der vergleichenden Kosten der Anlage und des Betriebs von Dampf- und elektrischen Bahnen für ein System wie dasjenige welches in Boston, Mass., centrirt, ist mit höchster Autorität geschrieben, und empfehlt sich der weitesten Aufmerksamkeit der Direktoren und Ingenieuren von Dampfbahnen in Europa sowie in Amerika.

Herr Short baut ursprünglich eine bildliche Vorortbahn nach Daten welche er von den beteutendsten Neu-England Bahnen erhielt, und stellt die Elemenen von Anlage- und Betriebskosten für diese Bahn fest, durch Dampf- sowie für den elcktrischen Betrieb. Die Mittheilung enthält Tabellen, welche die wesentlichen Unterschieden zwischen beiden Systemen klärlich darstellen.

Niveau-Kontakt System . . . . . [Seite 679

Dieses System wird gegenwärtig versuchsweise in Schenectady experimentirt, und wird auf einer Bahn in dem Fürstenthum Monaco eingeführt werden.

Neuer Bremsenschuh . . . . . [Seite 680.]

Moderner Drucker für Luftdruckbremsen . . [Seite 681.]

Befestigung für Luftleitungsdrähte . . . [Seite 685.]

Neue Gattung von Kuppler . . . . . [Seite 685.]

Drehgestelle . . . . . [Seite 682.]

Beschreibung von sieben neuen Typen von Drehgestellen welche durch eine bedeutende Firma eingeführt werden. Zwei derselben sind von der Maximal Traction Gattung.

Ein neuer Doppel-Fahrtregister . . . . . [Seite 685.]

Luftdruckbremsen während diesem Jahre . . [Seite 689.]

Der G. E. 57 Strassenbahn-Motor . . . . . [Seite 690.]

Ursprung des gemischten Systems von elektrischem Betrieb in Europa . . . . . [Seite 691.]

Brill-Wagen in Buffalo und Umgebung . . . [Seite 691.]

Neue Binderahmen-Maschine . . . . . [Seite 693.]

Neues Seitengeländer . . . . . [Seite 693.]

Heizung von Strassenbahnwagen . . . . . [Seite 693.]

Neuer Geleisreiniger . . . . . [Seite 694.]

Träger für überirdische Leitung . . . . . [Seite 694.]

Neue Schraubenwinde . . . . . [Seite 694]
Eine vollständig aus Stahl verfertigte Stromabnehmer-Stange. [Seite 695.]
Trolley-Wagen mit dehnbarer Plattform und Thurm . [Seite 695.]
Wattstundenzähler für Strassenbahnen . . . [Seite 695.]
Solider Vorort-Oberbau . . . . . [Seite 696.]
Wagenrad-Schleifer . . . . . [Seite 696.]
Selbstschmierende Dynamobürste . . . . [Seite 696.]
Schienenverbindung ohne Bolzen . . . . [Seite 697.]
G. 2. astatischer Wattstundenzähler . . . . [Seite 697.]
Strassenbahn-Bremse . . . . . [Seite 698.]
Elektrische Bogenlampe für elektrische Strassenbahnwagen. [Seite 698.]

Beschreibung eines Lampenreflektors, welcher drei Amperen verbraucht und ein Licht auf dreiviertel Kilometer vor den Wagen wirft. Der Reflektor wird in Serieen mit Widerstand verwendet.

Wagenführer-Schutzvorrichtung . . . . . [Seite 699.]
Doppelwagen . . . . . [Seite 699.]

Beschreibung eines Wagens welcher in kurzer Zeit von einem geschlossenen in einen offenen Wagen umgewandelt werden kann.

Fensterschirmen . . . . . [Seite 700.]
Kontaktrolle mit Kugeln versehen . . . . [Seite 700.]
Greifer für 8-förmigen Luftleitungen . . . [Seite 700.]
Eine wachsende Firma von Fabrikanten und Lieferanten [Seite 701.]
Zweifacher Fahrtregister . . . . . [Seite 701.]

Beschreibung eines Apparates welches zweierlei Arten von Fahrpreisen registrirt.

Neue Gattung von Schienenverbindung . . . [Seite 700.]
Schmierungen und Verwahrungsmitteln für Dampfkesseln [Seite 702.]
Beschreibung eines Typus von Strassenbahnmotor [Seite 702.]

Dieser Artikel beschreibt die Motoren der "Steel Motor Company," welche in drei verschiedenen Grössen ausgeführt werden.

Ein Grossartiger Lederriemen . . . . [Seite 704]
Ein Neuer Prinzip in der Construction von Dynamos [Seite 703.]

Dies ist eine Mittheilung über die durch Professor Sidney H. Short erfundene Methode um die schädliche Wirkung der elektrischen und magnetischen Reactionen in grossen Dynamos zu verhindern, indem kupferne Ringe um die Magneten zwischen den Schlägen gesetzt werden. Eine ausführliche Beschreibung der Art und Höhe jener Reactionen wird gegeben.

Beschleunigungsversuche von den Oberbeamten der Illinois Central-bahn . . . . . [Seite 704.]

Beschreibung einiger vor den Oberbeamten verschiedener Dampfbahnen stattgefundenen Versuche, welche die Einführung des elektrischen Betriebs auf ihren Linien für den Vorortsverkehr beabsichtigen. Die Versuche erwiesen dass ein 25 t. schwerer Wagen mit 18 Personen beladen, in dem Zeitraum von 20 Sekunden zu einer Geschwindigkeit von 66 Kilometer per Stunde gebracht werden kann.

Die bedeutende Strassenbahn-Verwalter der Stadt Buffalo und Umgebung . . . . . [Seite 706.]

Table des Matières—Octobre 1897.

Les chemins de fer électriques de la région de Niagara Falls. [Page. 585.]

Ceci est un résumé de la croissance et du développement actuel de la région environnant Buffalo et Niagara Falls et de son système de transports. Ce système comprend à peu près quatorze différentes lignes de tramways électriques, le tout réprésentant un bon example d'un tramway urbain modern dans une ville d'environ 350,000 habitants, une ligne de banlieue d'une longueur d'environ 40 kilomètres, et une ligne électrique de campagne traversant dans toute sa longueur la gorge de la rivière de Niagara en dessous des chûtes à une distance d'à peu près 12 kilomètres. La construction de cette dernière route fut particulièrement accompagnée de difficultés et donna lieu à bien des problèmes de génie. Il est fait usage de l'énergie hydraulique des chûtes du Niagara pour la génération du courant nécessaire sur la plupart de ces lignes.

Machines à vapeur pour les stations centrales de tramways électriques, par Charles E. Emery, Docteur ès Sciences . [Page 612.]

Ceci est le premier d'une série d'articles qui paraîtront dans les éditions internationales du STREET RAILWAY JOURNAL. Ils sont rédigés par l'un des premiers ingénieurs d'Amérique, qui a eu une expérience personelle de trente ans ou au-delà dans la branche de construction de machines à vapeur, et s'est consacré dernièrement à une étude spéciale des conditions de la traction électrique. Parmi les sujets traités dans ce premier article se trouvent les suivants: conditions requises pour les machines à l'usage de la traction électrique; défauts dans les dynamos; massivité d'apparence; modèle économique; principes généraux pour établir la proportion des machines horizontales et verticales; soupapes et accessoire automatique de soupape; chambre intermédiaire de machines compound.

Il est donné de plus une description de six machines américaines du type "cross compound," employant des soupapes Corliss, ainsi qu'une comparaison de certaines de leurs particularités essentielles, et une reproduction à l'échelle de dessins des ateliers des fabricants de ces machines en cours d'opération.

Le prochain article s'occupera d'autres types de machines, qui seront également décrits et illustrés en detail.

Notes sur la convention de Hambourg, Allemagne . [Page 632.]

Rapport sur la convention des compagnies de tramways d'Allemagne tenue à Hambourg le 5 Août dernier, avec illustrations de quelques-uns des objets exposés

Réunion de l'Association des Tramways de l'Etat de New York. [Page 633.]

Cette réunion eut lieu à Niagara Falls, les 14–16 Septembre dernières, au cours de laquelle les sujets suivants furent traités: "Comment Pouvons-nous Augmenter l'Efficacité de nos Employés?;" "Une Décade de Développement de Tramways;" "L'Influence des Mesurages sur un Service Economique;" "Kilométrage de Tramway;" "Faits et Chimères à propos de Tramways;" "Joints de Voie—Comment Pouvons-nous Obtenir les Meilleurs Résultats?;" "Ateliers de Réparation de Tramways Électriques;" "Avantages d'un Service Moderne de Tramway;" "Propriété et Exploitation Municipales de Tramways;" "Le Meilleur Moyen d'Empêcher des Accidents;" "Joints Défectueux—le Moyen de les Empêcher;" "Roues de Voitures; y a-t'il ieu de les Rendre plus Lourdes?;" "Réparation des Caisses de Voitures."

Réunion de l'Association des Tramways de Pennsylvanie. [Page 649.]
La bataille des forces motrices . . . . . [Page 650.]

Sommaire établi par les rédacteurs du STREET RAILWAY JOURNAL des différents avantages et inconvénients de divers systèmes de force motrice actuellement étudiés par les directeurs de compagnies de chemins de fer et de tramways dans toutes les parties du monde.

La rédaction du journal est d'avis qu'une opinion exprimée dans ses colonnes ne saurait manquer d'être particulièrement à propos, au moment où le meilleur système de force motrice à adopter dans de certaines conditions se trouve intéresser tous ceux qui ont à se préoccuper de la conduite des divers moyens de transport.

Membres du Conseil Exécutif de l'Association Américaine de Tramways . . . . . [Page 654.]
La convention de Niagara Falls . . . . [Page 658.]

Compte-rendu *in extenso* de tous les détails de la prochaine convention de l'Association Américaine de Tramways et de l'Association des Comptables de Tramways d'Amérique, qui se tiendra à Niagara Falls les 19–22 Octobre inclus.vement.

Le système de tramways de Sydney, Australie . [Page 661.]

Le système de tramways de cette ville est la propriété du gouvernment, et s'étend sur une longueur de 130 kilomètres, dont 100 kilomètres sont actuellement exploités à la vapeur, 15 kilomètres par cable, 5 kilomètres à l'électricité, et 1½ kilomètres par chevaux. Le gouvernement s'est dernièrement décidé à substituer la traction électrique sur les lignes à vapeur, et le présent article donne une description détaillée des plans généraux. Quatre unités accouplées directement de 850 k. w. chaque, seront installées de suite, de même que quatre stations auxiliaires à accumulateurs.

La question des tramways à Vienne, Autriche, par E. A. Ziffer. [Page 663.]

Description, par un Ingénieur Autrichien, des changements récents dans le situation des tramways à Vienne, donnant à comprendre que la ville obtiendra sous peu un contrôle plus complet du système de tramways actuel, et qu'en même temps l'occasion sera fournie à des capitalistes de s'intéresser à l'entreprise afin de donner une extension plus complète au système.

Distribution du kilométrage et de la capitalisation de tramways en Amérique . . . . . [Page 665.]

Analyse statistique de la distribution et de la croissance du kilométrage de tramways, et de la capitalisation dans divers états et sections des Etats-Unis et du Canada au prorata de la population.

Un chapitre d'accidents, par W. J. Clark . . . [Page 667]

Cet article contient les statistiques d'accidents de tous genres, y compris ceux occasionnés par l'exploitation des tramways à chevaux, électriques et funiculaires dans la ville de New York durant les derniers vingt-cinq ans, et l'auteur y analyse ces accidents de façon à présenter clairement divers faits de la plus haute importance pour les directeurs de tramways. M. Clark démontre, à l'aide de statistiques obtenues de sources officielles et dignes de toute confiance, que l'introduction des systèmes de traction perfectionnés n'a exercé qu'une minime influence sur le prorata d'accidents de tramways sur la population, et sur le nombre total d'accidents de tous genres étant survenus dans la ville de New York; il ajoute que les journaux ont complètement tort en affirmant que la traction électrique et funiculaire est de grand danger pour les piétons.

Accélération et freinage de trains, par W. B. Potter . [Page 670.]

En sa qualité de directeur de la section des chemins fer de la General Electric Company, la maison des constructions électriques la plus importante au monde, M. Potter s'est trouvé dans une position exceptionnelle lui permettant d'établir les essais et obtenir les données nécessaires pour ecrire un article consciencieux et exact sur les chemins de fer électriques. Dans le présent article il donne les résultats des essais d'accélération et de freinage faits sur les trois lignes de chemins de fer élevés de Chicago équipés à l'électricité, et les compare avec ceux faits avec des locomotives à vapeur de l'Illinois Central, et le chemin de fer élevé de New York. Les résultats sont surprenants, en ce qu'ils montrent une force d'accélération énormément supérieure avec l'électricité qu'avec la vapeur.

L'électricité comme force motrice pour le service suburbain dans la Nouvelle Angleterre, par Sidney H Short . [Page 673.]

M. Short est un savant de réputation internationale, et possédant une expérience considérable sur les sujets relatifs aux tramways, vu qu'il a été l'un des premiers dans le champ de la traction électrique. Son analyse du prix comparatif de l'équipement et de l'exploitation de chemins de fer à vapeur et électriques pour un service tel que celui qui se concentre à Boston, Massachusetts, est écrite en toute connaissance de cause, et mérite d'attirer l'attention générale de la part de directeurs et ingenieurs de tramways à vapeur en Europe aussi bien qu'en Amérique. M. Short commence par construire une ligne suburbaine typique d'après des données obtenues d'un certain nombre de lignes importantes de la Nouvelle Angleterre, et détermine les éléments des dépenses de premier établissement et d'exploitation sur cette ligne à la vapeur ainsi qu'à l'électricité. L'article est accompagné de diagrammes indiquant clairement les différences essentielles entre les deux systèmes.

Système de contact de surface . . . . . [Page 679.]

Ce système est expérimenté en ce moment à Schenectady, et une ligne en sera équipée dans la principauté de Monaco, Europe.

Nouveau sabot de frein . . . . . [Page 680.]

Compresseur moderne pour freins pneumatiqres . [Page 681.]

Trucks à pivot . . . . . [Page 682.]

Description de sept nouveaux types de trucks à pivot introduits sur le marché par une maison de construction importante. Deux d'entre eux sont du type à traction maxima.

Compteurs enregistrant deux sortes de prix de passage. [Page 685.]

Nouveau genre d'accouplement . . . . [Page 685.]

Accouplement de fils de trôlet . . . . . [Page 685.]

Types récents de générateurs et de moteurs . . [Page 686.]

Description détaillée des derniers appareils Walker.

Freins pneumatiques durant le cours de l'année . [Page 689.]

Le moteur de tramway G. E. 57 . . . . . [Page 690.]

Origine du système mixte de traction électrique en Europe. [Page 691.]

Voitures Brill à Buffalo et dans les environs . . [Page 691.]

Manière de chauffer les voitures de tramways . . [Page 693.]

Nouvelle machine à vapeur à bâti rigide . . [Page 693.]

Nouvelle balustrade de face . . . . . [Page 693.]

Nouvelle chèvre . . . . . [Page 694.]

Nouveau balai-brosse de voie . . . . . [Page 694.]

Suspensions pour matériel aérien . . . . [Page 694.]

Bras de poteau tout en acier . . . . . [Page 695.]

Wattmètre enregistreur pour voitures de tramways . [Page 695.]

Waggon de trolley avec plate-forme élevée et à extension. [Page 695.]

Construction suburbaine de grande solidité . . [Page 696.]

Machine à repasser les roues de voitures . . . [Page 696.]

Dans cette machine les roues à émeri sont actionnées à une très-grande vitesse, diminuant de cette manière la pression exercée contre la roue de voiture.

Balai de dynamo avec graissage automatique . [Page 696.]

G. 2, un wattmètre enregistreur astatique . . [Page 697.]

Joint de rail sans boulons . . . . . [Page 697.]

Frein de tramway instantané . . . . . [Page 698.]

Reflecteur électrique à arc pour voitures motrices . [Page 698.]

Cette lampe consume trois ampères et donne une lumière se projetant à trois-quarts de kilomètre en avant de la voiture. La lampe est employée en séries avec resistance.

Voiture mixte . . . . . [Page 699.]

Description d'une voiture qui peut être transformée d'une voiture fermée en une découverte en très peu de temps.

Abri pour mécaniciens . . . . . [Page 699.]

Nouveau type d'éclissage de rail . . . . [Page 700.]

Roulette de trôlet à billes . . . . . [Page 700.]

Tendeur de fil aérien en forme de 8 . . . . [Page 700.]

Jalousies de fenêtres . . . . . [Page 700.]

Agrandissement d'une maison de construction et de matériel. [Page 701.]

Compteur enregistrant deux sortes de prix de passage. [Page 701.]

Graissage et injection de chaudières . . . [Page 702.]

Description d'un moteur de tramway bien connu . [Page 702.]

Cet article décrit les moteurs de la "Steel Motor Company," qui sont exécutés en trois grandeurs différents.

Un nouveau principe en construction de dynamos . [Page 703.]

Compte-rendu d'une méthode inventée par le Professeur Sidney H. Short, pour empêcher l'effet destructif des réactions électriques et magnétiques dans lés générateurs de grandes dimensions au moyen d'anneaux de cuivre placés autour des aimants entre les induits. Il est donné une description detaillée de la nature et de l'étendue de ces réactions.

Courroie de cuir de grande dimension . . . [Page 704.]

Essais d'accélération en présence des chefs de service du chemin de fer de l'Illinois Central . . . . . [Page 704.]

Description de certains essais qui ont été faits en présence de chefs de service de chemins de fer qui se proposent d'équiper leurs lignes de banlieue à l'électricité. Les essais démontrèrent qu'une voiture pesant 25 tonnes et transportant 18 passagers pourait être amenée à une vitesse de 66 kilomètres à l'heure dans l'espace de 20 secondes.

Les principaux directeurs des lignes de tramways de Buffalo et environs . . . . . [Page 706.]

Lista de Materias—Octubre 1897.

Los ferrocarriles eléctricos de la región de Niagara Falls. [Pág. 585.]

Eso es un resumen del progreso y del presente desarrollo del districto al rededor de Buffalo y Niagara Falls, y de su sistema de transporte, el cual incluye unas catorce diferentes líneas de ferro-carriles eléctricos. Entre ellas se encuentra un buen ejemplo de un tranvía urbano moderno en una población de unos 350,000 habitantes, una línea interurbana de cerca de 40 kilómetros de longitud, y una línea eléctrica de campo, atravesando en toda su longitud el canyon del rio Niagara abajo de las cataratas del Niagara, á una distancia de unos 12 kilómetros. La construcción de esta última línea fué especialmente difícil, y envolvió varios problemas de ingenieria. La energía hidraulica de las cataratas del Niagara está usada para la generación de la corriente necesitada para el servicio de muchas de esas líneas.

Máquinas de vapor para centrales de tranvías eléctricos, por Charles E. Emery, Doctor en Ciencia . . . . [Pág. 612.]

Eso es el primero de una serie de artículos que van á parecer en los números internacionales del STREET RAILWAY JOURNAL. Son escritos por uno de los más prominentes ingenieros de América, el cual, después de ser en práctica activa durante los treinta años pasados ó más, ha hecho recientemente un estudio especial de las condiciones de tracción eléctrica. Algunos de los sujetos discurridos en el primero artículo son los siguientes: condiciones requistas por máquinas para sistemas de tracción eléctrica; puntos defectuosos en dinamos; aparencia maciza; diseño económico; principios generales para proporcionar máquinas; comparación de máquinas horizontales y verticales; válvulas y disposición de válvulas automáticas; camera intermedia de máquinas compound.

Terminando, son descritas seis máquinas americanas de primera clase, del tipo "cross compound," con uso de válvulas Corliss, con una comparación de ciertas de sus particularidades principales, así como grabados de los talleres donde son construidas dichas máquinas. El próximo artículo describirá con ilustraciones otros tipos de máquinas en un modo semejante.

Notas sobre la convención de Hamburgo, Alemania . [Pág. 632.]

Relación sobre la convención de compañías de tranvías de Alemania á Hamburgo, el 5 de Agosto pasado, con vistas de algunas exposiciones.

Congreso de la Asociación de Tranvías del Estado de Nueva York. [Pág. 633.]

Este congreso fué tenido los 14–16 de Setiembre pasados á Niagara Falls, y los siguientes sujetos fueron tratados: "Como Aumentar la Eficacia de nuestros Empleados?;" "Diez Años de Desarrollo de Tranvías;" "La Influencia de Medidas sobre un Servicio Económico;" "Kilómetraje de Tranvías;" "Factos y Imaginación en Respecto de Tranvías;" "Juntas de Carriles—Como se Obtienen los Mejores Resultados?;" "Ventajas de un Servicio Moderno de Tranvías;" "Talleres de Reparación de Tranvías Eléctricos;" "Propiedad y Explotación Municipal de Tranvías;" "El Mejor Método para Impedir Casualidades;" "Juntas Defectuosas; Como se Previenen?;"

"Ruedas de coches—si Deben ser Hechas más Pesadas?;" "Reparación de Cajas de Coches."

Congreso de la Asociación de Tranvías de Pennsylvania. [Pág. 649.]

El combato de las fuerzas motrices . . . . [Pág. 650.]

Eso es un sumario, por los redactores del STREET RAILWAY JOURNAL, de las diferentes ventajas y desventajas de los varios sistemas de fuerza motriz actualmente estudiados por los directores de ferrocarril y tranvías de vapor en todas partes del mundo.

Se cree que una expresión editorial de opinión sobre este sujeto será particularmente á proposito, en un tiempo cuando el propio modo de fuerza motriz en ciertas condiciones es un asunto de interés para todos los ingenieros encargados con el estudio de los diferentes medios de transporte.

Oficiales y junta ejecutiva de la Asociación Americana de Tranvías. [Pág. 654.]

La convención de Niagara Falls . . . . [Pág 658.]

Informe detallado de todos los sujetos relacionados con la próxima convención de la Asociación Americana de tranvías, y de la Asociación de Contadores de Tranvías de América, que será tenida á Niagara Falls los 19, 20, 21 y 22 de Octubre.

El sistema de tranvías de Sydney, Australia . . [Pág. 661.]

Este sistema es la propiedad del gobierno, y tiene una longitud de 130 kilómetros, 100 de cuyos son actualmente operados por vapor, 15 por cable, 5 por electricidad y 1½ por caballos. El gobierno se ha decidido recientemente á substituir la tracción eléctrica á la por vapor, y sus planos son descritos en detalle. Cuatro máquinas directamente acopladas, de 850 k. w., serán instaladas inmediatemente, así como cuatro estaciones auxiliares de acumuladores.

La cuestión de los tranvías en Viena, Austria, por E. A. Ziffer. [Pág. 663.]

Eso es una descripción, por un ingeniero Austriaco, de los cambios recientes en la situación tranviária en Viena, dando lugar de creer que en el porvenir la municipalidad obtendrá una dirección más completa del sistema de tranvías, que hasta ahora ha sido el caso, mientras que el capital privado será en posición de contribuir á una extension considerable de la red.

Distribución del desarrollo de tranvías y de capitalización en América . . . . . [Pág. 665.]

Eso es una estadistica de la distribución y del desarrollo de tranvías, así como de su capitalización en varios estados y secciones de los Estados Unidos y Canada, en proporción de la población.

Un capítulo de casualidades, por W. J. Clark . . [Pág. 667.]

En este artículo está dada la estadistica de casualidades de todo género, incluyendo las causadas por la explotación de tranvías á tracción animal, eléctrica y funicular en Nueva York durante los vienticinco años pasados; el autor hace una analisis de modo que presenta claramente muchos factos de mayor interés para los directores de compañías tranviarias. El Sr. Clark demostra por medio de figuras obtenidas de manantiales oficiales, y de confianza indubidada, que la introducción de la tracción perfeccionada no ha afectado sensiblemente la proporción de casualidades de todo genero en la ciudad de Nueva York, y que los periódicos han sido falsos en sus relaciones atribuyendo á los sistemas de tracción eléctrica y funicular gran peligro para los pietones.

Aceleración y frenaje de trenes, por W. B. Potter . [Pág. 670.]

En su capacidad de director de la sección de ferrocarriles de la "General Electric Company," la casa de construcción eléctrica más importante en el mundo, el Sr. Potter era en una posición excepcional para establecer los experimentos y obtener datos permitiendo que escribe con autoridad sobre el sujeto de ferrocarriles eléctricos. En ese artículo él da los resultados de ensayos de aceleración y de frenaje hechos sobre las tres líneas de ferrocarriles aéreos de Chicago instaladas con tracción eléctrica, y establece comparaciones con los hechos por medio de locomotoras de vapor sobre la línea ferrroviaria Illinois Central, y el Manhattan Elevated Railway, de Nueva York. Los resultados son maravillosos, y demonstran una inmensa superioridad de fuerza de aceleración en favor del sistema eléctrico.

La electricidad como fuerza motriz para el servicio de ferrocarriles suburbanos de Nueva Inglaterra, por Sidney H. Short. [Pág. 673.]

El Sr. Short está ventajosamente conocido y de reputación internacional por su experiencia sobre cuestiones relacionadas con la práctica de tranvías, habiendo sido uno de los primeros trabajadores en el campo de tracción eléctrica. Su análisis del coste comparativo de la instalación y explotación de trenes de ferrocarril de vapor y eléctrico para un servicio como el de Boston, Massachusetts, está escrita con autoridad, y merece la atención de los directores é ingenieros de ferrocarriles de vapor en Europa, así como en América. El Sr. Short, en primer lugar, construye una línea suburbana tipical, desde figuras obtenidas de varias líneas importantes de Nueva Inglaterra, y fija los elementos del coste primitivo y de mantenimiento de dicha línea, para la tracción á vapor y eléctrica ambas. El artículo está ilustrado con diagramas dando una idea clara de las diferencias entre los dos sistemas.

Sistema de contacto de sobrefaz . . . . [Pág. 679.]

Ese sistema es experimentado ahora en Schenectady, y será aplicado á una línea en la principalidad de Monaco, Europa.

Un nuevo zapate de freno . . . . . [Pág. 680.]

Compresores modernos para frenaje neumático . [Pág. 681.]

Carretones giratorios . . . . . [Pág. 682.]

Descripción de siete tipos nuevos de carretones giratorios introducidos en el mercado por una maquinista importante. Dos de ellos son del tipo de tracción máxima.

Un nuevo contador doble . . . . . [Pág. 685.]

Un nuevo tipo de acoplador . . . . . [Pág. 685.]

Enlace de alambre de trolley . . . . . [Pág. 685.]

Tipos recientes de generadores y motores . . . [Pág. 686.]

Eso es una descripción detallada de los más recientes aparatos Walker.

Los frenos neumáticos durante el año . . . [Pág. 689.]

El motor de ferrocarril G. E. 57 . . . . [Pág. 690.]

Origen del sistema mezclado de tracción eléctrica en Europa. [Pág. 691.]

Coches Brill en Buffalo y vecindad . . . . [Pág. 691.]

Varios tipos especiales de coches son descritos.

Nueva balaustrada lateral . . . . . [Pág. 693.]

Calefacción de tranvías . . . . . [Pág. 693.]

Nueva máquina de vapor con bastidor robusto . [Pag. 693.]

Nuevo tipo de alzaprima . . . . . [Pág. 694.]

Pieza de soporte para construcción aérea . . . [Pág. 694.]

Wattmêtro registrador para tranvías . . . [Pág. 695.]

Puntal de poste todo de acero . . . . . [Pág. 695.]

Carretón de trolley con plata-forma elevada y de extension. [Pág. 695.]

Construcción suburbana sustancial . . . . [Pág. 696.]

Amolador de ruedas de carro . . . . . [Pág. 696.]

Bruza de dinamo con engrase automático . . [Pág. 696.]

G. 2, un wattmêtro registrador astático . . . [Pág. 697.]

Nuevo limpiador de vía . . . . . [Pág. 697.]

Junta de carril sin remaches . . . . . [Pág. 697.]

Freno instantáneo de tranvías . . . . . [Pág. 698.]

Reflector de arco eléctrico para tranvías eléctricos . [Pág. 698.]

Este reflector emplea tres amperes, y proyecta una luz desde ½ y ¾ kilómetro en frente del carruaje. La lámpara está usada en series con resistencia.

Coche "Duplex." . . . . . [Pág. 699.]

Descripción de un coche que puede ser transformado de un coche cerrado en un abierto en poco tiempo.

Abrigo para maquinistas de tranvías eléctricos . [Pág. 699.]

Nuevo tipo de junta de carriles . . . . . [Pág. 700.]

Enlace de alambre de trolley en forma de 8 . . [Pág. 700.]

Polea de trolley con bolas . . . . . [Pág. 700.]

Postigos de ventanas . . . . . [Pág. 700.]

Contador registrando dos precios de pasaje . . [Pág. 701.]

Desarrollo de una casa manufacturera y proveedora . [Pag. 701.]

Engrase de calderas . . . . . [Pág. 702.]

Descripción de nn motor de tranvías bien conocido . [Pág. 702.]

Ese artículo describe los motores de la "Steel Motor Company," los cuales son construidos en tres tamaños diferentes.

Un nuevo principio en construcción de dinamos . [Pág. 703.]

Eso es la cuenta de un método inventado por el Profesor Sidney H. Short, para prevenir el efecto destructivo de las reacciones eléctricas y magnéticas en los dinamos de gran tamaño, por medio de anillos de cobre colocados cerca la yunta de imanes entre los inductos. Una descripción detallada es dada de la naturaleza y extensión de esas reacciones.

Correa de cuero de gran dimensión . . . . [Pág. 704.]

Ensayos de aceleración ante los jefes de servicio del ferrocarril Illinois Central . . . . . [Pág. 704.]

Descripción de ciertos ensayos hechos ante los jefes de servicio de ferrocarriles que desean introducir la tracción eléctrica sobre sus líneas interurbanas. Los experimentos han demostrado que un coche del peso de 25 toneladas, y llevando 18 viajeros, puede ser lanzado á una velocidad de 66 kilómetros por hora en el espacio de 20 segundos.

Los caballeros más prominentes en el campo de tranvías en Buffalo y vecindad . . . . . [Pág. 706.]

Financial Notes.

Anderson, Ind.—Reports state the Union Traction Company, recently incorporated, is a consolidation of the Anderson Electric Street Railway Company, the Marion City Railway Company and the Indianapolis, Anderson & Marion Railway Company, and that the lines of the last named company will be completed.

Chicago, Ill.—The directors of the North Chicago Street Railroad Company have declared the quarterly dividend of 3 per cent. payable Oct. 15.

Cincinnati, O.—The Cincinnati Street Railway Company will increase its capital stock outstanding from $15,600,000 to $16,224,000.

Cleveland, O.—The Cleveland City Railway Company has declared a quarterly dividend of three-quarters of 1 per cent.

Detroit, Mich.—The Detroit, Lake Shore & Mt. Clemens Railway Company, through George S. Davis, president, and Thomas N. Fordyce, secretary, has filed a first mortgage, for $260,000 running to the New York Security & Trust Company of New York. This deed covers all the franchises and property of the company and is security for an issue of $260,000 6 per cent gold bonds.

Elgin, Ill.—The directors of the Elgin City, Carpentersville & Aurora Railway Company have declared the usual annual 6 per cent dividend payable Oct. 1. J. B. Lane, vice-president, was also made general manager.

Hoosick Falls, N. Y.—The Hoosick Railway Company and the Bennington Electric Railroad Company have been consolidated under the title of the Bennington & Hoosick Valley Railway Company.

Lock Haven, Pa.—Judge Mayer has appointed William B. Given, of Columbia, receiver for the Lock Haven Traction Company, on application of the West End Trust & Safe Deposit Company of Philadelphia, trustee for the mortgage of the company.

New York, N. Y.—As the result of the vote at the special meeting on Sept. 14, the Metropolitan Traction Company went on, of existence as a corporation and was virtually consolidated with the Metropolitan Street Railway Company. President Vreeland explained the action as follows: "We have unanimously voted to dissolve the traction company and turn its assets over to the street railway company. The assets of the company consist of the capital stock, $30,000,000, of the Metropolitan Street Railway Company, and about $6,000,000 in securities and other properties. The capital of the two companies is the same, the traction company acting as treasurer for the street railway company. Each traction stockholder will receive in exchange for his stock an equal amount of the street railway stock, and, in addition, securities to the amount of 20 per cent of the par value of his stock."

The directors of the Manhattan Railway Company have declared the regular 1 per cent quarterly dividend. It is officially stated that the current quarter's earnings show an increase, and that more than 1 per cent has been earned.

Portland, Ore.—The City & Suburban Railway Company has leased the lines of the Portland Railway Company and will operate the lines of the two companies jointly.

To the Convention—via the Erie.

The Erie Railroad will arrange special accommodations for delegates and visitors to the convention of the American Street Railway Association to be held Oct. 19-22 at Niagara Falls. The principal trains for Niagara Falls via the Erie are: Train No. 7, which leaves New York daily at 7:25 P. M., arriving at Buffalo 7:15 A. M. and Niagara Falls 8:08 A. M. Train No. 1, which leaves New York daily at 8:55 A. M., arriving at Buffalo 8:00 P. M. and Niagara Falls 9:22 P. M. For particulars, address D. I. Roberts, General Passenger Agent, 21 Cortlandt Street, New York.

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San Diego, Cal.—The property and franchises of the Citizens' Traction Company were formally offered at public sale on Sep. 22 at a minimum price of $40,000, but no offer was made. Commissioner Dodson will probably be ordered to sell it again at a lower fixed price.

Daily Trains to Colorado, Utah and California.

At ten o'clock every night the Chicago, Milwaukee & St. Paul Railway train leaves the Union Passenger Station (Canal and Adams Streets, Chicago), with elegantly equipped Palace Sleeping Cars for Denver and other Colorado points, with through connections at Denver for Salt Lake City, Ogden, San Francisco and points in Southern California. The route to Denver is via Omaha and Lincoln, Nebraska, and is first class in every respect. All the modern facilities of travel are included in this direct route to Colorado—the Eldorado of the West. The allied lines, composing the route, viz., the Chicago, Milwaukee & St. Paul Railway—Chicago to Omaha—and the Rock Island & Pacific—Omaha to Denver and Colorado Springs—have united to make this the most popular route to all points west of the Missouri River. For further details, time tables, etc., address Geo. H. Heafford, General Passenger and Ticket Agent, C. M. & St. P. Ry., 410 Old Colony Building, Chicago, Ill.*,*

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ACT AS TRANSFER AGENTS FOR CORPORATIONS.

Street Railway Journal.

Vol. XIII. *NEW YORK AND CHICAGO, NOVEMBER, 1897.* *No. 11.*

PROCEEDINGS

OF THE

SIXTEENTH ANNUAL CONVENTION

OF THE

AMERICAN STREET RAILWAY ASSOCIATION,

HELD AT

NIAGARA FALLS, N. Y., OCTOBER 19-22, 1897

The sixteenth annual meeting of the American Street Railway Association was held at the Armory, Niagara Falls, N. Y., Oct. 19-22, 1897.

President Robert McCulloch, of St. Louis, called the meeting to order at 11 o'clock Tuesday morning.

On the platform were seated Ex-Presidents H. H. Littell, Henry M. Watson, H. M. Littell and George B. Kerper. The officers and members of the Executive Committee were also seated on the platform, as follows: Charles S. Sergeant, D. B. Dyer, C. F. Holmes, H. P. Bradford, Charles H. Smith and Secretary T. C. Penington, of Chicago.

THE PRESIDENT: I now have the pleasure of introducing Hon. A. C. Hastings, Mayor of Niagara Falls, in which city we are being so royally welcomed at the present time.

Mayor Hastings then gave an address of welcome.

THE PRESIDENT: Gentlemen, we are obliged to his Honor, the Mayor, for his words of welcome, and we hope that he will preside at the police court if any of us are unfortunate enough to stay out and be captured. (Applause.)

THE PRESIDENT: The next business is the calling of the roll.

The secretary called the roll, and the delegates of street railway companies present are given elsewhere.

THE PRESIDENT: The next order of business is in the nature of an opportunity for those who may be present, representing companies, to make known their desire to join, that the secretary may enter the names of their companies upon the membership roll.

The following companies then acquired membership in the Association:

Nassau Electric Railroad Company, Brooklyn, N. Y.

Binghamton Railroad Company, Binghamton, N. Y.

Buffalo Traction Company, Buffalo, N. Y.

Roxborough, Chestnut Hill & Norristown Railway Company, Philadelphia, Pa.

Chester Traction Company, Chester, Pa.

Colorado Springs Rapid Transit Company, Colorado Springs, Col.

Southwest Missouri Electric Railway Company, Webb City, Mo.

Union Traction Company, Anderson, Ind.

Atlanta Railway Company, Atlanta, Ga.

Wakefield & Stoneham Street Railway Company, Boston, Mass.

Mystic Valley Railway Company, Boston, Mass.

THE PRESIDENT: The next order of business will be the approval of the minutes of the last meeting. These minutes appear in our printed proceedings which were issued within thirty days after the adjournment of the St. Louis meeting.

MR. KELLY, of Columbus: I move that the minutes be approved as printed. Carried.

President McCulloch then read the following address:

ADDRESS OF PRESIDENT McCULLOCH

Gentlemen of the American Street Railway Association:

Our convention assembly for the sixteenth annual period is within the sound of nature's greatest wonder, but the wonders that are wrought in our own immediate application and appropriation of nature's resources are even more startling and awe-inspiring than the great Niagara Cataract. If our ancestors of two centuries ago could sit in judgment on our doings of to-day we would unquestionably be required to voluntarily undertake the feat of the gallant Captain Webb, and if, perchance, we survived the perils of the raging torrent, the bonfires of our aboriginal predecessors would be rekindled on the cliffs below, and a fat-frying would take the place of our discussions and merry making, as there could be no escape on our part from the charge of witchcraft. These great falls were worshipped by our red brother; the venturesome explorer and historian dipped his pen in consecrated fluid as he wrote reverentially of their grandeur; the poet and the maiden everywhere have sung of them in enchanting praise; reverence and poetry and romance have characterized the stories which tell us of them; but the matter-of-fact Yankee of to-day, casting reverence and poetry and romance to the winds, has harnessed them like an old plow horse, and compelled them, just as subserviently to do his bidding; they make heat and light and power for all purposes; they revolutionize the processes of the manufacturer and the chemist; and ere we meet here again, they will, without doubt have been saddled with the menial duties of cooking and washing and tilling the soil of all the country around. The enabling element for the utilization of this wasted energy of the past is electricity, in the development and search for uses of which the scientist and manufacturer sleep not, neither do they rest. They furnish us with their best and latest devices and appliances to-day, and to-morrow these devices and appliances are obsolete. To keep our place in the procession we must join in the cry of "The King is Dead, long Live the King." We must discard the old and adopt the new, or else be ground under the wheels of this juggernaut of progress. Unfortunately, if we endeavor to "shun Scylla, we are in danger of being wrecked on Charybdis;" hence we assemble here to counsel together as to how we may best shape our course. To learn more of this revolutionary factor in our business, to discuss this and other kindred subjects, to compare our experiences, to meet and greet each other, to renew old friendships and acquaintance, and to form new ties, to be forced, if need be, to recognize that "there are other pebbles," to find that the American Street Railway Association is filled with men to know whom is both an honor and a pleasure—these, my friends, are some of the things which have brought us together, and it is hoped that a full measure of pleasure and profit will reward all who honor us with their presence.

Our local brethren, with a hospitality as abounding and exhaustless as the never ceasing flow of their great river, have provided for our physical comfort and entertainment. We beseech them not to seduce us from a proper contemplation of the business before us.

Our noble ally, our helper in all the good work we accomplish, our always alert, jovial and genial friend, the supply man, has contributed, as usual, his share to our entertainment and enlightenment. He is here to show us the best of everything he has. He is not, in one sense, a member of our association; he does not partici-

pate in our deliberations; but he stands at our threshold, and the vigilance which he exercises, that none may escape, is worthy of our emulation in the conduct of our business. Let us show our appreciation of his efforts by inspecting his wares, by loading him with orders and by fraternizing with him, that his enjoyment of the occasion may be equal with ours.

We have still another and a new element in our gathering for this year. Whilst we are here engaged in the discussion of questions pertaining to the construction, equipment and operation of the roads and interests in our keeping, there is assembled near by, and also in deliberative convention, an earnest, intelligent, enthusiastic body of mostly younger men than ourselves. They have in view the same objects which bring us together—a betterment in the performance of street railway work. Their duties, whilst distinct and apart from ours, are just as essential, and the requirement is for the same degree of intelligence, industry and integrity. Their organization is young, and they are just starting out in their efforts to enlighten each other by a mutual interchange of information as to methods and ways. I allude to the Street Railway Accountants' Association. Let us not extend to them the right hand, but both hands, and help and encourage them to persevere in their good work. Their interest and efficiency in the performance of their duties is susceptible of the same betterment by convention as ours. If they find it desirable and convenient to meet at the same time with ourselves; and thus extend the acquaintance and good fellowship between the operating and accounting departments, which must result from contact, let that arrangement continue; but if it be considered wiser to have two separate meeting times and places, that may be the plan, but they should have our encouragement and indorsement, and even financial support, if necessary.

Our meetings are always attended by quite a number of persons engaged in the same business as ourselves, but whose companies are not members of the association, and we receive requests for information from the same source, which information is always cheerfully given. We would not like to close our doors against these non-members, but we would be glad to enter their names in our official lists, and their annual dues, which are only a small amount, would fill an aching void in our treasury.

There is still another class who, although members of our association, seldom or never grace our meetings with their presence. Whether this may be from a lack of time, a feeling of exclusiveness or a consciousness of a possession of all the knowledge attainable concerning our business, I know not. But if the first, an effort and sacrifice might be made experimentally; if the second is the cause of their absence, a surprise and discovery is in store for them if they will only develop it; and if the last reason keeps them away a feeling of charity and good will for their fellow laborers should impel them to come amongst us and show us how to surmount our perplexing obstacles.

The questions to be discussed in our convention have been selected with reference to newer developments and applications. The gentlemen honored by selection (and the honors should be much coveted) to prepare papers, have all been urged to be present and personally present their efforts, thus giving them a force that can only be imparted by the enthusiasm of the author. Time will be given for the presentation and discussion of each paper, and it is hoped the discussions will be free and exhaustive.

I wish that my successor in office may have a secretary and executive committee who as thoroughly realize and faithfully perform their duties as have the secretary and executive committee who have assisted me in the performance of my very pleasant work.

And now, my friends and brethren, thanking you with more earnestness than my language can express for the unexpected honor with which you crowned me a year ago, and promising an impartial ruling on all questions presented, we will proceed with the business of the convention.

The President: The next business is the reading of the minutes of the meetings of the Executive Committee. The secretary read the minutes as follows:

REPORT OF EXECUTIVE COMMITTEE

The following are the minutes of a special meeting of the Executive Committee of the American Street Railway Association, held at the Prospect House, Niagara Falls, Monday, Feb. 15, 1897. The president called the meeting to order at 10:15 o'clock A. M. There were present, Messrs. McCulloch, Sergeant, Dyer, Holmes, Bradford, Hippee and Penington. The treasurer presented a financial statement to Feb. 12, 1897. The secretary stated that collections for space at the St. Louis exhibition were still outstanding, to the extent of $50. On motion of Mr. Dyer, the secretary was instructed to cancel the foregoing amounts.

Messrs. W. Caryl Ely, H. H. Littell, Burt Van Horn and Charles B. Hill, of the local railway companies, here waited upon the committee, and made an appointment for the Executive Committee to meet at the Niagara Club at 12 o'clock, to discuss with a committee from the Chamber of Commerce of Niagara Falls with regard to the arrangements for the forthcoming meeting.

The secretary brought up the following resolution, offered at the St. Louis meeting by Mr. Davis, of Williamsport, and referred to the Executive Committee:

Resolved: That the secretary be instructed to obtain from the members of the association information and copies of municipal legislation relating to the imposition by their cities or municipalities, of taxes or license fees upon their property, franchise or receipts.

Mr. Dyer moved that it is the sense of the committee that at the present time it is deemed impracticable to take up the question involved in this resolution. Carried.

The matter of subjects of papers for the next meeting was then taken up, and the secretary read a list of topics which had been suggested by various members.

President McCulloch stated that the secretary should write to each person selected to read a paper, impressing upon him that the paper should be read by him at the meeting.

President McCulloch stated that the correspondence which he had up to the present time with the local people was very unsatisfactory. He then read several letters which he had received.

The secretary read a letter from the street railway companies of the city of Detroit, inviting the association to hold its meeting in that city in 1897, in case, for any reason, it was deemed advisable to change the place of meeting from Niagara Falls.

The committee then adjourned, subject to the call of the chair.

The Executive Committee then proceeded to the rooms of the Niagara Club. At that place they met President Ely and General Manager Van Horn, of the Buffalo & Niagara Falls Electric Railway Company; President Brinker, of the Niagara Falls & Lewiston Railroad Company; Vice-President Littell, of the Buffalo Railway Company, and Charles B. Hill, treasurer of the Niagara Falls & Suspension Bridge Railway Company. Also Mayor Arthur Schoellkopf, of Niagara Falls, and Messrs. William S. Humbert, H. W. Beardsley, A. J. Thibaudau and E. T. Williams, members of the Chamber of Commerce of Niagara Falls.

All the matters relating to the necessary arrangements for the convention were entered into fully and pointedly, and after lengthy discussion the Executive Committee retired, to consider the matters further.

Evening Session

The president called the committee to order at 8 o'clock P.M. Present, the same gentlemen as in the morning. The president announced the business in order to be the selection of topics for papers for the next meeting, and of gentlemen to read the same. The following were selected: "Municipal Ownership of Street Railways," by P. F. Sullivan, general manager Lowell & Suburban Street Railway Company, Lowell, Mass.; "Some of the Difficulties Met with in the Construction and Operation of Electric Railways of To-day," by George W. Knox, electrical engineer of the Chicago City Railway Company, Chicago, Ill.; "Application of Electricity to Railroads now Operated by Steam Power," by N. H. Heft, president Meriden Street Railway Company, Meriden, Conn.; "The Best Method of Settling Damage Cases, and the Prevention of Accidents by the Use of Fenders or Otherwise," by C. G. Goodrich, general manager Twin City Rapid Transit Company, Minneapolis, Minn.; "Application of Storage Battery to Electric Traction," by Charles Hewitt, electrician Union Traction Company, Philadelphia, Pa.; "Discipline of Employes," by George H. Davis, superintendent Canal & Claiborne Railroad Company, New Orleans, La.; "Power Distribution and the Use of Multiphase Current Transmission for Ordinary Street Railways," by Maurice Hoopes, electrician Lynn & Boston Railroad Company, Lynn, Mass.

Mr. Dyer moved that in case any of the persons selected should for any reason decline to prepare the paper, the president be authorized to select another gentleman, and the papers be prepared so as not to exceed thirty minutes in their reading. Carried.

At this point Messrs. Ely, Beardsley, Thibaudau and Williams waited upon the committee, and after a very full and thorough discussion of the matter, the arrangements for the meeting were agreed upon.

The secretary read a communication from W. F. Kelly, of Columbus, O., in regard to changing the time of meeting from October to September, which letter was accompanied by a number from other street railway men, connected with the association, to the same effect. Mr. Hippee gave notice of the following amendment to Section VII of the By Laws—Insert in place of the words "on the third Tuesday in October in each year, at such hour and place as shall be designated at the preceding meeting," the following, to-wit:—"At such time in the month of September or October in each year as the Executive Committee may decide to be suited to the locality in which the meeting is to be held; the place to be decided upon and each member of the association notified of the selection by the first day of March in the year in which the meeting is to be held." Under the rules action on this amendment was referred until the meeting of the association.

Mr. Holmes moved that a vote of thanks be returned to the Detroit Railway Companies and Swartz Brothers of the Hotel Cadillac, Detroit, and the Nashville Street Railway for their kind invitations to meet in their cities. Carried.

Mr. Dyer moved that the adjustment of the claim of Messrs. Richardson and Hook, for $210, be left with the president and secretary for such adjustment and settlement as they deem just and proper. Carried.

On motion of Mr. Holmes, adjourned, subject to the call of the chair.

Tuesday's Session

During the course of a complimentary dinner tendered by Messrs. Watson and Littell to the members of the Executive Committee at the Ellicott Club, at Buffalo, Mr. Hippee moved that the secretary be authorized to have prepared a steel plate engraving of the former secretary, W. J. Richardson and himself, to be sent to the members of the association. Carried.

The following are the minutes of a special meeting of the Executive Committee of the American Street Railway Association, held at the International Hotel, Niagara Falls, N. Y., Monday, Oct. 18, 1897. President McCulloch called the meeting to order at 3 P.M. There were present Messrs. McCulloch, Sergeant, Dyer, Littell, Bradford, Smith and Penington. Secretary Penington read the minutes of special meeting of the Executive Committe held Feb. 12, 1897. Mr. Littell moved that the minutes be approved, as read. Motion carried. The secretary read a letter from George B. Hippee, regretting his inability, on account of business, to attend the meeting of the Executive Committee.

The secretary stated that he had received a letter from C. G. Goodrich, of Minneapolis,to the effect that Mr. Goodrich was unable to write the paper on "Best Methods of Settling Damage Cases, and Prevention of Accidents by Use of Fenders or Otherwise," as he could not devote the necessary time to it, but that Mr. W. J. Hield of the same company would do so.

The secretary presented the following financial and other statements, to Oct. 12, 1897:

Cash on hand, Oct. 15, 1896		$1,640.94
Receipts to Oct. 12, 1897		
Annual dues	$3,789.58	
Membership fees	375.00	
Space, Exhibit Hall, 1896	2,146.30	
" " " 1897	180.00	6,490.88
		$8,131.82
Expenses to Oct. 12, 1897		
Printing and stationery	$1,762.67	
Postage	140.71	
Miscellaneous expenses	75.56	
Salaries	1,500.00	
Executive Committee, 1897	416.55	
Convention, 1896	1,074.85	
" 1897	230.00	5,200.34
Cash on hand, Oct. 12, 1897		2,931.48
		$8,131.82
Assets Oct. 12, 1897		
Cash in bank	$2,931.48	
Space, Niagara Falls Exhibition, unpaid	1,500.00	
Dues unpaid	350.00	
		4,781.48
Liabilities		
Richardson & Hook		210.00
Net assets		$4,571.48

MEMBERSHIP

October 15, 1896. Members, 160

NEW MEMBERS

Meriden Electric Railroad Co., Meriden, Conn.
Schuylkill Traction Co., Girardville, Pa.
Richmond Traction Co., Richmond, Va.
Houston Electric Street Railway Co., Houston, Tex.
Alton Railway & Illuminating Co., Alton, Ill.
Buffalo & Niagara Falls Electric Ry. Co., Niagara Falls, N. Y.
Atchison Railway, Light & Power Co., Atchinson, Kan.
Compañía de Ferrocarriles de Distrito, de Mexico, City of Mexico.
South Chicago City Railway Co., Chicago, Ill.
Lansing City Electric Railway Co., Lansing, Mich.
Citizens' Street Railway Co., Battle Creek, Mich.
" " " " Kalamazoo, Mich.
Niagara Falls & Suspension Bridge Ry. Co., Niagara Falls, N. Y.
Akron, Bedford & Cleveland Railroad Co., Cleveland, O.
Sioux City Traction Co., Sioux City, Ia. 15

175

WITHDRAWN

Chicago Passenger Railway Co., Chicago.
South Chicago City Railway Co., Chicago.
Geneva, Waterloo, Seneca Falls & Cayuga Lake Traction Co., Geneva, N. Y.
Houston City Street Railway Co., Houston, Tex.
Eighth Avenue Railroad Co., New York City.
Ottawa Electric Railway Co., Ottawa, Ont.
Hestonville, Mantua & Fairmount Passenger Railroad Co., Pa.
Lackawanna Valley Rapid Transit Co., Carbondale, Pa.
Vincennes City Street Railway Co., Vincennes, Ind.
Washington & Soldiers' Home Railway Co., Washington, D. C.
Toledo Electric Street Railway Co., Toledo, O.
Federal Street & Pleasant Valley Railway Co., Pittsburgh. 12

Membership Oct. 12, 1897, 163

DEATHS DURING THE YEAR

W. H. Sinclair, ex-president Galveston City Railroad Co., Galveston, Tex., Jan. 11, 1897.
A. M. Billings, president Memphis Street Railway Co., Memphis, Tenn., Feb. 7, 1897.
John Radell, vice-president Brunswick Traction Co., New Brunswick, N. J., May 9, 1897.
R. Dudley Frazer, ex-president Memphis Street Railway Co., Memphis, Tenn., July 10, 1897.

The president appointed Messrs. Dyer and Smith to obtain the necessary information and prepare suitable memorials upon the deaths of deceased members. Mr. Littell moved that the secretary be authorized to send to the families of the deceased members copies of the resolutions. Carried.

The secretary read a letter from H. F. MacGregor, regarding the requirements and regulations with reference to electric lighting from street railway currents. On motion, the letter was referred to the secretary, with authority to investigate the subject and reply to Mr. MacGregor.

Mr. Dyer moved that the action of the Executive Committee of last year, with reference to the issuing of banquet tickets, be reaffirmed—That there shall be issued two banquet tickets to each member company of the association, where there are two or more official representatives, and where there is only one such representative, only one ticket shall be issued, and where a company is not represented, no banquet ticket shall be issued on account of such company. Motion carried.

Mr. Dyer moved that each author of a paper read at the meeting and each speaker at the banquet be provided with a complimentary ticket, and also for their wives, if they accompany them. Carried.

Mr. Sergeant read a letter from the Massachusetts Street Railway Association, inviting the association to hold its next meeting in Boston. Mr. Bradford presented a like invitation from the Cincinnati League. Mr. Bradford moved that the secretary be authorized to have printed a card of admission to the exposition; the same to be placed in the hands of Messrs. H. H. Littell and Burt Van Horn, to be circulated at their discretion.

President McCulloch expressed his thanks for the courtesy of the members of the Executive Committee, and the promptness with which they had transacted the business of the association. Adjourned.

An expression of thanks to the Press for their uniform courtesy in publishing all notices, etc., sent out from the secretary's office was made by the committee.

THE PRESIDENT: Gentlemen, I will state that an auditing committee has been appointed, and at the opening of our meeting to-morrow morning, that committee will report on the accounts of the treasurer.

The secretary read letters of regret for their inability to attend the meeting, from Thomas Lowry, of Minneapolis, and C. Densmore Wyman, of New Orleans.

MR. H. H. LITTELL, of Buffalo: Mr. President, if I am in order I will offer a resolution which bears upon the address of the president :

WHEREAS, the American Street Railway Association, through the report of its president, has been officially informed of the organization of the Street Railway Accountants' Association of America, and

WHEREAS, the aims and objects of that association are to bring together those engaged in the accounting department of street railways for the interchange of ideas, to promote the adoption of a simple, concise and uniform system of accounts, and to improve the work of accounting department, and

WHEREAS, that association is now in convention assembled in this building, therefore, be it

RESOLVED, that the American Street Railway Association, believing that the statement of the aims and objects of the Accountants' Association will be of permanent benefit to the street railways of America, heartily endorses and approves of the organization of that association and pledges to it its cordial encouragement and support.

The resolution was unanimously adopted.

THE PRESIDENT: If there is no further business in connection with the opening exercises of the meeting, we will now proceed to the reading of the papers. The first paper is that on "Municipal Ownership of Street Railways," by P. F. Sullivan, general manager of the Lowell & Suburban Railway Company, Lowell, Mass. This is a subject to which Mr. Sullivan has given considerable personal attention, he has gone to great trouble and expense to procure information on this subject, and his paper will be very interesting.

The secretary read the paper which is given in full on page 751.

MR. BEAN, of St. Joseph: I move that a vote of thanks be extended to Mr. Sullivan for his very able paper, and that the same be spread upon the minutes. Carried.

THE PRESIDENT: We will now proceed to the next paper, "Some of the Difficulties Existing in the Construction and Operation of Electric Street Railways," by

G. W. Knox, electrical engineer of the Chicago City Railway Company.

Mr. Knox read the paper, which is given in full on page 755.

The President: Gentlemen, you have heard the paper prepared by Mr. Knox and presented to you. We shall be glad to hear some discussion upon it now.

Mr. H. H. Littell, of Buffalo: I move that the paper be received, spread upon the minutes and a vote of thanks returned to Mr. Knox. Carried.

The President: I think Mr. Knox also deserves thanks for being present and presenting his paper. It is my opinion that the selection of a man to present a paper before this association which gives him an opportunity (especially if he is a young man and is not known, except in his own city and amongst his own people, with whom he is thrown in contact) to become known all over the country, and to men who come from every section, ought to be appreciated so much that he would take the pains and trouble, recognizing the compliment of the selection, to prepare a paper and come here and read it, and Mr. Knox deserves credit for having taken that trouble, and I am glad that he has done so.

Mr. H. H. Littell, of Buffalo: I think that the paper just read commends itself to every street railroad man, whether he be president, general manager or superintendent of a company, and especially if he is the electrician. The paper should be read carefully and studied carefully, as it is very important, and especially in reference to buying the supplies and not buying in too large quantities, and also the point about calling the heads of departments and employes together. I have been practicing that for a good many years, and we have a school every morning. We not only talk over matters, but we discuss them, and the practice is attended with a great deal of good. It is certainly a great benefit to our company, and consequently to the public, and I think that this paper should be given a great deal of careful consideration.

On motion, the meeting adjourned until Wednesday morning at 9:30.

WEDNESDAY'S SESSION

President McCulloch called the meeting to order at 10:30 A. M.

The Saginaw (Mich.) Street Railway Company acquired membership in the Association.

The President: The first business this morning will be the report of the auditing committee.

Mr. Sergeant: Mr. President and gentlemen, I beg to say that we have examined the accounts, and we have affixed to the report of the treasurer the following certificate: "We have examined the cash account of T. C. Penington, treasurer, and find the same supported by proper vouchers, and find the same correct.

Niagara Falls, October 20, 1897.

C. S. Sergeant,
D. B. Dyer,
Auditing Committee."

Mr. Bean: I move that the report be received and spread upon the minutes. Carried.

The President: The first paper this morning will be that on "Application of Storage Battery to Electric Traction," by Charles Hewitt, Electrical Engineer Union Traction Company, Philadelphia, Pa.

Mr. Hewitt read the paper, which will be found on page 758.

The President: Gentlemen, you have heard Mr. Hewitt's paper. We would like to have it fully discussed.

Mr. McCormack, of Brooklyn: Mr. Hewitt, I understood, stated that there were two cities in the United States where a car storage battery would be applicable. I would ask what cities he referred to?

Mr. Hewitt: I have in mind the cities of New York and Washington. There may be other cities which would like to have that system, but these are the only two which are seriously considering the matter.

Mr. MacFayden, of Chester: Do you recommend the storage battery in conjunction with the booster in smaller stations, or the booster itself, say, with a capacity of 900 amps.?

Mr. Hewitt: From my observation I believe that all small stations would be benefited in a large measure in their economy, if they had a storage battery. Of course, the question of investment must be considered in all these cases, but, as a general principle, the operation of the station would be economised, if the battery can be used as an auxiliary.

Mr. MacFayden: What is the difference in cost between the kilowatt output of the booster, independent of the battery?

Mr. Hewitt: The only case in which I have had personal experience is the one in Philadelphia. I assume the output of the booster to be the same as the general output of the station. We do not keep separate records of the cost of it, and it would be impossible to do so. The steam furnished for the battery engines is from the same source as the steam furnished for the other engines, and we could not separate them; but I have taken the cost of the station for the months described, and assumed that was the pro rata cost of the kilowatt hour generated by the booster.

Mr. Harrington, of Camden: I ask Mr. Hewitt if the manufacturers of the battery installation have guaranteed the depreciation, and if so, what the guarantee is?

Mr. Hewitt: The storage battery people will guarantee the depreciation, and they have guaranteed the depreciation in our case. I believe it is for five or ten years, and at a certain ratio to the cost of the battery. I do not feel at liberty to say just what the figure is. I do not think, however, that there is any special secret about it. Any man who wants to purchase a battery will get the information from a battery company.

Mr. Patterson, of Salt Lake City: Mr. President, I am very much interested in Mr. Hewitt's paper. It brings out some things that I have been thinking of along on this same line. We in Salt Lake City have a steam plant as well as a water power plant, and we are now running our system by water power located 18 miles from the city. We have occasionally, though not often, been obliged to shut down, once from a snow slide, which swept away the channel which we had around the mountain, and once from losing a bucket off the wheel. We still have our steam plant kept in good running order, but it takes from an hour to an hour and a half to steam up when these things occur. I was thinking when listening to the paper being read, that it might be possible that we could operate a storage battery in connection with our plants. I would like to ask Mr. Hewitt if, in his opinion, we can have a storage battery, and if it would be a plausible scheme to turn the current after shutting down (we are at present, on average days, not counting the big days, running from 300 to 500 amps.), and run the plant by a battery; and if so, at which end of the plant would it be best to put the battery? I presume, of course, at the transformer end.

Mr. Hewitt: I think I am right in saying that the transmission referred to by the gentleman is an alternating current transmission, and there are difficulties in working a storage battery in conjunction with an alternating current. For that reason, it would be impracticable to put the battery on the generating end. To put it at the steam plant end, which, I presume, is in the city, is simply a question of dollars and cents. A battery can be bought large enough to run any road in the United States, if you want to pay for it. It takes a pretty large battery to run the road, independent of all other sources, but it is simply a question of dollars and cents. In using the battery in conjunction with other sources of power, as I have explained in the paper, you take up simply the fluctuations, and let the station do the main work; but to have a battery installation large enough to do the entire work, and

make up the fluctuations as well, you would find it necessary to have a pretty large battery for any ordinary road, but it can be done, if you want to buy it.

MR. MACFAYDEN: Would you consider it economical to have a booster and storage battery combined as a booster line, where you would only want the power at certain times, during heavy loads and on heavy grades? The reason I ask is, that we have a booster and only use it as required, and we have very good results, using it without any storage battery at all. I do not know about the economy. Would it be better to have the battery in conjunction with the booster for such work, or turn the generator into a booster? We can use it either way, as required. If we do not use it as a booster, we can run it as a generator.

MR. HEWITT: In the case referred to at Chester, I do not think the battery would add to their economy. The battery, as a potential regulator on the end of a long line, becomes useful when the variations are so great that in case of a sudden stopping of the cars the potential would go so high as to do damage. For instance, at Chestnut Hill, on our plant there, we at times have the booster as high as 250 volts above the usual 550 volts, making 800 volts in all. If the cars should be stopped or blocked at any point, the potential would go very high, would become dangerous, would blow out the lights in the lamps and cause damage to controllers, and other consequences would be sure to follow. The battery prevents the pressure going up in such cases. In the case the gentleman has spoken of, where the potential does not have to be boosted so high as to be dangerous, and is only boosted at times of heavy load, when the potential on the end of the line is within safe limits, I do not think it would be economical to use a battery. The local conditions of every case must be considered in all such installations.

MR. MUNDY, of Louisville: I desire to ask about the application of the battery particularly in suburban work, such as, for instance, race track travel, without the use of the booster. If the battery were mounted in cars, would it be practicable to run these cars out in cases of special loads to the end of the route, when you will have the load, and then during the race or anything of that sort, the battery would be charged from your line, and at the instant of starting of the cars, pulling off at the same time the battery, and discharging back into the line, to carry you over the heavy peak? What do you think of the application of that? You could use that same battery, in times of long waits of that kind, by having a side track at the station, and run it in to act as an auxiliary at the station.

MR. HEWITT: That is one of the variations of the scheme used abroad, which is perfectly possible. It is a matter, of course, on which an opinion could hardly be given in an off-hand way such as this. It would have to be considered entirely with a view to the local conditions. The cost of the battery would have to be considered against the cost of putting up the necessary line work, and running cars under these conditions, and the cost of maintaining the batteries would have to be considered as against the cost of running the cars in the other way. It might in some cases prove valuable, and it might in other cases prove very costly. I would not give an off-hand opinion or estimate at the present time.

MR. MUNDY: Which do you consider would be the most economical, the use of the battery or the use of the booster?

MR. HEWITT: I am hardly prepared to give a judgment in an off-hand way in a case like that.

MR. H. H. LITTELL, of Buffalo: This is the most important question, as far as dollars and cents are concerned, that has been brought before this meeting—the question of saving money. The gentleman talks of a saving of $33,000. It has been shown to us that we can save $75,000 yearly in our operation by the use of the storage battery, and I am almost led to believe that we can do it, but we have not made any contracts yet. I believe we ought to hear from all of the storage battery men. They have not asked me to make this request, and I have not talked with them on the subject. I believe we should give them an opportunity to say what they have to say. I ask that unanimous consent be given to the various representatives of the storage batteries to state the merits of their respective batteries.

President McCulloch put the question asking unanimous consent to have the representatives of the storage battery companies address the meeting; but as objection was raised by some of the members that the time of the convention would not permit this, the matter was not acted upon affirmatively.

MR. MUNDY: I ask the question if it is practicable to construct these batteries so that you could handle them on cars without drawing the liquid from the cells?

MR. H. H. LITTELL: That shows the necessity of hearing from the battery men. The battery Mr. Hewitt described does not go on the cars, and is not supposed to be put on the cars.

MR. MUNDY: I mean with reference to what I said a few minutes since, using it at the end of the line, if it could be handled in a car of that kind, to stand jolting without spilling the liquid in the cells?

MR. WILSON, of Sioux City: During the last few years a number of the smaller plants throughout the country, those which are operating a load from 300 to 1000 amps., have installed direct connected units, a great many of them using compound engines. As Mr. Hewitt stated, these engines run at their highest efficiency only through a small range of the load. Now, in these smaller plants those engines run at very light load the most of the time. Mr. Hewitt spoke, briefly I thought, of the application of storage batteries to stations for load regulations. I would ask him if he can say anything further on that point, and give some idea of what saving could be effected in stations of the size I have mentioned.

MR. HEWITT: I spoke briefly on that subject, because there has been so little done in that line. If I had gone any further, it would have been in the line of argument only, and I wanted to keep as close to the facts as possible. In the case at Easton, it required four engines to run their cars. At the present time they run with three engines. That of itself shows that these three engines will run more economically than the four in the previous case, the number of cars remaining the same. The difference will be between the economy of an engine running at approximately its maximum economy and an engine running at a low economy. Just what the difference is at Easton, I do not know, because I was unable to get the exact data, but it would probably be a difference of 25 per cent in the coal. If an engine is running at a low economy, with 5 or 6 lbs. of coal, at a low average load, and you increase the load to its maximum economy, you can probably reduce the coal per horse power hour output down to 20 or 25 per cent; but, in addition to that, you must deduct the loss in the battery itself, so that the net saving would possibly be 20 per cent or thereabouts. I do not wish to quote that as an authority, because I have not the facts.

MR. HARRINGTON, of Camden: I would inquire if there is any person present who has had experience in the question which has been raised, as to the matter of percentage of efficiency between running with or without the storage battery. It has been raised in our particular case, and just that one question is the hinging point, I think, more than anything else, to decide the question with us—just what saving would be effected, what the percentage would be. Mr. Hewitt thinks it would be about 20 per cent. If any of the Easton people are here, they would probably know.

THE PRESIDENT: Is there any gentleman here who has had experience so that he can answer this question?

MR. ELY, of Niagara Falls: I agree with Mr. Littell that this is probably the most important question coming before us, as it means, if successful, the saving of thousands of dollars, to say nothing of the cents. We are taking power for the Buffalo & Niagara Falls Railway, and the other street railways of Buffalo as well, from these

large generating companies, the Niagara Falls Power Company and the Niagara Falls Hydraulic Power & Manufacturing Company. They generate the power and sell it to the street railway companies at so much per electrical horse power per annum. You will see at a glance that the street railway company has to pay for that power, whether it is used or not, and for eight hours of the day, on an average, but a small quantity of the power will be used, and for a certain number of hours, on our line particularly, for four or five hours, no power whatever is being used; but we are paying all the time the fixed ratio for the entire amount of power. If the accumulator could be used to store the current, and we could use it at times when we might not take it from the power companies direct, it would be a saving to our companies of thousands of dollars per annum. In Mr. Littell's case it would be a great saving. His company is taking 1000 h. p. daily, per annum, from this transmission line, and it is going to take more. Mr. Hewitt, in your judgment, as the result of your investigation, has the state of the art advanced to that degree that storage batteries or accumulators may now be safely, practically and economically installed to meet such cases?

Mr. Hewitt: Yes, sir, I think the batteries can undoubtedly be installed in such cases, with economy. It is merely a question of size. If you install a battery powerful enough to do the work, it will do it well and reliably. The trouble in most cases has been an overrating of the batteries. The batteries are expensive, and in most cases the railroad companies have been afraid to buy a battery large enough to do the work well. If you buy a battery which is too small it will go to pieces. If you pay enough money to get one that will last you for years, it will do the work well and will be a valuable auxiliary. Whether it will be a saving to any considerable extent in this particular case, I could not say, off-hand. It could be figured out, and possibly effect a considerable saving. From what you have said, I can see that if you are paying for a twenty-four hour day, and you could accumulate a certain amount of power in an accumulator, you might reduce the amount of power which you are paying for; in other words, if you are paying for 1000 horse power hours, you might reduce it at the end of your present contract to a lower amount and use your whole power then the whole twenty-four hours. That is a possibility; whether it would save you money, I would not wish to say, off-hand. The expense of the battery, maintenance and such things would have to be figured out. As far as the physical possibilities go, it is perfectly feasible.

Mr. Dyer, of Augusta: I offer a resolution of thanks to Mr. Hewitt for this very able paper. It is certainly one we have all been much interested in, and we are under many obligations to Mr. Hewitt. I also move that the paper be received and spread upon the minutes. Carried.

President McCulloch, in putting the motion said: "Mr. Hewitt also deserves great credit for having been present and read his paper, and answered the questions asked of him. One hundred times the force and value is given to the paper, by being present and able to follow it out and answer questions as Mr. Hewitt has done." (Applause.)

The President: The next paper is on "Power Distribution and Use of Multiphase Current Transmission for Ordinary Street Railways," by Maurice Hoopes electrical engineer Lynn & Boston Railroad Company, Lynn, Mass. Mr. Sergeant says that Mr. Hoopes intended to be here and read his paper, and answer questions, but has been compelled to abandon his work, and go away for recuperation, and as he is unable to be here the secretary will read the paper.

The secretary read the paper, which will be found on page 763.

Mr. Kelly, of Columbus: I move that a vote of thanks be tendered to Mr. Hoopes for his able paper, and that it be received and placed on file. I also move that a telegram be sent to Mr. Hoopes congratulating him on the paper, and expressing the hope that he may soon be restored to health. Carried.

Mr. Hewitt: I trust the meeting will pardon a few words in reference to this paper. It is a matter which has interested me a great deal. I have done considerable figuring on such transmission as it is the closest competitor to the storage battery and booster, of the former of which I spoke earlier in the session. As far as the problems have come up in ordinary street railway work, with such distances as ordinary roads handle, I have been unable to figure any economy in the multiphase transmission, as compared with the direct, using the booster. When you get to distances beyond, possibly, 15 miles, the problem then becomes more favorable to the alternating current. There are several things to be considered. In the first place, if you have a long line already running, you have copper which you are already using on that line. The first thing you must consider is whether this copper can be used in alternating transmission, should you use such; and in the second place, could the cables be used economically in an alternating current transmission. Very frequently they cannot. If you have a cable of 500,000 c. m. in use, and you want to use an alternating transformer of high potential, in which you only require a No. 0 wire, you dont need to use a wire of 500,000 c. m. where No 0 wire would do, and you do not want to throw it away. That becomes a serious question, where the lines are underground, as they are in Philadelphia and other large cities, and the problem is largely magnified, for the reason that the insulation cost of three cables to run the tri-phase transmission becomes enormous, as compared with the cost of the copper, the extra copper for the single cable to run the direct current; and in the cases that we have met with in Philadelphia, for our long lines, where we run underground cables for a large part of the area, the difficulty has been that the insulation cost of three cables was so great that it was more unprofitable to use a smaller cable, and use three of them, than to use the single cable and use more copper. We figured out very carefully the question of alternating tri-phase transmission, in place of our battery, and we found the battery more economical, and I think the results have shown conclusively that such is the case. From what I gather from Mr. Hoopes' paper, I think he confirms the conclusions which we have reached. As I stated before, when you get to long lines, you then get to cases which are more favorable to the tri-phase, and it is a question in my mind whether we are not on the eve of a very successful tri-phase motor, so that instead of using the rotary transformers we will use the static transformers with a tri-phase motor on the car. I feel sanguine of the future possibility of this motor. I have seen such motors working experimentally, and they bid fair to give very good results.

The President: The next business is the appointment of the nominating committee to nominate officers and select the place for the next meeting. If there are any gentlemen who desire that the next meeting should be held in their respective cities, we should be glad to hear from them. I will appoint as the nominating committee, H. M. Watson, Buffalo, chairman; George B. Kerper, Dayton; Ernest Woodruff, Atlanta; W. Worth Bean, St. Joseph; Albert T. Potter, Providence; John A. Rigg, Reading; E. S. Goodrich, Hartford.

N. H. Davis, of Cincinnati, presented an invitation on behalf of that city. Mr. Graham, of Boston, followed with an invitation for Boston, and Mr. Taylor, of Omaha, presented the claim of that city.

The meeting then adjourned until Thursday morning.

THURSDAY'S SESSION

President McCulloch called the meeting to order at 11 A. M.

The secretary read a letter from H. H. Vreeland, of New York, and a telegram from Thomas H. McLean, of the city of Mexico, regretting their inability to be present at the meeting.

The secretary read a letter from H. H. Littell, vice-president and general manager of the Buffalo Railway Company, inviting the delegates to visit the power houses of that company.

THE PRESIDENT: I will say that during the meeting of the Executive Committee here last February, Mr. Littell very kindly showed us through his power house, and it is well worth anybody's time to go over to see it. There may not be anything there newer or better than many of us have, but we will all find lessons in tidiness, neatness and care, that are good things for us to see, and the manner in which they handle their coal is very interesting. I will now call for the report of the committee which was appointed two years ago, at the Montreal meeting, to confer with other societies as to the formation of standard electrical rules for construction and installation of electric wires. Frank R. Ford was appointed the chairman of that committee.

MR. BACON: I am a member of the firm of Ford & Bacon. Mr. Ford was appointed by this convention to meet several other electrical bodies, to prepare a set of rules governing electrical installation for light and railway systems, and not being able to be present to-day he requested me to make his report.

Mr. Bacon read the following report:

NEW YORK, Oct. 15, 1897.

SECRETARY AMERICAN STREET RAILWAY ASSOCIATION,
NIAGARA FALLS, N. Y.:

DEAR SIR—Supplementing the reports of July 21, 1896, and Oct. 20, 1896, made by me as delegate of the American Street Railway Association to the National Conference on Standard Electrical Rules, I would state that upon Dec. 11 and 12, the Committee on Code of this conference adopted its final report. The following associations were represented by delegates:

American Institute of Architects.
American Institute of Electrical Engineers.
American Society of Mechanical Engineers.
American Street Railway Association.
Factory Mutual Fire Insurance Companies.
National Association of Fire Engineers.
National Board of Fire Underwriters.
National Electric Light Association.
Underwriters' National Electric Association.

As a result of this conference, a revised set of rules has been formulated, to which the name "National Electrical Code" has been given, a copy of which is herewith submitted.

This code has already been adopted or approved by all of the bodies forming the conference as above stated, with the exception of the American Society of Mechanical Engineers and the American Street Railway Association. At the next meeting of the former society the question of adoption will come up and favorable action will undoubtedly be taken.

As the meeting of the American Street Railway Association is the last of the societies and associations named above, it is consequently the last one to which this code is submitted for approval.

As representative of your association I was appointed secretary of the Committee on Code which performed the actual work of revising the rules, and have kept in close touch with all the details of this work.

The new code contains many desirable amendments as to the technical requirements, having had the advantage of the co-operation of some of the most prominent electrical experts in the country representing the various associations and societies in attendance.

The form of the code has also been entirely revised, so as to obtain a more logical and up-to-date arrangement. This fact is particularly important as previous codes contain many repetitions and interpolations. It is not claimed that the code is perfect, but it can be said that each word in it was carefully considered by a number of men representing the most adverse interests and points of view. Amendments can and will be made from time to time as the progress of the art demands.

The great desideratum of uniformity has however been obtained, so that now instead of a number of sets of electrical rules governing construction throughout the country, the "National Electrical Code" will be recognized as the one set of rules to which all electrical work must conform. The fact that it has already been adopted by almost all of the important bodies represented in the conference insures this result and in order to complete the good work made possible by the co-operation of this association, I earnestly recommend that the American Street Railway Association give its formal approval to the "National Electrical Code."

Respectfully submitted,
FRANK R. FORD, Delegate.

MR. BEAN, of St. Joseph: I move that the report of the committee be adopted. Carried.

THE PRESIDENT: Last February there was presented to the Executive Committee a resolution to be acted on at this meeting, which would leave it discretionary with the Executive Committee to fix the date of the meeting at such time in the month of September or October as it might think best, according to the locality, so that if the convention should be held very far North it could be held a little earlier than this date, and if held in the South it might be held a little later in the season.

The secretary read the proposed amendment, as follows: "Mr. Hippee gave notice of the following amendment to Section VII of the By-Laws—Insert in place of the words, 'On the third Tuesday in October, in each year, at such hour and place as shall be designated at the preceding meeting,' the following, to wit—'At such time in the month of September or October, in each year, as the Executive Committee may decide to be suited to the locality in which the meeting is to be held; the time to be decided on and each member of the association notified of the selection by the first day of March in the year in which the meeting is to be held.'"

MR. DAVIS, of Williamsport: I move that the date be fixed not earlier than the fifteenth day of September.

MR. NEWMAN, of New Orleans: I come from a city pretty far South, and we would like to have this convention meet in our city one of these days. We do not expect it next year, but we want you to come down there as soon as you can. We want you, when you do come, to come at the most pleasant season of the year with us, and I move, as an amendment, that the time be extended to include Dec. 15, say, from Sept. 15 to Dec. 15.

Mr. Davis accepted this amendment, and the question being put to the house, the amendment was carried.

THE PRESIDENT: Mr. Dimmock, of the Omaha & Council Bluffs Railway & Bridge Company wishes to address the meeting.

MR. DIMMOCK: The directors of our interurban line, which I represent, have asked me to endeavor to obtain discussion at this meeting of the convention on the subject of United States mails as to the amounts to be received from the Government for carrying the same, with the object in view of obtaining better rates, and a uniform price for the same, feeling that through the convention channels is about the only way the street railways can obtain fair receipts from this class of service. We do not feel that we can get this subject before you so that you can do much at this meeting, but our experience is that the Government is reducing the rates in our vicinity, 50 per cent of what we have received for the past five years; and upon making inquiries of a number of other roads, we find that they have also decreased their receipts from this source. It appears to me that there is no way in which we can do anything with the Government upon this subject except to get it before this association; and I think within the next year, if all the members will take this question up, the street railway companies can obtain much larger revenue from this source than they have had heretofore. All I ask is that this subject be taken up and handled between now and the next convention, so that we can find out what rates we can obtain. I do not think that the street railway companies are under any obligation to the Government to carry these mails at a less rate than the steam railroads receive, and in a great many cases they are doing so.

THE PRESIDENT: We will discuss this question in a few moments. We have just coming into our meeting a body of young men who have been in session all the time we have been in session in the room below. It is the Accountants' Association. It is the new branch of this association, of which I spoke in my opening address. They are young men; they are hustlers, and they have come here for business, and they have attended to it, and they have set us an example that we will do well to follow, in their earnestness and intentness upon their work, and I guarantee that they will carry away from here better and more lasting results than we have carried away from any convention we have ever held. (Applause.) I have the pleasure of introducing Charles N. Duffy, the first vice-

president, Mr. Wilson, of Boston, the president, having been unavoidably kept at home.

Mr. Duffy, of St. Louis: Gentlemen, we want to thank you for the honor conferred upon us in inviting us to appear before this body, and we assure you of our appreciation of it. We want to thank Mr. McCulloch for his kind mention of our Association in his address, and above all, we want to thank the members of this Association for the strong resolutions of endorsement and hearty support that you have passed. That means to us a great deal, more than you probably realize; and in that connection we want to thank all the gentlemen who have come to our meetings, and those who have joined our Association, and more especially those who are managers and not strictly accountants. The Street Railway Accountants' Association was organized in Cleveland, March 23-24 of this year. The work of the accounting departments of street railways is very diversified. It is largely the result of the ideas of the men in charge, or the conditions under which the road is operated, and we feel that it is wise for us to have a convention and better our work and learn from one another, just as you operating gentlemen have done in this convention, and that is our purpose—to acquire information from one another and interchange ideas, and to bring out the good points of all systems of accounting, for the common good; also to attend these conventions and to profit by the exhibits and other advantages which you gentlemen enjoy. We desire, if possible, to promote a simple, wise and elastic system of accounting, which will be economical and uniform, so that as far as possible all street railway accounts shall be on the same basis. That does not mean that I am to know what the other man is doing, or the other man is to know what I am doing; but it does mean that, if our general managers want to know how they stand as compared with other companies, in the performance of the power plant, or operation of the road, or maintenance of track, or any other department of the work, they can at least compare things on a uniform basis. (Applause.) That is our idea. We feel that the accounting department of a street railway company is just as important as any other department, and all we hope to do is to improve our work and improve ourselves in the same way as, and by the same means that the American Street Railway Association is helping the operating department. Gentlemen, I thank you. (Applause.)

The President: Before discussing the mail question, we have a Committee on Rules for the Government of Motormen and Conductors, appointed at the last meeting, which will now report.

Mr. Kelly, of Columbus, presented the following report:

To the American Street Railway Association:

Gentlemen—Your committee appointed at the Annual Association meeting in St. Louis, in 1896, to consider the advisability of this association adopting a standard code of rules for the government of street railway employes, begs leave to report, that after a careful consideration of the subject, we deem it both necessary and desirable that such a code be adopted by this association, and therefore recommend that a committee be appointed to formulate such a code of rules, and report the same in full at the next annual meeting of this association.

The committee in thus reporting in favor of the adoption of such a code of rules wishes to disclaim any intention of desiring to make the use of such rules obligatory on any member of the association, but desire s that, if such a standard is adopted by this body, it be left to the discretion of the members to adopt it for their roads in its entirety or select such portions as in their judgment is applicable to their local conditions. Respectfully submitted,

W. F. Kelly,
Ira A. McCormack,
E. C. Foster.

The President: It looks as if this committee wanted to get somebody else to do the work we detailed them to do.

Mr. Kelly: It was my understanding, Mr. President, that we were to prepare such a code of rules, and so far as I am concerned, personally, I had a number of suggestions that I desired to incorporate in such a code. At a meeting of the committee, some of the members seemed to be of the opinion that it was not our business to prepare the code, but simply to report on the advisability of taking action looking to the adoption of such a code. There was a difference of opinion as to what we were to do. I hope the committee will be directed to make such a report.

Mr. Akarman, of Worcester: I move that we accept the report of the committee, and that the same committee be continued for another year, with instructions to report such rules to the convention. Carried.

The President: We will now take up the discussion of the matter brought up by Mr. Dimmock, on the subject of the carrying of mail.

Mr. MacFayden, of Chester: Why would it not be a good idea to appoint a committee to investigate into the mail matter, and have them report at the next convention.

The President: That matter will be referred to the incoming executive committee.

Mr. Hield, of Minneapolis: I represent the street railway systems of Minneapolis and St. Paul. In addition to the local service of the two cities, we operate a line between Minneapolis and St. Paul, which for the last six years has been the official mail route. We carry box mail only, every car being equipped with a box, and the route is such that we pass the post office in each city. When we started that, there had never been any legislation, and we took the lowest classification which was given to railroads, which, I believe, is limited to 200 lbs. We carry nothing but letters, so that our weight never came anywhere near that. In addition to the box service we have a regular passage of mail between the post offices every thirty minutes. That is package mail, which goes direct from one post office to another. We continued in that contract, I think, for five years, and have just renewed it. We were never satisfied with the remuneration we were getting and it has been very materially increased. I was surprised at Mr. Dimmock's statement that there had been a general reduction, because that has not been the case with us. We also carry the mail in Minneapolis to one other post office, not a substation, but an independent post office in the suburbs. We also carry the mail to four substations, and our remuneration for that service is on a basis of three cents a mile. That applies to pouch service—every thing except our interurban box service.

Mr. Dimmock: Mr. Hield's remarks go to show that the Government is making contracts in one part of the country that are different from those in other parts, and also show that the subject is one which can be discussed by the members of this association to the advantage of each company. I know of a number of roads where the rates have been reduced. I think on account of the shortness of time this morning it would be well to have this subject up for discussion at the next meeting.

Mr. Hield: I think I am safe in saying that the representatives of the Government drive as good a bargain as they can. They usually get the service at the best rate they can make. There is no legislation covering the subject.

Mr. Jones, of Memphis: Our experience has been a little different from that of Mr. Dimmock. We carry mail to a number of sub-stations, and within the last thirty days the Government notified us of a 50 per cent increase of the amount which it allows us, without any solicitation on our part whatever.

President McCulloch: I will state what occurred on one of the roads in St Louis, which has for a long time been carrying mail from the city out into the different sections of the county. The contract expired a year ago. The company was not satisfied with what it had been getting, and the Government declined to increase the rate. It ran the mail car into the car house, and there was such a demand for the mail service, that the Government immediately made satisfactory arrangements.

Mr. Hawken, of Rockland, Me: The representative of the mail department in Washington came to the Rockland, Thomaston & Camden Street Railway Company, to make an arrangement with us to carry the mail, and we fitted a car up and carry open mail. We are allowed 3½

cents a mile, the same as the steam railroads, and the Government also pays part of the salary of a postal clerk. The postal clerk looks out for passengers, and express and baggage business, and handles the car.

THE PRESIDENT: We will now listen to the paper on "Discipline of Employes," by George H. Davis, superintendent of the Canal & Claiborne Railroad Company, New Orleans.

MR. DAVIS read this paper, which will be found on page 767.

MR. RIGG, of Reading: I move that the paper be received and filed, and a vote of thanks be extended to Mr. Davis. Carried.

THE PRESIDENT: We would like to have discussion upon this paper. (A pause.) If there is none, we will proceed to the next paper on "Application of Electricity to Railroads now Operated by Steam Power," by H. N. Heft, of the Meriden Street Railway Company, Meriden, Conn.

MR. HEFT read this paper: which will be found on page 776.

The reading of Mr. Heft's paper was followed by loud applause.

MR. BEAN, of St. Joseph: I move that the paper just read be received and placed on the record, and that a vote of thanks be extended to Mr. Heft for his able paper. Carried.

MR. PALMER, of Fall River: I ask Mr. Heft what the costs he has given us represent—the total cost of power or the cost of fuel only?

MR. HEFT: I stated plainly it was the cost of fuel only.

MR. PALMER: Can you give us any figures which will show us the total cost of power per kilowatt hour or car mile?

MR. HEFT: That would depend entirely on the conditions at your station. No two stations would have the same conditions. At Stamford you will notice that our power costs us a great deal less, because we are running nearer to the normal capacity of our engines. At Nantasket the economy is not so great, and at Berlin, where we are only running the high pressure side of the engine, it costs a great deal more. This is true, also, of the labor. The labor where the large engines are costs more than it does with the small engines, where you are running away below your normal load. If we were running our Berlin station up to its normal capacity we would show a greater economy in fuel and labor than in the other power stations, because there is a certain fixed charge which we are subjected to at all stations, and the amount of that depends on the size of the station and the number of units.

MR. PALMER: I appreciate that what you say must necessarily obtain, but what I wanted to find out was whether you had at hand or could give the cost for any one particular station?

MR. HEFT: We have that information in our office. I did not put it in this paper.

MR. PALMER: It seems to me that it would be very interesting for some of us who are operating street railway power stations to be able to compare our cost of production of power with the cost of production of power in those plants which have so recently been fitted up with everything of the latest type, and I should like to be able to compare some of the figures which we have made with some of those which the New York, New Haven & Hartford has been making in its stations. For instance, the total cost per kilowatt hour delivered at the switchboard, including all expenses which should properly come in—taxes, insurance, interest, labor, supplies and everything else chargeable to it.

MR. HEFT: I will say through you, Mr. President, to the members of the Association that we will very gladly furnish any of these data that you ask for, upon application at our office. We will supply any of our plans, maps or data sheets. We have nothing that there is any mystery or secrecy about, and we will be glad to place it at the disposal of any member of the Association. (Applause.)

MR. NEWMAN, of New Orleans: What is the cost of the sparks?

MR. HEFT: I stated that to be seventy cents for a ton of 2000 lbs. These figures are compared with coal costing $3 a ton. While the sparks do not cost our company anything (it is really an expense to get rid of them, as every steam railroad man knows), we pay our motive power department of the road the cost of handling and loading, and the freight department the freight between the points where it is loaded and our power station.

MR. DURBIN, of Denver: Can you give us some idea of the relative cost of construction of the third rail system, as compared with the overhead and feeder system, in his case?

MR. HEFT: I think, if I recollect the figures aright, that the third rail construction costs us, for the third rail, bonding of the rail, and cables at the grade crossings, and bonding of the surface rails, about $3000 per mile. Figured against our cost at Nantasket, it is about one-half, if I recollect the figures rightly; but I will also furnish those figures to anyone. We have them made up in our office. I did not think of bringing these items with me.

THE PRESIDENT: We will proceed to the next order of business, which is the paper on "Best Methods of Settling Damage Cases and Prevention of Accidents by Use of Fenders or Otherwise," by W. J. Hield, of Minneapolis.

Mr. Hield read the paper which will be found on page 770.

Mr. Rigg moved that the paper be received and a vote of thanks returned to Mr Hield. Carried.

MR. DAVIS, of Williamsport: I move that the papers to be read at the meeting be printed fifteen days in advance of the meeting, and distributed among the members. Not agreed to.

THE PRESIDENT: The report of the nominating committee is now in order.

MR. WATSON: The Committee on Nomination of officers for the ensuing year reports in favor of the following persons: for president, Albion E. Lang, of Toledo, O; first vice-president, W. Caryl Ely, of Niagara Falls, N. Y.; second vice-president, John A. Rigg, of Reading, Pa.; third vice-president, Edward G Connette, of Nashville, Tenn.; secretary and treasurer, T. C. Penington, of Chicago, Ill.: executive committee, Robert McCulloch, of St. Louis, Mo.; C. Densmore Wyman, of New Orleans La.; Henry C. Moore, of Trenton, N. J.; John M. Roach, of Chicago, Ill., and Robert S. Goff of Fall River, Mass. For place of meeting, the committee recommend Boston, Mass. Respectfully submitted,

H. M. WATSON,
A. T. POTTER,
JOHN A. RIGG,
E. S. GOODRICH,
W. WORTH BEAN,
E. WOODRUFF,
G. B. KERPER.

MR. SHAW, of Boston: I move that the report be accepted. Carried.

MR. BEAN, of St. Joseph: I move that the secretary be authorized to cast the ballot of the association for the gentlemen nominated.

The secretary duly cast the ballot.

THE PRESIDENT: I declare the gentlemen duly elected.

The meeting then adjourned.

FRIDAY'S SESSION.

President McCulloch called the meeting to order at 10:45 A. M.

MR. KERPER, of Dayton: I move that a vote of thanks be tendered to the president, vice-presidents and the Executive Committee for the able manner in which they have conducted the affairs of the association during the past year. Carried.

Mr. Rigg of Reading: Mr. President, I desire to offer the following resolution:

Resolved, That the members of the American Street Railway Association in annual meeting assembled, express their thanks to the several passenger associations of the United States for their courtesy in granting reduced rates to the members of this association and their friends, who are in attendance upon our annual meeting. Carried.

The President: These passenger associations are very courteous, but they give us no more than any other association with one hundred delegates can receive. I believe we should have a single fare for the round trip. I have therefore considered it wise to appoint a Committee on Transportation. I will name on that committee, the secretary, T. C. Penington; James H. McGraw, of the Street Railway Journal, and H. H. Windsor, of the *Street Railway Review*.

Mr. Bean: Mr. President, I move that a sincere and hearty vote of thanks be extended to his honor, Mayor Hastings, who so warmly welcomed the association to this city; to the general committee, the committee on banquet, the committee on exhibits, and the committee on entertainment, for the complete arrangements which they made for our entertainment and the thorough manner in which they were carried out; to the Niagara Falls Hydraulic Power & Manufacturing Company, the Niagara Falls Power Company, the Niagara Falls Paper Company and the Carborundum Company, for the opportunity of inspecting their interesting plants; to the International Hotel Company, for unceasing attention; to the Buffalo Railway Company, the Niagara Falls & Suspension Bridge Railway Company; the Niagara Falls & Lewiston Railroad Company; the Great Gorge Route; the Buffalo & Niagara Falls Railway Company; the Niagara Falls Park & River Railway Company, and the Niagara Falls Navigation Company, for transportation facilities furnished to the delegates and visitors, and for which we desire to express our deep appreciation. Carried.

Mr. Rigg: I desire to move a vote of thanks to the Ladies' Reception Committee for their kindness in entertaining the ladies of the convention. Carried.

The installation of officers then followed.

President McCullough said: "Mr. Lang, I am glad to turn over to you, sir, the gavel of the association. I hope that you will hold the office of president of the American Street Railway Association with as much pleasure and satisfaction and as much pride as I have, and I wish you the same courteous treatment and the same support in your administration that I have received." (Applause.)

President Lang: Gentlemen, I open my administration with an apology for my late arrival at the hall; I wish to assure you of my profound pleasure in being called to this office. I deem it a great honor, from the fact that I was in no sense a candidate for the office. My place in the association has simply been that of a quiet and earnest listener, endeavoring to learn all I can for the property I represent. We have had opened up to us in the papers presented at this meeting a number of interesting questions that will command our earnest attention, and some of the improvements suggested we will want to introduce in our systems in the course of the coming year. Other questions will arise which will require our attention at our next meeting. I do not think it is proper at this time to enter upon the discussion of any questions of a practical nature. If I am as successful as my predecessor, and as successful as his predecessors have been, in keeping up the interest in this organization, I shall be very thankful. It does not lie entirely with the officers of the association to make a success of the association; it depends upon its members, and as we send out communications during the year, asking for suggestions for topics to be considered at the next meeting, and the assignment of persons to prepare the papers, I hope you will give the matter your prompt attention. (Applause.)

The meeting then adjourned to convene in Boston, Mass., in 1898, on such dates as may hereafter be designated by the Executive Committee.

DIGEST OF THE PROCEEDINGS

OF THE

Street Railway Accountants' Association of America,

AT ITS

FIRST REGULAR ANNUAL CONVENTION,

HELD AT

Niagara Falls, N. Y., October 19-22, 1897

The first regular annual convention of the Street Railway Accountants' Association of America was held at Niagara Falls, N.Y., Oct. 19, 20, 21 and 22, simultaneously with the sixteenth convention of the American Street Railway Association. The Executive Committee held its last meeting prior to the opening of the convention, at the International Hotel on Monday evening, Oct. 18, and the special committee charged with the preparation of a standard system of street railway accounting had been in session in Niagara Falls several days before the convention, in order to complete a very interesting and comprehensive report which it submitted on this occasion.

All of the sessions of the convention were well attended. Considering the actual numerical strength of the association, it mustered a much larger percentage of its force at each meeting than is ordinarily the case with business or technical organizations. Interest was sustained throughout, and it is seldom indeed that men in a common calling get together under more harmonious conditions and with better results than characterized this gathering.

Weather and other conditions were likewise propitious. For the most part the sessions were in the forenoons, although on Thursday, two sessions were held, each being of unusual length, which is only another way of saying, of unusual interest.

TUESDAY'S SESSION

In the absence of the president, H. L. Wilson, of Boston, first vice-president, C. N. Duffy, of St. Louis, presided at the meetings. The first session on Tuesday morning, Oct. 19, was called to order shortly after ten o'clock, the hour fixed by the programme. After roll call came the reading of the minutes of the Cleveland meeting, the meeting for organization. Next followed the annual report of the president, which in his absence was read by the secretary, and is as follows:

REPORT OF PRESIDENT

I have steadily looked forward to this occasion from the day our association was formed and it is with the deepest regret that I am forced to delegate the reading of my address to another.

With the rapid development of electricity as applied to the street railway business has come a very decided improvement in many ways. There has been a marvelous appreciation of real estate in the outlying districts and a great improvement in the streets of both the cities and towns. The small wage earner can now afford both the time and money required to travel back and forth from a pleasant home in the suburbs to his work in the city. The rolling stock has greatly improved and the comfort of this mode of traveling has greatly increased. Everything connected with the business has received careful attention, even to the accounting, and it is a matter for congratulation that although this is the first regular convention of this association, not a little has already been accomplished toward improving this department, by the comparatively few members who attended the meeting when this association was formed in the city of Cleveland last March.

Those of you who were present at that time will remember the enthusiasm that was shown by all present, not only to learn something for their own use, but to do what they could in the way of imparting information to others, and the papers that were presented on that occasion showed that much thought and time had been expended in their preparation, and the general discussions which followed the reading of each, clearly indicated the deep interest all present took in every department of street railway accounting.

Some people claim that it is hardly fair to ask them to give to others the value of what has cost them much time and thought in perfecting, but it is a pleasure to know that this feeling does not exist to any great extent among the members of our profession, and that most of them consider that it is no more than courtesy to impart to others what their experience has taught them. It is very

unusual if one does not obtain some useful information by a comparison of methods. Every one is very apt to be prejudiced in favor of the way he has been keeping his accounts, but the chances are that there may be some points which he has overlooked, that some other person has observed, and if he does not find some improvement worth adopting, may find some mistakes that he will be able to avoid.

As our constitution states, one of our chief aims is "to promote the adoption of a uniform system of accounts" and the most important subject that will come before this meeting is the report of the committee which was appointed to investigate (as far as the limited time would permit) the different methods now in use and give at this meeting the conclusions they have been able to arrive at. The three gentlemen who so kindly consented to assume this very arduous task undertook what it is sincerely hoped will be the beginning of the end of this question, and in the limited time which they have had to prepare their report have accomplished much more than could possibly have been expected when the matter was first suggested.

This question has been brought up several times by the American Street Railway Association, but they have so many important subjects to consider that they have been unable to do much more than suggest that certain methods be approved. It is a great pleasure for me to state that they thoroughly approve of this association and most heartily endorse our aims and objects and their executive committee has assured your officers that any encouragement that they can offer will be most heartily given. They have already tendered us the use of their meeting place as well as the great privilege of attending any of their meetings, their banquet, and in fact, all of the privileges to which their members are entitled, and we shall always feel deeply grateful for their hearty support and endorsement.

What we greatly desire now is to increase our membership and while we are particularly strong in certain localities we wish to represent all sections of America. Among the applications which have been favorable acted upon by the Executive Committee was one from the Republic of Mexico, and as the two principal street railways of the Dominion of Canada were already enrolled upon our membership, it was particularly gratifying to obtain a representative from the neighboring country at the South.

Before this convention adjourns it is sincerely hoped that our membership will have increased to a very large number, and if every member will earnestly try to induce some of the many street railway men whom he will meet during the next few days to join our association, this can easily be accomplished.

Before closing I wish to say a word or two about our very good friend, Mr. H. H. Windsor, of Chicago. To his energy and ability we owe nearly all of our present success, the idea of such an association was only suggested to him when he immediately took hold of the project and devoted much valuable time and no little money toward bringing us together, and when this was accomplished he continued in many ways to direct and encourage us and ever since has evinced a deep interest in everything pertaining to our welfare.

We also owe our gratitude to the members of our fraternity in the city of Cleveland who so kindly entertained us when we met in their beautiful city last spring and we shall always remember the generous hospitality which they extended to us on that occasion.

The report of the Executive Committee and of the treasurer followed and are given herewith.

REPORT OF THE EXECUTIVE COMMITTEE

GENTLEMEN.—The objects of our association, the business transacted by us at Cleveland, O., at our organization meeting are too well known by all to need any remarks from us regarding them, but from the adjournment at that meeting to our convening here there is due from us an account of our stewardship.

At the Cleveland meeting there were represented twenty-five roads; since then we have received applications from and elected to membership twelve others, a list of which is given in the secretary's report, making thirty-seven in all. We have lost one, the Cincinnati Street Railway Company, leaving us at the present time thirty-six companies in good standing from nineteen different states and three countries.

The books of the secretary and treasurer have been examined and found correct, and show a balance on hand of $222.08. In this connection it is proper for us to say that the great burden of getting our affairs in shape, of arranging programmes and keeping in touch with the members has fallen upon our secretary and it gives us pleasure to state his work has been done thoroughly and well. His management has been a most economical one as his detailed report will show.

Our meeting at Cleveland has borne fruit in the way of increased membership; so let us keep up the pace set at that meeting for hard and faithful work until we have upon our rolls every road possible.

Respectfully,
THE EXECUTIVE COMMITTEE.

NIAGARA FALLS, N. Y., Oct. 19, 1897.

REPORT OF THE SECRETARY AND TREASURER

To the Executive Committee:

GENTLEMEN.—In presenting this first annual report of the secretary and treasurer, I wish to attract your attention to a fact which has its bearings upon the past, the present and the future of the association, viz., that the association has been in existence but seven months and during that time the organization has had to be planned throughout, almost entirely by mail, and those plans placed in operation. But the matter of the most importance, that which has caused the secretary the most concern, is that every act, every letter written, every idea placed in practice has had to be in the nature of the case a precedent, many of which will still be in effect many years, perhaps as long as the association shall live. Thus the importance of not only making progress as quickly as possible, but in the right direction and manner, has always had its place in whatever has been done.

In obtaining the books of record, the stationery and circulars required, a due economy has been observed which has given you respectable stationery, but at moderate cost.

We came away from the organization meeting at Cleveland, O., with twenty-five actual membership companies. Since then there have been added the following:

The People's Railway, St. Louis, Mo.
The St. Louis & Suburban Railway, St. Louis, Mo.
The New Orleans Traction Company, New Orleans, La.
The Lowell, Lawrence & Haverhill Street Railway, Lawrence, Mass.
The Richmond Traction Company, Richmond, Va.
The Compañía de Tranvías de Merida, Merida, Mex.
The Lindell Railway, St. Louis, Mo.
The Missouri Railroad, St. Louis, Mo.
The Elmira & Horseheads Railway, Elmira, N. Y.
The Worcester Consolidated Railway, Worcester, Mass.
The Birmingham Ry. & Electric Company, Birmingham, Ala.
The Kokomo City Street Railway, Kokomo, Ind.

Twelve in all, making thirty-seven companies from nineteen states and in three countries. One company, the Cincinnati Street Railway Company, Cincinnati, O., has withdrawn from membership, leaving a net membership on this date of thirty-six companies.

Receipts and expenditures.

Dues received from thirty-seven companies at $10. .		$375.00
Expenditures made for stationery and printing . . .	$46.53	
Postage.	31.00	
Expenses of Committee for a System of Standard Accounts for stationery and postage for circular.	24.33	
Secretary's office expenses.	18.95	
" traveling expenses, exclusive of railroad fare	8.61	
Expenses of Cleveland meeting	18.50	
Total expenditures		$147.92
Leaving balance in Home Savings Bank, Toledo, O.		$222.08

Arrangements have been made whereby the association will receive interest at 3 per cent. upon the monthly balances in the bank.

The secretary is under obligations, and wishes to announce in this public manner his thanks to Robert McCulloch, president, and T. C. Penington, secretary of the American Street Railway Association, and to H. H. Windsor, of the *Street Railway Review*, and E. E. Higgins, of the STREET RAILWAY JOURNAL, for the invaluable assistance rendered and the cordial manner in which they have responded to our needs.

Respectfully submitted,
W. B. BROCKWAY, Sec. and Treas.

TOLEDO, O., Oct. 16, 1897.

After which there was the formal appointment of the convention committee as follows:

Committee on Blanks and Forms, Thos. J. King, of Washington, D. C., C. K. Durbin, of Denver, Col., and P. V. Burington, of Columbus, O.

Nominating Committee, C. K. Durbin, E. B. Hibbs, of Jersey City, N. J., James A. Stratton, of Birmingham, Ala., Robert A. Wallis, of Fitchburg, Mass., and W. G. McDole, of Cleveland, O.

By the composition of the above committees it must be evident to all that the chairman believed new members should be put immediately into harness and given something to do. The gentlemen appointed on these committees, in several instances, had not been introduced to each other at the time of their selection, but the matter of making them mutually acquainted was most gracefully performed by Chairman Duffy, who called upon them forthwith to stand up and become acquainted with each other.

The next matter in order was a paper by C. L. Wight, auditor of the Toledo Traction Company, Toledo, O., entitled "The Care and Handling of Fares from Receipt to Bank," which in his absence was read for him by the secretary, W. B. Brockway. Mr. Wight's paper, (printed in full on page 786) was listened to with profound interest from beginning to end, and that the discussion to follow was to be valuable was evinced by the care with which various members were using the margins of

their programmes for memoranda while the reading was in progress. As a matter of fact, the discussion of each of the papers read at the convention, by reason of calling out the experience of different men laboring in different divisions of the field, proved quite as valuable as the papers themselves. Mr. Wight's paper was accompanied by various blanks, which unfortunately were not explained in the reading, but accompany the paper as given elsewhere in this issue.

The discussion of Mr. Wight's paper was opened by E. D. Hibbs, of Jersey City, who raised the question whether sales of tickets were to be regarded as the measure of the earnings of a road for the day, or whether the earnings were to be estimated by the tickets taken up. He pointed out that in the practice of his company the proceeds of tickets sold are carried to a Suspense Account from which account, amounts are taken from time to time as the tickets are redeemed. He also pointed out that in his practice the cash receipts of a given day are gotten into the bank early the next morning.

Various answers were made to Mr. Hibbs' question with respect to the distinction between sales of tickets of a given day and actual earnings · Some roads, by reason of local conditions, found very little difference between the two, and therefore saved the labor and expense of maintaining a Suspense Account, by treating them as though they were the same. In other cases the conditions were quite the opposite.

The discussion next turned upon the use of receivers' safes, the advantages of which were described in more or less detail by several speakers.

Mr. Durbin, described how sacks are used for conductors' receipts upon his road.

Chairman Duffy at this point called upon J. F. Calderwood, auditor, of Minneapolis, for a statement of his experience. Incidentally Mr. Duffy stated that many roads do not employ the receiver system at all and remarked in conclusion that the receiver system is not in use in St. Louis.

Mr. Calderwood stated in brief that his company has virtually tried all systems, but that the most satisfactory plan that it has found is the receiver system. He explained that the receivers are paid at the rate of $40 a month, and that conductors make returns to them at the end of each trip. He asserted that it is the policy of the management to get the tickets and transfers out of the conductors' hands as soon as possible, and that the cash is turned in at the end of each run. He explained the use of the trip sheet and described how the account is verified in the presence of the conductor. The receivers at the station handle all transfers, and, in addition, assist materially in keeping up the rules of the station. The cash as gathered up is receipted for and is deposited daily.

Mr. Durbin inquired how many hours receivers are required to work. Mr. Calderwood answered that the receivers report about eleven o'clock each morning or at such an hour as the first runs on the different lines are being completed. Mr. Durbin inquired if there is any account of the tickets and transfers taken and if the cash is counted by the receivers, to which Mr. Calderwood replied in the affirmative. The chairman asked about the verification of the conductors' cash and how the receivers' cash is checked. The reply was that the cash is always counted and that the trip sheet goes in with the bag.

Several members expressed themselves in favor of the receiver system, declaring it, all things considered, to be the most economical of any plan that had been suggested for the purpose. One member pointed out that the receiver takes whatever comes to him and asks no questions.

The experience of W. G. Ross, comptroller of the Montreal Street Railway Company, Montreal, Can., was asked for. Mr. Ross, in reply, explained that with his road, in common with others in the Dominion, it is customary to use the hand fare-box entirely. Inasmuch as this may be regarded as something as a novelty to street railway men of the United States, he had taken the precaution to bring with him samples for inspection. The hand box was facetiously compared by one member to the collection box sometimes passed at church, but this idea was soon effaced by explanation of the popular construction of the box and the way in which it is used. The box as exhibited appeared to be some 8 ins. high by 6 or 7 ins. long, and 2½ to 3 ins. wide. Each box is provided with a handle, easily grasped by the conductor. There is a slot for dropping in the ticket or the fare. In the course of Mr. Ross's remarks it was pointed out that the boxes are hung up in the car, in plain sight, when not in use. Various questions were propounded by different members with respect to the use of these boxes, among others being how varying rates of fare are managed. In reply to this Mr. Ross pointed out that the conductors sell tickets, and that the tickets as deposited in the fare boxes furnish that information. Incidentally he pointed out that transfers are put into envelopes and returned to the office in that form. He asserted that there is no danger of duplicate boxes being used, a statement which was offered in reply to some one who called attention to the use of duplicate bell punches by certain conductors in the past. It was pointed out that the boxes are too large to be carried under the coat successfully. In answer to another question, Mr. Ross stated that there is nothing in the fare box system to prevent conductors transporting their friends free, except the usual supervision of spotters or detectives. Overloaded cars were also referred to, with indications of how the system works under such conditions, the conclusion by those who have employed the system being that in this regard it is on a par with the best. Mr. Ross stated in conclusion that the money taken up by conductors is counted at the end of every trip, and that care is taken to keep the work up-to-date as closely as possible. He said that earnings are credited only as tickets are taken up.

Mr. King was here invited by the chair to give his ideas upon the subject under discussion. He responded that the line that he represented might be described as a small road, and that its system is such that the cash received one day is ready to be deposited in bank the succeeding day, as early as the bank is opened. He said that his company is using a peculiar safe which has been brought into use as an improvement upon the Slawson box. He indicated briefly the objections to the Slawson box, and pointed out how sometimes it could be beaten. The safe, which was briefly described, was one of ordinary construction, in which are several cylindrical compartments or boxes. Each conductor has a box in the safe, and the cylindrical construction is such that any particular box may be brought into agreement with the slot in the desk or counter, thus accommodating it to the special uses in view. It was pointed out that it had been customary with his company to require all conductors to make good their shortages, and also that it had been customary until recently to refund to them any overplus which might be found in their packets. This latter plan, however, has been lately abandoned, because, Mr. King explained, in his estimation, the presence of an excess was, as a rule, quite as much an indication of something wrong in the conductor's affairs as a shortage. Accordingly, at present the rule is to refund only where a request is made for it, with such circumstantial evidence in support as to convince the management that the conductor is really entitled to it.

W. G. McDole, of Cleveland, was next invited to state his experience in handling fares. He replied that conductors in his company are required to turn in their reports once a day. Receivers' safes are located at the stations. In the morning the cash is taken from his safe by each receiver, placed in a strong bag and sent to the counting room of the main office, where the cashier takes charge of it. Here special clerks do the counting. Some of the clerks count cash, while others count tickets. The cashier receipts for the entire amount, the individual packages being carefully labeled. The deposit of the pre-

vious day's receipts gets into bank about eleven o'clock. Shortage and overage slips are made out for all variations. In reply to a question of how Sunday work is managed, he replied that formerly it had been customary to have certain clerks work on Sunday, for the purpose of taking care of Saturday's receipts. Latterly, however, the company had abandoned this species of Sunday work and had demanded only that the clerks come a little earlier Monday morning and work somewhat harder that day. The first work on Monday, therefore, would be to clean up Saturday's report and to get Saturday's cash into bank. This accomplished, the Sunday work would be next in order. This plan caused two deposits to be made on Monday, one in the early part of the day, representing Saturday's receipts, and the other somewhat later, covering those of Sunday. He said that quite a lot of shortages (and occcasionally overages) occur, and that the shortages are adjusted by showing the reports to the conductors and pointing out to them their mistakes.

Chairman Duffy inquired if there is any reason why the company represented by Mr. McDole could not go into the receiver system, to which the reply was made that it could very readily adopt the receiver system if it desired to do so, but that it was believed by the management that it had something in use at present that was quite as satisfactory as it, if not much better.

Then followed a general discussion about minor details, with various references to the honesty of conductors and the reverse, and how some mistakes occur among them from lack of intelligence or lack of familiarity with simple bookkeeping requirements. References were also made to the special requirements of interurban roads, where the receiver system would be impossible, by reason of the relatively large expense which it would involve. Secretary Brockway explained in brief the plans that are in use upon the road with which he is connected.

The discussion by this time had continued somewhat beyond one o'clock, and attention having been called to this fact, motion of adjournment was made to meet at nine o'clock Wednesday morning.

WEDNESDAY'S SESSION

Whether the visit to the power house of the Niagara Falls Hydraulic Power & Manufacturing Company, and also to the power house of the Niagara Falls Power Company and to some of the other industrial enterprises of Niagara Falls, to which Tuesday afternoon had been devoted, caused the members to be somewhat late in getting together on Wednesday, or whether the delay was due to some of the evening entertainments which had been provided at the different hotels, including music and dancing, is not an essential part of a formal report of the convention. It suffices to say, therefore, that it was after ten o'clock on Wednesday morning when the meeting was called to order, notwithstanding the fact that the officers and some of the members had been waiting nearly an hour. There was the usual roll call, after which the secretary announced a considerable number of applications for membership, indicating that before the convention formally adjourned there would be a very large accession to the ranks of the association.

The first paper on the programme for the session was that by J. F. Calderwood, auditor of the Twin City Rapid Transit Company, Minneapolis, Minn., entitled "The Handling and Checking of Transfers from Printer to Furnace." Prior to the reading of this paper there had been put upon the wall a map of the street railway systems of Minneapolis and St. Paul, and there had also been placed below it an enlarged fac-simile of one of the transfer tickets which are used by these roads. There was passed around among the members present, during the reading, a collection of the blanks referred to in the paper, and also samples of the transfer tickets showing the variations in numbers, colors, etc. Mr. Calderwood's paper is published in full on page 782.

At the conclusion of the reading, the discussion was started by Chairman Duffy asking Mr. Calderwood if his company had gone into transfers voluntarily and as a matter of principle, or in response to an ordinance. Mr. Calderwood replied that it was in compliance with an ordinance—in other words, that it was under compulsion rather than by choice that the transfer system had been adopted.

In answer to another question, Mr. Calderwood explained at length the method of checking that is pursued in the office of his company, and how precautions are taken to supervise the entire work of the conductors employed upon their numerous lines, in a way to keep everything well in hand and up-to-date, while also maintaining a minimum of expense. The checking, he stated, was done by bright girls, carefully drilled, and working under competent supervision. The question was asked whether it was the policy of his company to hold conductors responsible, to which the reply was made, "not financially." In reply to the question as to the largest number of transfers at any one point, Mr. Calderwood said that away from the records he could not answer with entire satisfaction. With transfers running as many as 20,000 a day, there might be as many as 6000 or 8000 at a given point. It was asked if the checking clerks were ever paid premiums for discovering irregularities, and this question was replied to affirmatively. It was also pointed out that the precaution is occasionally taken of "plugging" the envelopes containing the conductors' reports. Plugging was explained to be substitutions as to the contents of the envelopes before the counters examined them, thus making it possible for the management to determine the efficiency of the counters and their skill in detecting changes of any kind. It was pointed out that supervision upon this plan was very carefully conducted and that the general method had proven very satisfactory in the experience of the company.

The question was asked Mr. Calderwood if his company had had experience with what are called "go-betweens." He replied that it had. Another question proposed to Mr. Calderwood related to the method employed for getting the transfers from the conductors to the office. He replied to this that the conductors put the transfers in envelopes and deposit them at the end of every trip. These envelopes are taken in a large sack to the office as often as two or three times a day. There girls count the contents, the envelopes being delivered to them with their face sides down so that the count is made without the counter knowing the stated contents of the envelope. He was next asked whether passengers were obliged to take the connecting car at the point of intersection, to which he replied affirmatively. He was then asked if the system outlined does not throw a large amount of work upon the conductors. His reply to this was to the effect that the conductors are able to make up their reports at the end of the line or when they are nearing the end of the trip, and at a time when they have abundant leisure for the purpose.

The chairman asked if there was anyone present who does not register transfers, to which there were several replies, "Yes." Thereupon, chairman Duffy, speaking for his company, said that it did not register transfers for fear of trading.

Mr. Meneely, of Brooklyn, explained with reference to his company, that at present it employs transfer agents. He stated that the first effect noticeable upon the introduction of this plan was a reduction of transfers in a very considerable amount. At present his company has from forty to fifty transfer agents at work, and the general average of reduction where the transfer agents are employed, is from 3 to 5 per cent. At the same time the cash receipts have been kept up. On one line he asserted that the decrease in transfer has been as much as 25 per cent of what formerly prevailed. He said that the system had not yet been extended to all the lines operated by his company, but that it was likely to be made inclusive in the course of time. He pointed out in enumerating the advantages of the plan that transfer agents are much easier to watch than conductors, and that inasmuch as they were fewer in number, it was far easier to select reliable

men for their duties as well as to carefully supervise them in the course of their regular work, than to look after a large force of conductors. About eighty transfer agents, he said, would be required for their entire lines and they are employing at present upwards of 2000 conductors. The pay of transfer agents, he stated, averaged $2.25 per day.

A member from Washington, D. C., next gave some account of the transfer system in use in that city. He pointed out that the companies there had been over the entire ground referred to. Formerly they had required the conductors to register transfers the same as they registered fares. More recently they had adopted the system of transfer agents and, he estimated, had saved thousands of dollars by so doing.

Chairman Duffy at this point gave a brief account of the experience of the companies in this regard operating in St. Louis. He said there are some 75 miles of road under operation. In all there are seven systems. Before the time that limited transfers had come into use, they had debated a long time about the employment of transfer agents and the registration of transfers by the conductors. He said that final conclusions in matters of this kind are largely governed by local conditions, and pointed out that it was quite possible for the public to beat a transfer agent. Registered transfers, he asserted, are readily negotiable. With respect to the volume of passenger traffic over the St. Louis lines, he pointed out that it amounted to some 80,000 revenue passengers and 20,000 transfer passengers per day. He said that the consensus of opinion at present was not to register anything but cash fares.

In response to this, one of the members asserted that in his opinion it was expedient to ring up everything a conductor receives. Everybody, he thought, should be rung up who boarded the cars, except, possibly, policemen and others in uniform. He advocated having two registers on each car—one for cash fares and the other for tickets, properly distinguished by tone of bell and in other particulars. The sum of the two registers then must agree with the load on the car. Upon this plan, further, spotters could readily notice whether the cash collected is rung up on the cash register or on the ticket register. He concluded his remarks by saying that the principal objection to transfer agents is that the public can readily take advantage of them, and pointed out that persons will sometimes board a car that is approaching a transfer point, and before the conductor can reach them to collect the fare, will leave the car and walk up to the transfer agent for a ticket. He also pointed out that others, by ingenious gymnastics, will appear to jump from a car when they have never been on at it all, and in the same manner approach the transfer agent for a transfer, thus securing passage over the connecting line without paying anything. It is impossible, he asserted, for a transfer agent to discriminate in such cases, and of necessity he is obliged to give a transfer to everyone who demands it and who apparently has got off the car that has just passed.

F. R. Greene, secretary of the Chicago City Railway Company, pointed out that it was formerly the custom of his company to register transfers. It was discovered, however, that under this system conductors would exchange with each other and turn in the transfers in place of cash collected.

A. H. Williams, of the Manchester (N. H.) Street Railway, inquired if there was anyone present who had had experience with the warrant system, by which was meant, as he subsequently explained, the drawing by the conductor of orders on the transfer agent, for transfers. To this Mr. Durbin, of Denver, Col., answered that his company had formerly employed that plan, but that it had abandoned it.

At this point, the discussion of Mr. Calderwood's paper was brought to a close.

Frank R. Henry, of St. Louis, presented a paper, entitled "Time Keeping, Pay Rolls and Method of Paying." This paper, which called forth as much useful discussion as any other presented during the convention, is printed in full on page 788 of this issue.

The discussion of Mr. Henry's paper included a consideration of various details such as methods of recording time, reporting pay rolls to the general office, paying by distributing the cash directly to the men through the paymaster's department and putting the money into envelopes. Each of a great many different methods of paying was referred to by the speakers, ranging from that of allowing the conductors to pay themselves and their respective motormen daily out of their cash receipts, on the one extreme, to payments made by checks on a bank, drawn to the order of the individual employes, on the other. The current practice of the steam railways of the country was referred to by several speakers as indicating safe precedents to follow. It was pointed out that the usefulness of paying by check depends in some measure upon the intelligence of the man as well also as upon the conveniences which exist for having the check cashed. One speaker objected to paying by check because the most convenient place for the conductors, for example, to get their checks cashed is at the ubiquitous liquor saloon. He did not think that a company was doing right by its men in subjecting them to the necessity of going into such places to get the money which the company should pay them. Another speaker controverted this point by saying that he had no fears of the saloon on that score, in fact, he believed that the check system of paying was a check on the saloon and on the use the men made of the saloon. Few men, he argued, would be likely to have their checks regularly cashed in a saloon when thereby they left behind such a definite record of their visits to the place. He pointed out, as a rule, the check is cashed by the storekeeper, for the most part, the grocer, where the family of the man had been getting supplies during the week—that it first goes to pay up the little score existing, and then furnishes the cash in hand for what is to be expended in other directions.

Secretary Brockway gave some account of the method employed by a company with which he was acquainted, employing some 2500 men in engineering and construction work. It was found in this case that it was inexpedient to pay all the men by check, for by reason of the character and meagre intelligence of the men, checks in many cases would have been difficult things for them to manage. Further, some of the men were employed in places where it would be difficult, in any event, to get checks cashed. Accordingly, among that fraction of the men the cash was distributed, while with others of superior intelligence and working where it was easy to secure the cashing of checks, payments were made upon the check plan.

C. H. Babcock, auditor of the Elmira & Horseheads Railway Company, Elmira, N. Y., gave some account of his practice. A voucher form is issued to each man, which serves to identify the man, while the payment itself is made by cash put up in an envelope. The men sign the vouchers before presenting them.

At this point some member advanced the idea that where the check system is employed it is necessary to draw the checks against a certain fund. In reply to this another member pointed out that it was the charge that was made for the money paid out, whether delivered to the man upon one plan or another, that was vital, and not so much the special division of the company's cash against which the checks were drawn, whether for a single amount or in a large number of small amounts.

The practice of the Pennsylvania Railroad Company of paying by check was referred to and commended by different speakers. The checks, it was said, are drawn to bearer and are in shape to be cashed anywhere. The checks are delivered upon presentation of a pay card properly filled out. At this point a member inquired if a check made payable to bearer was preferable to one drawn to order. The reply was made that where it is customary to issue checks drawn to bearer, it is so done because of the lack of education upon the part of the men paid, some of whom are unable to write. The practice of the Erie Railroad Company, which pays entirely by check, the check being drawn to the order of the man, was here re-

ferred to, and it was pointed out that the endorsement of the employe upon the back of the check is equivalent to a receipt in full.

W. S. Dimmock, of Council Bluffs, stated that it is the custom of his company to pay entirely by check. If the men require money between pay days, as is sometimes the case, they can obtain it by signing a due bill. At the end of the month the due bill is surrendered to him at the same time that the check is issued for the balance to be paid, and he signs a voucher for the entire amount.

Another member stated that after making up the pay roll a special deposit is made in bank, for the amount the men are paid by check, the checks being drawn against the amount that is deposited for the purpose. The company formerly used an envelope system, but thinks it better to pay by check, throwing the detail work upon the bank instead of doing it by their own clerks.

C. K. Durbin, of Denver, said, "We pay our shop men, track men and car house men by checks, and do not take any other receipt. The men endorse the checks. We allow the train men to pay themselves. The conductor pays himself and his motorman each day, turning in in lieu of the cash thus taken from his receipts, a proper voucher signed by himself and another signed by the motorman. The amount is noted at the bottom of the trip sheet which the conductor and motormann both sign. We check these amounts up the next morning in the office. If we find that a conductor has taken too much, we call him to account for it, and if we find that he has taken too little, as sometimes occurs, we also bring the matter to his attention. We save time and clerical labor by this plan. The conductors do the bookkeeping. One clerk checks up the work of 150 men."

John I. Beggs, general manager of the Milwaukee Electric Railway & Lighting Company, Milwaukee, Wis., asked Mr. Durbin to explain how bookkeeping is saved by this plan, and indicated by his remarks that in his estimation the necessary checking up and examination of what the conductor has done, in the sense of appropriating money for his own use and that of the motorman, and keeping everything straight, would result in far more work than conducting an ordinary pay roll. In the course of Mr. Durbin's remarks in reply it was pointed out that one advantage of his plan was avoiding garnishees. This statement was criticised, and the assertion made that in most states a garnish applied to whatever a man is earning irrespective of the manner in which he is being paid. In concluding his remarks Mr. Durbin asserted that it was formerly the practice of his company to pay twice a month by check. He pointed out that the work of checking up what the conductors do is performed by the same person who checks the register and in the same general way. The workings of the system, he declared, have been very satisfactory and there have been no kicks whatever.

W. M. Barnaby, of Brooklyn, stated that his company has between 4000 and 5000 men to pay, and that payments are made weekly in accordance with the requirements of the New York State law. A very compact system is at present in use. Payrolls are under the supervision of the heads of the different departments. Finally, they are certified to by the division superintendents. Calculations are reviewed in the payroll department. The payroll amounts to about $45,000 per week. The money is distributed through the departments, substantially reversing the order taken by the payrolls. The different foremen certify to the amounts. He pointed out that it was not the rule to pay in envelopes, and that receipts are not demanded, but that the individual man is paid in the presence of a witness. It is the custom of the company to take time by the trip and not in hours.

Chairman Duffy here remarked that his company pays its men in the same general way. He desired to be rid of the labor of making out and filling envelopes, and also that of writing checks. Mr. Duffy asked Mr. Barnaby, if his company is entirely satisfied with the system it is employing, to which Mr. Barnaby replied that it would not think of making a change. Mr. Barnaby added to the explanation that he had already given, how unclaimed wages are returned to the general office and the routine that is pursued when workmen do not appear to take their money at the time it is ready for them, but apply for it subsequently. John I. Beggs, of Milwaukee, Wis., made a strong argument for the system of paying by checks, adducing reasons in support of the plan from the standpoint of the general manager of the accountant and of the employe.

The discussion would undoubtedly have been still further prolonged had not the chairman called attention to the rapid passage of time and the necessity of adhering somewhat to the printed programme.

The next number in order was a paper by W. G. Ross, comptroller of the Montreal Street Railway Company, Montreal, Can., entitled "Materials and Supplies Accounts from Purchase to Use."

This paper which is printed in full on page 788 of this issue, like all that had preceded it, called forth an interesting discussion.

Mr. Beggs, complimented the author upon the excellent suggestions that it contained, making the point in his opening remarks that accounting is the vital part of street railway management. He explained how general managers are specially interested in the work which the accountants are doing, and also set forth, by reference to his own work in different fields, the personal interest that he takes in accounting affairs. He complimented the Accountants' Association very highly in its methods of doing business.

Before the discussion of Mr. Ross's paper was fairly commenced, it was one o'clock, and in view of the excursion which had been provided by the local committee of entertainment for the afternoon, it was deemed necessary to adjourn without further delay, deferring the balance of the discussion to Thursday morning.

THURSDAY'S SESSION

The first order of business, according to the adjournment of the preceding day, was the discussion of Mr. Ross's paper on "Materials and Supplies Accounts from Purchase to Use." It was begun by a member asking the speaker how he kept track of materials charged direct to different accounts. The reply was that nothing was charged direct, but instead everything went into stores, the charges to the accounts being made as the materials and supplies are issued for consumption. The question next proposed was how about labor being added to some of the materials purchased? The reply made by Mr. Ross was that with his company there was no manufacturing conducted. If manufacturing was undertaken, the rule would be to charge the labor to stores, thus adding approximately to the cost value of the different articles on hand. The increased cost would then be taken into account as the articles are withdrawn from the stores. One of the members, speaking on this point, said that it was customary to render regular invoices for the labor expended upon materials and supplies bought, the same as though it had been purchased outside. Mr. Ross was next asked how often it was customary with his company to inventory, to which he replied, "Once a year," and added that so closely are the accounts kept that the variations do not amount to over $200 a year.

Mr. Calderwood remarked that in the system employed by his company everything goes into stores first, and is withdrawn from stores as required. Mr. Duffy pointed out that with his company no single storehouse is maintained, but instead, the storage is distributed through the different departments and in different parts of the system, according to convenience and the requirements of use. In the light of experience, purchases are made in a way to have the supplies come to hand about as they are required for use, no more being delivered in a given month than is necessary for that month's consumption. In other words, the supply people are made to carry the stock, and the invoices which they render are equivalent to vouchers for the materials and supplies consumed during the month for which they are dated.

One member asked how it would be managed where a given article of materials or supplies varied in price from time to time. The reply was made that upon the storehouse system the supplies must always be taken out at the same price as they are put in, and that with varying prices it was expedient to use first that which first went into stores. By keeping things in order in this way there would be no difficulty in properly adjusting the expense accounts.

At the conclusion of the discussion of Mr. Ross's paper, the report of the committee appointed at Cleveland, on a "Standard System of Street Railway Accounting," covering the classification of operating expenses, classification of construction and equipment accounts, and form of annual report was presented. The chairman of this committee was C. N. Duffy, but inasmuch as he was acting as chairman of the meeting, the report was presented by W. F. Ham, secretary of the Nassau Electric Railroad Company, Brooklyn, N. Y. This report will be found in full on page 771.

Copies of the distribution of operating expenses had been printed and freely distributed during the previous sessions of the convention, so that every one was measurably familiar in advance with the leading features of the report. As discussion subsequently indicated, various members had given careful attention to the different items and therefore were in position to talk about them.

It was an agreeable surprise to the committee, and no doubt a surprise also to many of the members present, that the discussion which followed, extending over two days, resulted in very few changes, and none of great importance. At the conclusion of the discussion the report remained unchanged in all essential particulars, a circumstance which reflects great credit upon the committee doing the work. The fact that the committee had closely followed with adaptations the classification of expenses used by the steam railways as specified by the Interstate Commerce Commission, and also approved by the State Boards of Railroad Commissioners of New York and Massachusetts, and the further fact that it had in some of its work the active help of the secretary of the State Board of Railroad Commissioners of New York, C. R. DeFreest, met with the general approval of the members and gave a character to various recommendations made, which in all probability it would not have possessed if some other plan had been pursued in making up the report.

At the very beginning of the discussion, Chas. S. Sergeant, general manager of the West End Street Railway Company, of Boston, and first vice-president of the American Street Railway Association, who was present, was asked by the chair to address the meeting. Mr. Sergeant replied that he was always interested in accounts, and asserted that the real foundation of business is proper accounting. He had seen companies in the slough of despond because their accounts were wrong, and he had seen the same companies restored to a condition of prosperity by reason of their accounts being properly adjusted and their affairs correctly managed in the light of the information which the accounts supplied. He directed particular attention to one item which, he said, appears upon the reports of various European railway companies, but which is very seldom seen in reports of American companies, namely, Depreciation. He asserted that it was something which by rights should appear in the statements of all American companies, and he expected in due course, as the result of the deliberations of the Accountants' Association, it would so appear.

The ensuing discussion with reference to the classification of operating expenses and other features of the report largely assumed the form of questions by members, and answers upon the part of the committee. The members were evidently in search of information, and desired on many points to learn just what the committee's careful investigation had produced. Mr. Ham was spokesman for the committee through the early part of the discussion, and Mr. Duffy for the remainder.

A member inquired what becomes of the old horse railway accounts and equipment which many electric companies take over at the beginning of their existence. To this Mr. Ham replied that the committee did not deem it part of its work to inquire into questions of this kind, but, instead, held itself to the preparation of a system of accounting. He pointed out that the question under consideration was merely classification of accounts, not the possible assets of a company. A member next asked where stable expenses should be charged in the case of a cable road. Mr. Ham, in reply, stated that, as he had been informed, C. R. DeFreest, secretary of the New York State Board of Railroad Commissioners, had instructed the Third Avenue Railway Company, of New York, to report stable expenses as part of the expenses of motive power. Personally, Mr. Ham was disposed to differ from Mr. DeFreest in this regard.

At this point a motion was made to take up the list of operating expense accounts as published, and to discuss in a general way the items seriatim, and afterwards, in view of such modification as had been made in course, to consider the report as a whole. This motion was carried.

To get the matter fairly before the meeting, Mr. Ham here inquired of the members present if the four general heads: A. Maintenance of Way and Structures, B. Maintenance of Equipment, C. Conducting Transportation and D. General Expenses, were satisfactory.

It was moved by T. J. King, of Washington, and seconded by F. R. Greene, of Chicago, to extend the classification to five heads instead of four, by dividing class A into two parts, one being Maintenance of Way, and the other Maintenance of Structures.

During the somewhat animated discussion which followed upon this motion and which served to call out the reasons underlying the different heads of classification as prepared by the committee and the changes suggested in the motion, an invitation was received from the American Street Railway Association for the Accountants' Association to visit it in a body. Accordingly, a recess was taken and all present made their way to the upper room, the officers finding places upon the platform, and the members on the floor.

After the accountants returned to their room, the meeting was again called to order. Chairman Duffy introduced General Bartlett, treasurer of the Manchester Street Railway, Manchester, N. H., who made a brief address. General Bartlett's remarks at the outset contained facetious references to the congress of street railway representatives then in session, alluding to the main convention upstairs as the "lower house"—a sally that was greatly relished. The special point made in General Bartlett's address was to urge the appointment of a committee to be instructed to confer with the boards of railroad commissioners of the different states, including his own state, New Hampshire, for the purpose of impressing upon them the desirability of uniformity in reports, etc., not only applying to the railways in their own states, but also among those of neighboring states. He was under the impression that with the earnest and successful work which the accountants were doing, the commissioners would be very willing to listen to suggestions from them, and prophesied that accordingly they would be able to do even a larger work than they had ever contemplated. At the conclusion of General Bartlett's address it was pointed out that the function of the permanent committee, to have in charge the standardization of accounts of street railways, would include just such duties as the speaker had outlined, and that therefore his suggestion would be referred to that committee.

Discussion was then resumed of the motion which had been made, with respect to a division of the expense accounts falling under the general head A. After considerable discussion, the original motion was withdrawn and a motion by H. J. Davies, of Cleveland, duly seconded, was substituted as follows:

"Resolved, that it is the sense of this meeting that Maintenance of Structures should be classified separately from Maintenance of Way."

After further discussion this motion was put and was lost, two members voting for it and fourteen against it. The object of the substitution was simply to vary the phraseology, making the motion, if carried, only a suggestion to the permanent committee to be charged with carrying forward the work of standardization. It was agreed at this point that in all the motions to follow relating to the different heads of the report, the convention would commit itself to nothing more than an expression of opinion for the guidance of the permanent committee to which the report was to be referred.

Finally, the motion unanimously prevailed that the printed form, so far as relates to the general classes, A, B, C and D, be approved and recommended to the permanent committee. A motion also prevailed that the divisions under A be approved and recommended to the permanent committee.

The general class B, Maintenance of Equipment, was then taken up. Mr. Wallis inquired why repairs and renewals of electric plant (items 4 and 5) are put under the head B, Maintenance and Equipment, instead of in class C, Conducting Transportation. To this Chairman Duffy replied that the items under B affect the physical condition of the property, while the items under C relate to the operation of the property. He pointed out that maintenance is one thing and operation quite another. Reading of the specification of accounts falling under subdivisions 4, 5 and 15, was called for. This served to clear up the questions which had troubled the minds of some of the members, and upon vote, subheads 4 to 10 inclusive, were referred to the permanent committee as having the approval of the convention.

Class C, Conducting Transportation, subdivision Operation of Power Plant, No. 11 to 16, were then similarly discussed, with the specification under each of the several heads carefully read by the spokesman for the committee. No. 13, Water for Power, proved a stumbling-block for some of the members. The evident meaning of the committee was water for steam power. It was urged by some who are obtaining their electricity from water power, that the phrase was liable to be misunderstood. No. 13 was finally changed to read "Water for Steam Power," and in accordance with this, No. 4, which had already been passed, was modified to read "Repairs and Renewals of Steam or Water Plant."

The note printed under No. 16 then came up for discussion. The sense of the meeting was that it should be modified to read that the *cost* of power sold should be deducted from the cost of operating power plant. In the discussion, a principle, long recognized in mercantile lines, was exploited by some of the members, and the necessity of following the rule, not as given in the printed form, but as modified, was illustrated by the supposititious case of a company selling a considerable amount of power at so high a price as to make its income from that source greater than the cost of all the power produced. Of necessity, therefore, the cost of the power sold must be subtracted from the operation of the power plant, and not the selling price of the power. The latter in this case would result in an absurdity. The position taken by Secretary De Freest, of the New York Board of Railroad Commissioners, was also referred to in this discussion. A vote was then taken that Nos. 11 to 16, including the foot note, with the modifications above mentioned, be recommended to the permanent committee for adoption. This was carried.

At this point a recess was taken for lunch. The meeting for the afternoon session was called to order at a little after three o'clock. On the motion of Mr. Calderwood, a committee of three, Messrs. Meneely, Burington and King, was appointed to draft proper resolutions expressing the thanks of the association for the various courtesies received, etc.

The discussion of the classification of operating expenses was then resumed, beginning with Car Service, and including items 17 to 25 in the printed form. Mr. Ham read the specification of each of the subheads. There was comparatively little discussion on Nos. 17 to 22, inclusive, all of which were recommended to the permanent committee without change. No. 23, Miscellaneous Transportation Expenses, was very carefully inquired into, and remarks were made by Messrs. Barnaby, Duffy, Burington, Davies and others. Mr. Barnaby objected to the charge in this account of the cost of Secret Service and said that with his company that charge went into General Expenses. Mr. Duffy stated that the disposition of the item referred to was one upon which a great diversity of views existed. He asserted that the committee had debated the point very carefully before locating it as it had. Mr. Burington advised putting it in General Expenses, and said that Miscellaneous Expenses is always too large an item. He advised more thorough classification with a view of reducing the miscellaneous item to the lowest possible amount. Mr. Davies said that it was the rule with his company to charge this item into Car Service, opening a special account for it. Mr. Durbin, of Denver, said that it was the habit of his company to put the item into a special account under Transportation. The result of the discussion was finally to approve of the classification recommended by the special committee, and therefore this item, with others, was passed on to the permanent committee without change.

Item 24, Cleaning, Watering and Sanding Track, was discussed very fully and served to call out the diversity of detail in different sections of the country. Watering the track had been assumed by some of the members prior to the discussion to mean sprinkling the streets, but it soon transpired that what was meant by the committee, based particularly upon the practice in St. Louis, was cleaning the rails by water, in fact, washing them, something which, Mr. Duffy explained, served to greatly reduce friction and therefore materally diminish the amount of power required to drive the cars.

The discussion of No. 25 called out a statement of requirements made by different boards of railroad commissioners, particularly of the State of Massachusetts and New Hampshire, with reference to reports. In some cases the removal of snow and ice is required to be included in the cost of transportation. Mr. Ham stated that he was under the impression that Mr. DeFreest, of the New York Board of Railroad Commissioners, was not fully convinced of the correctness of the classification which that board had approved. He had understood that at the outset Mr. DeFreest thought that the removal of snow and ice was a maintenance charge, but more recently he had seen reason for putting it under Transportation Charges. Mr. Duffy, further explaining Mr. DeFreest's position, said that a snow storm was an effect of the elements and that it frequently destroys the track. It could be compared to a washout on a steam road, the repairs of which were certainly chargeable to Maintenance. He said that as he understood it, this was substantially the position of the New York Commissioners. Mr. Hibbs thought that removal of snow and ice is really a maintenance of way with electric companies as well as with steam roads. A member here pointed out that the view that the removal of snow and ice is maintenance of way, is based upon conditions prevailing with steam roads and which do not exist with electric roads, and that new conditions must be reckoned with when electric lines are considered. Mr. Barnaby urged that the item be left where it is, and referred to the different conditions prevailing as between a Northern city and a Southern city. In the first there would be a considerable expense under this head, which by rights should be separately stated, while in the second there might be little or no expense under the head. Therefore it was best to maintain for this item, the position which the committee had assigned it.

A vote was here taken on No. 24. Those in favor of putting cleaning, watering and sanding track under the head of Transportation were asked to rise. Twelve responded. Those in favor of putting this item elsewhere were called upon to rise, to which only five responded. A vote was then taken on the Removal of Snow and Ice. Those who were in favor of allowing No. 25 to remain as

reported by the special committee were called upon to rise. Fifteen responded. Those in favor of changing its location were called upon to rise, to which seven responded. It was then moved and seconded that Nos. 17 to 25, inclusive, be referred to the permanent committee for adoption. This was carried unanimously.

Division D, General Expenses, was taken up, being items Nos. 26 to 38, inclusive. The only point of difference in opinion with respect to No. 26 was the salary of general counsel, which by the committee had been put with the Salaries of General Officers. A number of the members thought that this should go in lump into Legal Expenses, No. 34. This suggestion drew attention to No. 35, Injuries and Damages. On motion to adopt No. 26 as read, it was found that the sentiment of the house was unanimously opposed to it. The salary of general counsel was therefore transferred to No. 34, Legal Expenses.

No. 27, Salaries of Clerks, called forth considerable discussion, one point at issue being the expediency of placing all salaries of clerks in one item instead of distributing the expenses of the clerical force in accordance with the special classes of work upon which the force is engaged. Messrs. King, Burington, Ham and Durbin were the principal speakers. Mr. Ham asserted, in behalf of the committee, that everything pertaining to accounts belongs by its nature to General Expenses. In this he was sustained by Mr. Durbin and others On motion this item was unanimously recommended to the permanent committee for adoption. No. 28, Printing and Stationery, was similarly approved. No. 29 was modified to read "Miscellaneous Office Expenses," and similarly approved.

At this point a motion was introduced by A. L. Lawton, of Colorado Springs, that a verbatim report of the proceedings of the convention, including all the discussion, should be printed at the expense of the association at the earliest possible moment, and distributed among its members exclusively, and if the funds in the treasury prove inadequate for the purpose, that an assessment pro rata be made. This motion was carried unanimously.

The consideration of the committee's report was then continued. No. 30, General Stores Expenses, was approved as read. No. 31, General Stable Expenses, was also approved. Quite a little debate followed upon the reading of No. 32, Advertising and Expenses of Park Property. In this discussion the motives of street railway companies in establishing parks and amusement resorts near their terminals was very thoroughly ventilated, and the principles underlying a proper adjustment of accounts were expounded by a number of speakers. Mr. Hibbs made the point that park expenses in themselves are not a part of the legitimate expenses of a road. This was combated by reference to advertising of other descriptions. The question was raised to what account should the increased receipts be credited that follow upon the presence of an attraction at the end of the line? Mr. Burington explained the situation, so far as his company is concerned, and stated that a park enterprise had been entered upon, not out of love for it, but under the stress of competition. He said that the management of his company would not approve of including the expenses of park property under the head of operating the road. He explained that whatever it was believed properly belonged to transportation should be charged to that account, but that the balance should be passed directly to Profit and Loss Account. After still further discussion, Mr. Ham offered the suggestion that the logic of the situation was with the report as submitted by the committee, notwithstanding Mr. Burington, Mr. Hibbs, and the State Board of Railroad Commissioners of the State of New York were on the other side of the question. The sole object of park property both in investment and in operation is to increase the earnings of a road. Accordingly, the expense of a park becomes a part of the operating expenses of the road. Finally, the motion was put and carried that No. 32 be approved as read and referred to the permanent committee.

At 5:30 adjournment was taken to Friday morning.

FRIDAY'S SESSION

The debate on the classification of operating expenses was at once resumed, the first item being No. 33, Miscellaneous General Expenses. This was approved and recommended to the permanent committee. Under the head of No. 34, Legal Expenses, quite a discussion ensued, reviving in some measure that which had previously occurred with reference to No. 26, Salaries of General Officers, wherein it had been agreed to remove from the latter the salary of general counsel, and to include it in No. 34. The result of the new debate was to confirm what had previously been done, and besides this to add a new head in further analysis of what the committee had included under the joint heads, 34 and 35. No. 34, it was agreed, should read "General Legal Expenses," 35, "Legal Expenses in Connection with Injuries and Damages," and 35a, "Injuries and Damages."

Mr. Davies made the point, after the above had approved and referred to the permanent committee, that those roads which carry accident insurance should substitute for "Damages" some such title as "Casualty Insurance."

Mr. Roach raised the question of the propriety of including Injuries and Damages under the head of General Expenses. He argued that the transportation is under the control of the superintendent, and that many accidents are the result of mismanagement on the part of those engaged in the transportation department. He concluded therefore, that Injuries and Damages in matter of classification is out of place under the head of General Expenses. His remarks, he explained, were submitted only in the sense of asking for information. Mr. Duffy made the point that many accidents are entirely beyond the power of the superintendent to prevent, that some occur through carelessness of the public, and that the amounts assessed by the courts for injuries and damages are in many cases out of reasonable proportion even though the transportation department has been somewhat negligent; that the measure of damages very largely depends upon the prejudice of the community against the railroad company as reflected through the jury.

Mr. Ham was disposed to agree with Mr. Roach, in that it is possible for thorough superintendence to prevent a good many accidents, and that therefore accidents occurring in transportation are in a sense part of the cost of operation. Mr. Meneely in support of this point, said that it explained one reason why his company was employing transfer agents. They serve to give conductors more time to look out for the comfort and safety of passengers. Mr. Roach suggested the disposition of damages among the several departments. Mr. Ham made the point that a mere enumeration of the number of accidents of the different kinds and classes would be worth more to the management than the money cost shown by any statement. Mr. Meneely stated that it was the custom of his company to have its claim agents prepare a detailed statement of the accidents, showing kinds and classes. Mr. Duffy said that while he did not believe that the majority of accidents are due to the carelessness of the men, he had been in the habit of keeping a very careful account of accidents in a way to fix proper responsibility. Formerly, he gave this subject much more care than he has time for at present. His experience shows that a very much larger proportion of the expenses of injuries and damages come from a class of accidents which the men could not avoid by any amount of care and precaution. He, therefore, claimed that the transportation department is not responsible broadly for the expense of accidents. Damages are frequently assessed greatly out of proportion to the real loss inflicted, the prejudices of the community having much to do with the amount.

Mr. Calderwood made a statement with respect to the experience of his company, referring to certain strikes that they have had, and estimating that injuries and damages under prevailing conditions have cost at least 50 per cent more than they ought to have cost. Mr. Duffy in-

quired of Mr. Calderwood how many of the accidents on his road he believed occurred through the carelessness of the employes of the company, and how many through the carelessness of the people carried. Mr. Calderwood's estimate was that somewhere in the neighborhood of 75 per cent of the accidents could be avoided by proper care upon the part of the men. Mr. Meneely asked Mr. Duffy if he did not find it difficult in many cases to properly fix responsibility for accidents, to which Mr. Duffy replied in the affirmative. At this point Mr. Roach made the motion that the item, Injuries and Damages, be included under the head of Transportation. Mr. Ham seconded the motion, which on being put by the chair was lost by a large majority. The motion was then made to refer head No. 35 to the permanent committee, with a recommendation of adoption as its stands. Nos. 36, 37 and 38 were disposed of with very slight debate, all being referred to the permanent committee with approval.

At this point the committee introduced what by courtesy was called a "trailer," being a list of the deductions to be made from income. Mr. Wallis raised the question of depreciation, eliciting the reply that this item was not provided for in the report as submitted, but would be something for the permanent committee to take up and bring to the attention of the association at the next convention.

Mr. Davies then called attention to the fact that while practically all the items of the classification of accounts of operating expense had been approved, there had been no action upon the report as a whole. Before reaching such a vote he desired to ask one or two questions of the committee. He would like to know what, under account No. 3, is meant by "Improvement." Mr. Duffy answered in behalf of the committee that it includes such items as sewers, street paving, etc. Mr. Davies then asked if the committee had provided in Expense Accounts for the cost of heating car houses. Mr. Duffy replied that this item would come under the head of Miscellaneous Car House Expenses. Mr. Davies asked where the item of bridge rentals and tolls on bridges would fall. Mr. Duffy answered, under the head of Track Rentals. Mr. Davies then inquired about car rents, mentioning that some companies rent their cars, and stated that it was the rule of his company to charge this item into Car Service. An account, he explained, was kept under this general head called Car Rentals. Mr. Duffy asked if the company made repairs upon rented cars, to which Mr. Davies replied in the negative. Mr. Davies then inquired concerning the placing of the expenses of experiments. He said that he supposed that whether these expenses should be charged to Operating Expenses or Capital Account, depends in some measure upon conditions prevailing at the time and the showing that it is desired to make of the company's affairs. He suggested, therefore, that the permanent committee should consider the question of location of expenses of experiments and report its conclusions at some future date. He said, as indicating his own views, that he was in favor of charging these items into the expenses wherever the experiments are made. Mr. Davies then referred to the loss and damages following upon electrolysis. He raised the question whether this should be charged to Maintenance of Way, to Maintenance of Power Plant, or should it be charged to Damages. He thought the permanent committee should take up this question for consideration also.

Mr. Hibbs referred to the special head No. 2, Repairs and Renewals of Electrical Track Construction, suggesting that its name should be changed. He would substitute the word "line" for "track." Mr. Duffy explained the preferences of the committee for the word "track." Mr. Hibbs suggested "line construction" as something for the permanent committee to consider.

At this point Deductions from Income were again taken up, and the list was read—Taxes, Interest and Rentals of Leased Line. It was moved that the "trailer" be approved and recommended to the consideration of the permanent committee. This was carried. The motion was then made to adopt the report as a whole, and that as amended it be referred to the permanent committee. This was carried unanimously.

Mr. Burington then introduced a resolution thanking the committee whose report had just been considered, complimenting it for its thorough work, and including therein the reappointment of the same persons on the permanent committee. Vigorous protests were offered by each of the several members of the committee against the suggestion of continuing them in the work. Seriously, they argued, they had already done what they could, and now new thought was necessary in the interest of the Association for carrying the work forward to its proper conclusion. This idea was combated by the statement made by several speakers that new men whoever they were would be obliged to acquire the same degree of familiarity with the subject as members of the present committee, already have, in order to be in a position to do the work at all and that therefore on the mere score of economy the same committee should be continued. Mr. Burington's motion was finally enlarged to make the permanent committee consist of five. The permanent committee finally decided upon, is as follows: Messrs. Duffy, Ham, Calderwood, Wilson and Davies.

At this point, Robert McCulloch, president of the American Street Railway Association, entered the hall and was very cordially greeted.

Mr. Meneely in behalf of the committee on Resolutions, here presented a report, submitting resolutions thanking the citizens of Niagara Falls, the officials of the street railways of Niagara Falls and vicinity, the American Street Railway Association, Secretary DeFreest, of the New York State Board of Railroad Commissioners, H. H. Windsor, editor of the *Street Railway Review*, E. E. Higgins, editor of the STREET RAILWAY JOURNAL, and others, for numerous courtesies extended. These resolutions were carried unanimously.

There still remained on the published programme of the meeting the paper by E. D. Hibbs, entitled "Statistics: Their Use and Abuse," and the paper by H. J. Davies, on "Car Mileage, how Arrived at and Its Use." After informal discussion, and at the suggestion, or at least with the approval of the authors, these papers were carried over to the next convention. Mr. Greene moved a vote of thanks to the chairman, C. N. Duffy, first vice-president, for impartiality in presiding and for general efficiency in conducting the sessions of the convention and also to Secretary Brockway for the painstaking industry and efficiency with which his duties have been discharged. Carried. Mr. Hibbs moved that the secretary be voted $100 for the year 1897, with the same allowance to be continued into 1898, for the expenses of his office, etc. This was carried. Mr. Brockway acknowledged the courtesy of the organization in thus reimbursing him for expenditures, and gave some account of the large amount of work that has been performed and is necessary to keep up in order to properly discharge the duties of the office, etc.

At this point the report of the Nominating Committee was called for, which in the absence of Mr. Durbin, who had been called away from the meeting, was read by the secretary. At the mention of the name of each nominee there was loud applause. The convention was evidently unanimously in favor of the nominations as made. A motion therefore prevailed that the secretary cast one ballot for the ticket as reported by the Nominating Committee. Accordingly, the following officers for the ensuing year were elected: president, H. L. Wilson, auditor West End Street Railway Company, Boston, Mass.; first vice-president, E. D. Hibbs, auditor Consolidated Traction Company, Jersey City, N. J.; second vice-president, P. V. Burington, secretary and auditor Columbus Street Railway Company, Columbus, O.; third vice-president, A. H. Bird, secretary and treasurer New Orleans Traction Company, New Orleans, La.; secretary and treasurer, W. B. Brockway, auditor Toledo, Bowling Green & Fremont Railway, Toledo, O. Executive Committee: The above,

together with the following: Wm. F. Ham, secretary Nassau Electric Railroad Company, Brooklyn, N. Y.; F. R. Green, secretary Chicago City Railway Company, Chicago, Ill.; H. J. Davies, assistant secretary and treasurer Cleveland Electric Railway Company, Cleveland, O.; J. M. Smith, comptroller Toronto Railway Company, Toronto, Ont.

The secretary was then directed to send a telegram of congratulation to President Wilson, voicing the sentiment of the individual members of the association, and promising attendance at the convention of 1898, over which he would undoubtedly preside.

The question of the days of meeting for the next annual gathering was referred to several times during the debate. The desire upon the part of many was to make such a selection that while the convention of the accountants should be held simultaneously with the convention of the general association, would afford time for the principal sessions of the Accountants' convention apart from the hours devoted to the principal sessions of the other convention, thus making it possible for treasurers, superintendents and others interested in the general convention to attend the meetings of the accountants so far as they desired to do so. As a result of debate upon this question, it was referred to the incoming Executive Committee, to be arranged as circumstances permit.

Adjourned.

NEW MEMBERS

The following new members were admitted to the association at the Niagara Falls meeting in addition to the companies named in the report of the secretary and treasurer, that acquired membership between the Cleveland and Niagara Falls meetings:

Columbia Railway Co., Washington, D. C.

Brooklyn City & Newtown Railroad Co., Brooklyn, N. Y.

Memphis Street Railroad Co., Memphis, Tenn.

Metropolitan Railroad Co. Washington, D. C.

West Chicago Street Railroad Co., Chicago, Ill.

Union Depot Railroad Co., St. Louis, Mo.

Milwaukee Electric Railway & Lighting Co., Milwaukee, Wis.

Tonawanda Electric Railroad Co., North Tonawanda, N. Y.

Denver Consolidated Traction Co., Denver, Col.

Colorado Springs Rapid Transit Railway Co., Colorado Springs, Col.

Wilmington City Railway, Wilmington, Del.

Hamilton Street Railway Co., Hamilton, Ont.

Fitchburg & Leominster Street Railway Co., Fitchburg, Mass.

Manchester Street Railway Co., Manchester, N. H.

Columbus Central Railway Co., Columbus, O.

Notes.

Two very interesting papers which had been prepared for reading at Niagara were by unanimous consent carried over to the next convention. Some one suggested, after it was found that there was not time to complete the programme, that it would be well, inasmuch as the manuscripts were ready, to have the papers approved without reading and printed in the report. This was very generally objected to, several members making the point simultaneously, that the papers must be saved for the purpose of discussion, for the discussion in all cases was even more valuable than the papers which called it forth. This, with other events reminds one of the plan which has been pursued by some of the engineering societies for a long time past, of having all the papers put in type before the meeting, and proofs distributed among the members sufficiently in advance to allow every one to become thoroughly familiar with the subjects that at the meeting are to come up for discussion. The papers are then submitted by mere reading of titles, and the sessions are devoted to discusston exclusively. Perhaps the street railway accountants would find this plan advantageous, because it would enable members to come to the meeting better prepared for the discussion than otherwise.

There is another argument to be offered in support of this plan of printing papers in advance, and that is, that comparatively few technical men are good readers. They are not trained in the arts of oratory, nor do they need to be, so far as their usual duties are concerned. Again, comparatively few technical men are good listeners. They are not in the habit of taking in information by the ear. They are very much better readers than they are listeners. Their practice keeps them well up in the art of absorbing information by the eye, and therefore papers put in type, and proofs distributed, would be a much better plan of bringing to the individual member the special ideas of the essayists.

It will perhaps be the effort of this organization in the course of time, to publish its transactions in yearly volumes. In any event, the precedent established by the convention just adjourned is to have the papers and the discussion published at the earliest possible moment, at the cost of the association. Accordingly, putting the essays into type in advance of the meeting as above suggested, would not entail any great amount of extra expense. Almost any printer would agree to keep the type standing from, say, three weeks prior to the convention date until the stenographer's report of the discussion could be supplied, and then deliver the complete volume in a very short period of time thereafter.

The value of discussion to the members of the Accountants' Association is something that is not likely to be overestimated. What appears at the outset to be a very simple question sometimes proves to be only the signal for opening a number of volumes of interesting and valuable experience. However carefully the press may report an accountants' convention, and however extensively the published transactions may go into the discussion, still there is a something in the meeting itself, where questions are being asked and answered, that can never be adequately reflected in cold type. Pertinent items of information are furnished in reply to questions asked, and the result of long years of experience are sometimes condensed into a single sentence which, read away from the environment of its delivery, is robbed of half its force. There was not a member of the association present at the convention, who did not take away with him from the discussion many suggestions that will have an important influence upon his work in the future. If he did not get all that he wanted, it was his own fault, for every speaker was ready to answer all the questions proposed. Outside accountants, who are merely readers of the printed reports, are the only ones debarred from the advantage of questions. If there had been a larger attendance at this meeting—that is, if the Association were numerically very much stronger—the beneficial results of the discussion would have been greatly multiplied.

Social History of the Convention.

The convention of the American Street Railway Association in 1897 was eminently one of business men for business purposes, and nothing was allowed to interfere with the regular programme carefully laid out beforehand by the secretary and Executive Committee. Nevertheless, there existed an entirely separate programme of entertainment, which in variety and interest has never been excelled at any convention, and full advantage of which was taken by a large proportion of those in attendance.

The holding of the convention at Niagara Falls was doubtless the reason for the unprecedentedly large number of ladies accompanying delegates and others in attend-

ance, and never were the services of a Ladies' Entertainment Committee more needed or more gratefully received and appreciated. The hospitality extended by the local committees to all was most cordial and unremitting, and it is doubtful if there has been, or will be a single discordant voice in the chorus of praise which is given to all who had anything to do with the management of the convention of 1897.

The first formal event on the programme of entertainment was a visit to the power house of the Niagara Falls Hydraulic Power & Manufacturing Company, the power house of the Niagara Falls Power Company, and the factories of the Niagara Falls Paper Company and the Carborundum Company. These visits were of a character to profoundly interest the men of the visiting party, and to excite the liveliest curiosity on the part of the ladies. Cars of the Niagara Falls & Suspension Bridge Railway were called into requisition for transporting the party to and from the different factories and power houses.

On Tuesday evening there was a wide scattering of the visitors. In the hotels, particularly the International Hotel, was an impromptu ball, with music, dancing, concerts, etc., while a number of parties were organized to visit the Falls. Others went to Buffalo to attend the theatre or to find other entertainment, and a large party of invited guests, forty-six in all, was taken to Buffalo by special car to participate in a dinner given by J. G. White at the Buffalo Club. To those who were privileged to be present, this dinner was one of the most enjoyable events of the entire convention, for the flashing of wit and outpouring of wisdom around the board was far more free and spontaneous than is usually the case with more formal banquets, while the club steward certainly outdid himself in providing things solid, toothsome and dainty for the palate. The officers and executive committee of the association, the principal officers of the street railway companies of Buffalo and Niagara Falls, and the mayors and other municipal officers of the two cities were among the invited guests, and the lists of the latter also include Charles R. DeFreest, secretary, and Ashley W. Cole, member of the State Railroad Commisssion; F. W. Brooks, W. J. Clark, W. Caryl Ely, N. H. Heft, Wm. F. Habirshaw, Charles R. Huntley, H. H. Harrison, E. E. Higgins, F. L. Hart, F. S. Kenfield, I. A. McCormack, T. C. Martin, J. H. McGraw, L. H. Parker, Charles W. Price, G. Tracy Rogers, G. H. Walbridge, W. F. Zimmerman, and others well known in the street railway fraternity. The kindness of W. Caryl Ely and Charles R. Huntley, members of the Buffalo Club, who most cordially co-operated with Mr. White in the matter of club accommodations, special transportation, etc., was fully appreciated by Mr. White and the party.

On Wednesday afternoon the convention was late in adjourning and as a consequence the entertainment features were somewhat delayed. At about three o'clock, parties left the different hotels and walked across the upper Suspension Bridge to the Canadian side, where a long string of cars of the Niagara Falls Park & River Railway were waiting to take the party over that road. The weather was threatening and the rain finally came down to such an extent as to somewhat mar the pleasure of the beautiful scenery along the bank of the river from Chippawa to Queenston, but the trip was not without many enjoyable features nevertheless. At Queenston, the steam ferry of the Niagara Falls Navigation Company took the party to Lewiston, whence the return trip was made via the Niagara Falls & Lewiston Railroad—the "Great Gorge Route." Owing to the delay early in the afternoon, this part of the trip was not finished until after dusk.

In the evening there was more music, dancing, and general enjoyment of the social possibilities found in so large a gathering of friends. The General Electric Company threw open its parlors to all to witness an exhibition of X-ray apparatus and photographs, some of which were very startling and all interesting. As on Tuesday night, quite a number went down to Buffalo to the theatres, and as on every convention night, there were all sorts of "stag parties" in different parts of the hotels, apparently thoroughly enjoying themselves with songs, stories, recitations, cornet solos, "coon bands," etc.

On Thursday, the ladies reception committee, assisted by the gentlemen of the general reception committee, took the visiting ladies on a special trip to Youngstown and Fort Niagara over the "Great Gorge Route" and the Frontier Railroad, and although the weather was not exactly suited to outdoor excursions, the trip was nevertheless much enjoyed.

In the evening came the social event of the convention, the annual banquet, which was held in the large dining room of the International Hotel at about 8:30. After the disposition of the dinner proper, came, as usual, a series of toasts—this year, as last, responded to chiefly by local orators who were called to their feet by Hon. W. Caryl Ely as toastmaster. "The City of Niagara Falls" was the subject of a clear, straightforward and interesting talk by Hon. Arthur C. Hastings, its mayor; Smith P. Galt responded to the toast, "The Association;" Henry W. Box, counsel of the Buffalo Street Railway Company, discoursed at length on "Wit and Humor of the Bar;" "The Evolution of Niagara" was the text of one of the finest and most stirring addresses ever heard at a street railway convention, by Hon. Thomas V. Welsh, and Henry H. Windsor, editor of the *Street Railway Review*, responded most acceptably to the usual toast, "The Technical Press." Hon. Ashley W. Cole, member of the New York Board of Railroad Commissioners, was present during the entire convention and was down on the programme to respond to a toast on "Railroad Commissioners," but was unfortunately called away, and sent to President McCulloch the following letter:

NIAGARA FALLS, New York, Oct. 21, 1897.

CAPTAIN ROBERT MCCULLOCH, President A. S. R. A.,

Dear Sir:—I very much regret that an urgent and unexpected matter of official business requiring my attendance at Albany, precludes me from the pleasure of being present at the banquet of the American Street Railway Association, and of responding to the toast which had been reserved for some remarks on the subject of Street Railways and the Railway Commission.

The opportunity however exists for me to say in this more formal way, that the representatives of the New York State Commission who have attended this convention and exposition, have been deeply interested in the transactions of the association, and in the exhibition of street railway mechanism and appliances, which has been here gathered under its auspices.

All such meetings and displays of progress in the form of enterprise with which you are all identified, exercise a most salutary influence upon the problem of local transportation service, and tend to elevate and dignify the calling of every man engaged in it, whether he be a high officer in the company, or a practical mechanic in its service.

The New York State Railroad Commission has an intimate official relation to the street railways of the Empire State, and it gives me pleasure to believe that the managing minds of those great interests feel confident in the integrity of the commission, and concur in the legislative and executive wisdom which created and maintains this form of governmental recognition and reasonable control of the service. We feel assured that no fairly administered existing corporation, and no projected legitimate enterprise in street railroading in this State, mistrusts or fears the exercise of the large power which the State has placed in our hands. With such a mutually conservative and honest feeling and relation, the best interests of the corporations and the people are readily recognized, and adjusted more promptly and satisfactorily than could be the case without such official scrutiny and interpretation.

Very truly yours,

ASHLEY W. COLE.

During the evening and after the banquet the General Electric Company were scheduled to give a searchlight exhibition at the Whirlpool Rapids, and in fact did so for a short time, but owing to a heavy rain, announcement was made at the banquet that it would be repeated on the following night.

There were no features of entertainment down on the programme for Friday, but nevertheless there were a number of parties made up to visit the Cave of the Winds and other points of interest around Niagara Falls. Nearly all those in attendance at the convention left for home on Friday, having had, by universal testimony, a most satisfactory and enjoyable time.

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EDITORIAL NOTICE.

Papers and correspondence on all subjects of practical interest to our readers are cordially invited. Our columns are always open for the discussion of problems of operation, construction, engineering, finance and invention.

Special effort will be made to answer promptly, and without charge, any reasonable request for information which may be received from our readers and advertisers, answers being given through the columns of the JOURNAL, *when of general interest, otherwise by letter.*

Street railway news and all information regarding changes of officers, new equipment, extensions, financial changes, etc., will be greatly appreciated for use in our Directory, our Financial Supplement, or our news columns.

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NEVER, so far as we are aware, has there been presented in a short period of time so large a number of valuable and suggestive papers and articles bearing on municipal transportation in all its varied phases, as has been the case during the last two months in the State and National Street Railway Associations and in the technical journals. Never have the larger engineering and administrative problems been dealt with so thoughtfully and in so comprehensive a manner. Few, if any, of the great industries of the world require *brains* and breadth of mind more imperatively than that which satisfies the transportation needs of the people, and we find these brains in evidence in the work done in public or private by those in general or departmental charge of our street railway enterprises. Glance over the proceedings of the associations and the contents of our technical journals ten or twelve years ago—alive though they were to all then-existing possibilities—and compare them with those of to-day, if a measure of the broadening out processes which have been at work in the street railway industry, is desired. Is it not true that one of the most thoroughly satisfactory results achieved in the evolution from horses to the cable and electric systems is the immeasurable increase in the dignity and efficiency of the working force from top to bottom—in the skill, intelligence, professional ability and administrative power which modern street railroading demands and obtains?

* * * * *

We cannot comment upon, nor summarize in any adequate manner, the wealth of scientific, technical and administrative material which has been so generously given to the world by street railway operators during these past two months. Each individual paper is a text from which a sermon could be preached, or conversely, according to the point of view, a sermon which could be digested into one or more valuable texts. We have had the relative advantages of municipal and private ownership of street railways most thoroughly and ably presented by such representative street railway managers as H. H. Vreeland, of New York, Clinton L. Rossiter, of Brooklyn, P. F. Sullivan, of Lowell, and W. W. Cole of Elmira, while some of its phases have been touched upon by President G. Tracy Rogers, of Binghamton, and W. J. Clark, of New York. Opposed to all of these gentlemen, who are firm and consistent believers in private ownership, we have Hon. John DeWitt Warner, who contributes to *Municipal Affairs* an article advocating city ownership and operation. This subject is far too important to be dealt with hastily or superficially, and we shall therefore reserve until next month, comment upon Mr. Warner's arguments and those on the side of private ownership. We have had from N. H. Heft and Sydney H. Short carefully written papers on the economic results and possibilities of heavy electric railroading, while W. B. Potter gives most valuable technical data concerning the relative acceleration curves of steam suburban, steam elevated, and electric trains, which show an immense advantage in the use of electricity for obtaining high average schedule speeds. H. S. Cooper, of Schenectady, and W. J. Hield, of Minneapolis, have made valuable suggestions regarding the prevention of accidents. Mr. Cooper makes a strong plea for recognition of the "personal element" in engaging employes, believing that good character, habits and clearness of intellect in the car service department are far better preventatives of accidents than any number of safety appliances. Mr. Hield puts down in plain black and white a number of direct personal suggestions to claim agents which can hardly fail, if followed, to have a favorable influence upon the "Cost of Injuries and Damages." Among the papers relating to different details of street railway operation may be mentioned one on "The Influence of Accurate Measurements," by C. D. Haskins, of Boston; one on "Track Bonding," by H. S. Newton, of Syracuse; one on "Low Joints," by C. L. Allen, of Syracuse; one on "Car Bodies and Trucks," by Robert Dunning, of Buffalo; one on "A Method of Keeping Street Railway Mileage Accounts," by T. J. Nicholl, of Rochester, a paper on "Repair Shops," by J. P. E. Clark, of Binghamton, and a paper on "Car Wheels," by F. D. Russell, of Rochester. All these papers will be read with much interest by street railway managers.

* * * * *

The organization, management and efficiency of the operating force of employes has been the subject of three able papers, one by W. W. Wheatley, of Brooklyn, before

the New York State Association, and the others by George W. Knox, of Chicago, and George H. Davis, of New Orleans, before the National Association. Mr. Davis describes the application of the "Brown system," so-called, to his railroad in New Orleans. This system, first put in operation by George H. Brown, general superintendent of the Fall Brook Railway, is one by which suspensions from work of employes for any cause are entirely done away with, together with the imposition of fines for negligence, accidents, etc. Instead of this, every employe is given good or bad marks for his daily work and makes a record for himself upon which his retention in the office depends. If his bad marks at any time exceed the good by a certain fixed number, he is immediately discharged without the possibility of appeal. The essential principles of this system are unquestionably correct. They bring about a far better feeling among the men, promote an *esprit du corps*, remove many temptations from the men which are common where fines or suspensions are freely imposed, and when carried out to their logical conclusion by a system of promotion from the ranks to the upper branches of the service based on the records, they must certainly tend to increase the ambition of the men and their loyalty to the company. The Brown system is now widely used on steam railroads and has been adopted on not a few street railways, among them the Metropolitan Street Railway Company, of New York City, and the Canal & Claiborne Railroad Company, of New Orleans, of which Mr. Davis is superintendent. Mr. Wheatley also cordially endorses this system and quotes from statements of its originator, Mr. Brown, as follows:

"Penalties are imposed for two purposes: first, to uphold the law and prevent its further violation, and second, to reform the violator. Punishment inflicted indirectly benefits many who do not violate the law as well as the one who does. It often occurs that the disgrace and injury occasioned by a strict enforcement of a sentence does more to ruin the guilty than anything else, and a wise provision has been made allowing courts to use their judgment as to carrying out punishments; this is known as 'suspending sentence.' If the sometime offender does better, and is not guilty of the same or other offenses, the judge conveniently forgets the indictment hanging over him, but should he go on committing one misdemeanor after another, his 'record' rises up to condemn him. I believe in the practice of suspending sentence with railroad employes."

* * * * *

In this connection the system of "service stripes" which has just been adopted by the Metropolitan Street Railway Company, of New York, and which, with some modifications, is used on several other street railway systems, may well be mentioned as tending in the same direction, namely, to increase the ambition and loyalty of the men to their companies. In New York a conductor, motorman, inspector, starter, foreman, or division superintendent, who has been with the Metropolitan Company from one to five years is entitled to wear on his left coat sleeve one blue stripe for each complete year of service; at the completion of the fifth year the blue stripes are removed and a single gold stripe substituted; while for every subsequent five years' service another gold stripe is added. There are two principal objects gained by such a system, the first being due and proper recognition of each other's length of service by the members of the organization itself, in the ordinary dealings of daily life, and the second, the recognition by the public of the fact that the man standing before them with a gold stripe upon his arm is not a callow and untried fledgling who can be assumed to know little or nothing about the proper treatment of the public, but a man tried and tested in the company's service. A third benefit, more or less local in character, is found in the relations of the company to the public. In New York City, where the conditions of service are exceptionally severe, the public is prone to believe that the street railway companies are employing men for political reasons and that changes are frequent and new and untried men common. Exactly the contrary is the case, as a matter of fact, and the service stripes will tend to impress this upon the public. Still a fourth benefit is found in the additional self-respect of the men in dealing with the public and their own superiors and their greater self-restraint in giving vent to anger and impatience. "Where more is expected of a man more is obtained from him" is a general rule of pretty wide application.

* * * * *

The distribution of power for railway purposes over large areas or long lines is a problem involving for any particular case engineering and practical ability of the highest order. Its importance has never, perhaps, until recently been thoroughly understood. It cannot be solved by merely adding cable after cable to overloaded lines without due consideration of the general distribution system. In these modern days the street railway managment must—as Maurice Hoopes and Charles Hewitt point out in their papers before the association—consider no less than five systems of distribution of power in their longer lines from the power station. In cases where the overloading is for only a short period of the day and a large temporary loss in the transmission circuits may therefore be permitted, rather than the constant twenty-four hour loss in interest on additional copper, a special generator may be run at increased voltage to handle the distant sections, or a (series wound) booster may be used to raise the bus bar voltage to such an extent as to deliver current to the different cars at approximately normal voltage, though with heavy loss in the lines. In the far greater number of cases, however, where a large service is regularly maintained in distant sections of the system, these solutions involve too heavy and constant a power loss to be considered, ordinarily, for a moment. Selection may then be made from three other possibilities, the three wire system, the alternating current transmission system, and the storage battery system. The three wire system can, theoretically, be used to good advantage on a double track system where the loads on both tracks are approximately equal. In this case the difference of potential between the two trolley wires is 1000 volts and between each trolley wire and the earth is 500 volts. The transmission is, therefore, at 1000 volts instead of 500, and with the loads on the two tracks exactly equal, there would be no current returning through the track to station, and the amount of copper necessary with any given loss would be theoretically but one-quarter that required for 500 volt transmission. As a matter of fact, however, there is not nearly so large a saving as this in railway practice, and Mr. Hoopes states that the only conditions where the method seems to be applicable are those where there are excessive track losses with fair opportunities for balanced load. The alternating current transmission system with rotary converters has been used in a few long distance cases with success and economy and is now going into operation on a very large scale in the cities of New York and Brooklyn in order to avoid

the necessity for several railway stations in the former city and lighting stations in the latter, real estate being high, and water for condensing purposes being difficult to obtain at the most central power station locations. Where the average load factors of the distant sections are large, i.e., when the section is heavily loaded throughout a large portion of the day, economy over direct transmission can frequently be shown for the alternating current transmission system, but in the case of the Union Traction Company of Philadelphia, Mr. Hewitt has given most valuable and interesting data which seem to prove a decided advantage in that particular place for the storage battery over all other transmission schemes possible to use. There is no question that storage battery manufacturers have clearly demonstrated their right to a patient, and in many cases a favorable, hearing in two distinct lines of work; first, in the equalization of load at the power station, by which higher economy can be obtained from the steam and electric plant through the reduction in the fluctuation of voltage, and an economy in labor also, perhaps, for night service; and second, in maintaining and equalizing voltage at distant sections of a distributing system in the manner so carefully and thoroughly described by Mr. Hewitt. Whether or not they will succeed in successfully solving the storage battery traction problem for individual cars is a matter for the future to determine. Mr. Hewitt regards it as doubtful and cites some valuable and interesting comparative data concerning the financial and operative results of accumulator cars abroad.

* * * * *

We have nothing but words of praise for the fine work done by the Accountants' Convention which met at Niagara Falls at the same time and in the same building as the American Street Railway Association—and nothing but praise and cordial good will for the young association was heard from street railway managers "up stairs." A more hard working and business-like convention has never, we believe, been held. Questions of great technical interest were discussed, papers read and forms presented—all to the permanent benefit of every member company represented. The committee appointed at Cleveland to recommend a standard system of accounts, this committee consisting of C. N. Duffy, of St. Louis, W. F. Ham, of Brooklyn, and J. F. Calderwood, of Minneapolis, have borne the brunt of the work laid out by the Cleveland convention and will continue in the work, so well begun, during the following year, they having been reappointed, with two additions, H. L. Wilson, of Boston, and H. J. Davies, of Cleveland, as a permanent committee to bring about uniform bookkeeping among street railways upon the general lines of their initial report, with such modifications as further study, and the experience of the ablest accountants and railroad commissioners in the country, may furnish. At another time we shall perhaps have something to say about the details of classification which they recommend. Here, however, we need only say that the general scheme is sound, reasonable and according to precedent, and as classifications of this character when once made up on a logical basis are, in their details, matters of mere convention as to phraseology, etc., it seems only necessary to secure the requisite endorsements from official bodies, such as the railroad commissioners in the several states, who have the power to impose classifications upon street railway companies.

Editorial Notes on Convention Happenings

The association voted unanimously to authorize the Executive Committee to fix the date of future conventions between Sept. 15 and Dec. 15, taking into account climatic and other conditions in the locality where the convention is to be held. Due notice must be given to all members of the association on or before March 1.

The following statement of the association's membership will be of interest.

	1895	1896	1897
New members gained, year ending Oct. 15		4	15
Withdrawals and suspensions, year ending Oct. 15		17	12
Membership Oct. 15	173	160	163
New members joining at Niagara Falls			12
Membership Oct. 22, 1897			175

Of the twelve new companies who became members at Niagara Falls, seven are from the New England and Middle States, two from the Central States, two from west of the Mississippi, and one from the South.

The hard work done by the officers, members and committees of the Accountants' Association is deserving of the greatest praise. The meetings were called to order promptly at the time appointed each morning, and adjournment was taken only after the business on the programme had been fully disposed of, while afternoon sessions were held in one or two cases in spite of the attractions provided by the local entertainment committee which were open to all members of this Association. The discussion of the papers presented was of the most valuable and suggestive character, and the subjects were so important and fundamental in character that it was thought best not to publish the discussion broadcast, but the secretary was instructed to print the full proceedings and send out numbered copies to members only.

Mr. Hield endorses most emphatically the "safety gate," first used, so far as known, on his system in Minneapolis and St. Paul, and a device which has excited no a little controversy among street railroad men. He states that it has almost done away with platform accidents to passengers stepping on or off the cars.

A fine personal tribute, and one which is known to be well deserved, was that made on the spur of the moment by W. Caryl Ely to Robert McCulloch at Mr. White's dinner at the Buffalo Club, Tuesday evening. Mr. Ely had been called to his feet in the interchange of wit, wisdom and byplay across the board, and, catching sight of Captain McCulloch's typical military figure opposite, he gracefully turned the call upon the association's president in a brief speech, which will be remembered for many days by those who had the pleasure of hearing it—a speech in which he not only voiced the feeling of deep reverence and affection of all those who personally know Captain McCulloch, but also the broad and generous recognition, now so common both North and South, of the bravery and patriotic devotion shown by those who fought on "the other side" in our Civil War. So touching and eloquent were Mr. Ely's words that Captain McCulloch was quite overcome and unable to respond.

Mr. Knox says:

"Much valuable time is lost and money thrown away by roads

which are keeping so many records on matters pertaining to operation. Where a few records may be gotten out with a view of demonstrating that a leak is going on in some line of the work, or for the purpose of comparison in spurring some of the departments up when they are inclined to be negligent, there is, of course, money in it, and in fact it is necessary in order that the work may be handled intelligently, but where you have your men spending their time in keeping track of how long a certain armature ran, the length of time it takes to make repairs of a certain part of the motor, etc., which records are rarely referred to, and should one want to use them, it would be necessary to spend as much time as it originally took to get them out in looking them up for use—it is all a waste of time and money. The man in charge of a department should be able, when called upon, to show exactly what it is costing to perform any part of the work under his charge, but he should be able to have this knowledge without the constant keeping of a lot of records."

If financial solvency and improvement in condition of treasury are tests of a successful business administration, Secretary Penington is to be congratulated on the way in which he has handled the association's affairs since his election two years ago. It will be remembered that at Montreal the entire indebtedness of the association was wiped out through subscriptions from members, and Secretary Penington was given practically a clean balance sheet—assets and liabilities about *nil*. The following statement shows the association's balance sheet for the last three years.

Assets. Year ending Oct. 15,	1895.	1896.	1897.
Cash on hand	$ 386	$1,641	$2,931
Uncollected dues	charged off	225	350
Convention space	" "	846	1,500
Miscellaneous	335	200	
Deficit	4,087		
Total	$4,808	$2,912	$4,781
Liabilities.			
Miscellaneous	$4,808	$ 382	$ 210
Surplus		2,530	4,571
Total	$4,808	$2,912	$4,781

It will be seen that the surplus last year was $2530 and this year $4571. From the last named figure will have to be deducted, of course, the expenses of the Niagara Falls convention, and the current expenses for the year in order to reach the net surplus at the beginning of the next association year, but it seems probable that the association will go to Boston next year with cash in hand of not less than $4000 to $4500. Mr. Penington has few quarrels and fewer enemies. The work of his office has been carried out with a promptness never equaled in the history of the association, as is shown by the fact that the proceedings were published in pamphlet form within thirty days of the close of the convention, while the usual notices have been sent out during the year in ample season for all requirements.

In the Chestnut Hill division of the Union Traction Company, of Philadelphia, Pa., a most careful comparison of three methods of obtaining current was made by the company's engineers. The end of this line is 11.2 miles from the power station, and the service upon it is heavy. Before the late extensions the accumulated investment for feeders had reached a point considerably exceeding $100,000, not including the conduits. The first method open to the company for handling a greatly increased service along the line was to expend about $275,000 in copper; the second method was to build a new power station to operate the Chestnut Hill line alone, the cost of which would have been about $85,000; and the third method was to install a storage battery plant on the Chestnut Hill line to be fed from the main station, which was done at a total cost for battery and booster of about $33,000. In the matter of initial investment, therefore, it can easily be seen that the storage battery possessed an enormous advantage. In annual operating expenses Mr. Hewitt estimates that there is a saving of about $16,000 a year over what would have been the cost of operating a separate station; and if interest on investment at 5 cent and depreciation at 5 per cent, on the cost of additional copper for direct feeding, be allowed—both very moderate charges—there would be a saving of nearly $14,500 by using the storage battery, over the interest and depreciation of the copper.

Four of the past presidents of the association, H. H. Littell, George B. Kerper, Henry M. Watson and H. M. Littell, were present at this convention and occupied seats of honor on the platform. Another, Thomas Lowry, sent a letter of regret. It may be noted that the position of president of the American Street Railway Association appears to be more conducive to longevity than that of president of the United States, for of the sixteen past presidents, no fewer than twelve are now living.

The association by a nearly unanimous vote refused to authorize the secretary to print in advance the papers to be presented at each meeting in order to distribute them to the delegates. In this respect the association has taken a different course from that followed by many of the great professional associations, and as a consequence its discussions—the life of most conventions—are necessarily cut short in the pressure of work.

Mr. Heft says:

"Nothing is more certain to my mind than that carelessness about making a track return circuit is a most serious mistake, and that carelessness about testing and maintaining joint connections is another. I would rather spend a $1000 or more in providing ample carrying capacity of rail bonds than to put the same amount of money into the overhead circuit, if, by doing the latter, I should neglect the former."

Our exceptionally complete lists of those in attendance at the convention from year to year, show that 1042 were present at Niagara Falls as against 903 at St. Louis, the distribution being as follows:

	1896	1897
Representatives of member companies	249	330
" " manufacturing and business houses	496	558
Ladies	122	113
Representatives of the press	36	41
Total	903	1042

According to Mr. Hoopes, all rail bonds are "very, very good," or "horrid." There is no intermediate ground, for the slightest defect in bonding will increase rapidly to the point of breakdown.

The Accountants' Association is now fairly on its feet, and left Niagara Falls with a membership of fifty-five companies, as against but twenty-eight companies origi-

nally forming the Association. The only one of these twenty-eight original companies which has withdrawn is the Cincinnati Street Railway Company.

General Manager C. Peter Clark, of the New England R. R. attended the convention for the purpose of inspecting the exhibit of apparatus, which interested him very much. Mr. Clark is himself trying some novel transportation experiments on the New England system. He has had built at the Schenectady Locomotive Works a special combination dummy car to be used on feeder lines. This car is of about the usual length of a passenger coach, and the entire motive power is at one end and is sufficient to draw a second car as a trailer if desired. The main part of the motor car is, however, given over to passengers, and the motor is so designed as to permit of high acceleration. Coke is used as fuel. The makers of this car believe that it will have a wide field of usefulness.

Mr. Heft says:

There will always be room, doubtless, for railroads of two characters, the one operating on a purchased right of way, where trespassers can be kept away and high speed obtained, and the other operating on streets and highways, where passengers can be taken up and let off at their own doors. It is possible that, in some thickly settled districts, such as are found in New England and the Middle States, where population groups almost touch each other, these two classes of service may occasionally be performed by the same agency, but there is no reason ordinarily, why there should not be the most amicable and friendly relations, and not infrequently of a business character, existing between steam railroad and street railway companies.

In his paper on Municipal Ownership, P. F. Sullivan called attention to the experience of France and Brazil in the Government ownership of railways. The South American republic has determined to abolish state ownership and is now negotiating with English capitalists for a lease of the entire system, consisting of 14,000 miles of track. When it took charge of the Central Railroad, that corporation had paid as high as 9 per cent dividends, but under governmental control it has been an actual burden upon the people to the extent of from $2,000,000 to $3,000,000 a year above receipts. In France, the tariff of rates is a little higher than that of private railroads, and the cost of operation is considerably larger. The net return upon the whole capital invested is but 1.35 per cent, which means, of course, a considerable deficit over what the money costs the Government in interest paid out. In Canada, the Government owns about 10 per cent of the entire railroad system, and loses about $500,000 annually. Mr. Sullivan might have also spoken of the German state railroad system which is built and operated for military purposes primarily and the convenience of the public secondarily. If the public can be served, well and good, if not, "no matter," is said to be the point of view of German official circles.

The elaborate experiments made by the Chicago City Railway Company in educating its employes by means of lectures, etc., on the construction of motors has been found, according to Mr. Knox, to be a failure and a waste of time.

"Nothing is accomplished by giving them an insight into, and ncouraging them in determining the cause and remedy of some electrical trouble with which they may meet on their cars while on the road; you have men with all kinds of theories, wasting the company's time in tearing apart and dissecting the equipment, and perhaps not then locating the trouble, at the same time they are undoubtedly blocking the line; where, had they, after failing with the simpler methods of locating the trouble, called for an emergency crew, or been pushed into the depot, they would have been doing much better service. There are, of course, some cases where it is excusable for men attempting the locating of trouble on their cars, but, as a rule, it is found to be the wrong practice. If they understand the brake mechanism, the proper manner of applying the power to their motors, how to cut out a disabled motor, and the rules as given in the rule books, they will have about all they are able to master."

Those who met President Brinker, of the "Gorge Road," and had so pleasant a recollection of his dry humor and cordial hospitality will be glad to learn that, through a fortunate mischance (?)—missing by about two minutes the 7:30 eastbound train from Buffalo on Saturday night—he escaped the terrible accident which befell that ill-starred train on the Hudson River embankment, by which nineteen persons lost their lives. Among its passengers were, however, several of those who had been in attendance at the Niagara Falls convention, including E. G. Long, of the Peckham Motor Truck & Wheel Company, F. H. Stillman, of Watson & Stillman, and W. F. Hanks, of the *Electrical Engineer*.

At one time during the convention it looked as if the advocates of the several cities desiring the 1898 convention might bring the contest upon the floor of the convention without regard to the recommendations of the Committee on Nominations, but owing to the careful, patient and protracted work of Chairman H. M. Watson and his associates, the threatened difficulty was averted, a unanimous report was presented, and the association was equally unanimous in adopting the committee's report.

The railroad passenger associations of America came in for some criticism at the convention because of the fact that they furnished no lower rates for transportation for the 1000 or more who attended the Street Railway Convention than for any convention of 100. There will probably be an effort made next year to obtain round trip tickets at one rate fares.

Mr. Heft says:

To make a run of 10 miles with sixteen stops in twenty-six minutes; to be *obliged* to do this in order to connect with boats arriving at regular half hour intervals, and to keep out of the way of frequent regular steam trains on the main line of the Plymouth division; to allow but four minutes at each end for unloading, switching (including running around trail car), and loading; and to do this day in and day out, in regular service, through an entire summer; these are things which cannot possibly be accomplished by steam locomotives.

W. E. Dimmock, of Council Bluffs, raised an interesting question in the convention relative to the rates paid by the Government for carrying mails, and he is doubtless congratulating himself on having done so and on being a member of an association in which an interchange of experience and opinions is possible, inasmuch as it appears that the Government has increased the rates on many roads either voluntarily or upon their demand, while his

own company has suffered from an opposite action. There does not seem to be any reason why street railway companies should hesitate to treat the Government of the United States in a way different from what they would treat a private customer desiring special cars, etc. The Government has no right to fix unprofitable rates, and no company is bound to accept such as the Government may offer. President McCulloch hit the nail on the head, as usual, in stating that when the Government declined to increase the rate in St. Louis to a satisfactory one, the company ran the mail car into the car house and refused to perform the service, upon which there came such a demand from the people for its continuance that the Government immediately made satisfactory arrangements.

According to Mr. Hewitt, the negative plates in the accumulator cars running in Paris, are lasting for about 93,750 car miles, and the positive plates, 8750. The efficiency of the batteries is 70 per cent and the weight of the loaded cars is 30,870 lbs., of which the cells weigh 6615 lbs. At the Hague, which has one of the finest and most smoothly running accumulator roads in the world, the positive plates last from 9000 to 11,000 car miles, but the cost of maintenance of cells alone per car mile is 17 cents, and the cost of handling 4.6 cents additional. In Birmingham the cost of repairs and maintenance of accumulator cars is 10.98 cents, and in Paris (in 1893) the cost of maintenance and handling of accumulators is 5.074 cents.

Captain McCulloch, as president of the association, handled the convention in an eminently practical and common sense manner, expediting its work, and at the same time holding members in convention until the work was finished, in a way that commanded respect for his ability as a presiding officer. He is now to be credited with a large portion of the success of two most successful conventions, and after his term as member of the Executive Committee for 1897-8, he may feel that he may retire with the consciousness of having well served the association.

Mr. Heft's generous offer to furnish full information regarding the records, results, curves and data in general of the New Haven Company to any member of the American Street Railway Association who might wish to write him in the matter, was most heartily appreciated and will probably be taken advantage of by not a few, as it is well known that Mr. Heft has gone very thoroughly into every detail of operation so far as at present developed under the conditions met with by his company.

It is a very satisfactory thing to know that all the principal engineering, professional, industrial and underwriting organizations of the country, dealing with electricity for lighting and power purposes are at last to have a standard set of rules through the intelligent and persevering effort of a general committee composed of delegates from every organization. The "National Electrical Code" is now established by the approval of the American Institute of Architects, the American Institute of Electrical Engineers, the American Street Railway Association, the National Electric Light Association, and four National Boards of Fire Underwriters; the only association which has not yet formally approved the code being the American Society of Mechanical Engineers, which has not yet met to pass upon the question of adoption. Frank R. Ford, representing the American Street Railway Association, performed most valuable work in the National Conference, and the association at Niagara Falls unanimously adopted the report upon his recommendation.

Mr. Hoopes says:

"Especially is it undesirable to install for railroad work a system which may be disturbed by the extreme overloads such work introduces, and which cannot be restored to an operative condition immediately the load is brought within bounds. With the rotary transformer system, any short circuit or extreme load, which is not relieved by the sub-station direct current circuit breakers, may stop the rotaries and shut the power off the line during the long interval it takes to start them and put them into service."

The recognition by the Association of the new Street Railway Accountants' Association was most cordial and emphatic, and it is doubtful if the members of the former realize how thoroughly their generous action was appreciated by the members of the latter. There has been some fear by the Accountants' Association that their purposes and methods would be misunderstood by the general managers of street railway companies, and the knowledge that the older men in the industry are heartily in favor of standardization of accounting methods has greatly encouraged the young Association.

The difference between a regular half hour service from early in the morning until late at night at a cent a mile rate, and a variable long interval service at a two cent rate, in heavy electric railroading through a thickly settled territory, is well shown in Mr. Heft's paper by the statement that the passengers carried with the former kind of service are from three to four times greater than with the latter. Those who look behind mere statements of this kind to see the underlying causes and possible effects, will perhaps note the possibility that electric interurban roads operating on highways may find this new era in heavy electric railroading a tremendously serious thing to meet in competition.

An interesting statement was made by Charles Hewitt in the discussion that followed the reading of his paper concerning the comparative economy of storage batteries and three phase transmission work. Mr. Hewitt called attention to the fact that, where larger feeders were already installed for electric transmission at high voltage, there might be a decided question if the latter would be more economical than the installation of storage batteries, particularly in view of the fact that the insulation for the direct current work would not probably be sufficient for the high tension transmission.

The special car which took Mr. White's dinner party from the Buffalo Club to Niagara Falls over the Buffalo & Niagara Falls Electric Railway on Tuesday night made the fastest run in the history of the road, covering the entire distance in one hour and ten minutes, and the 18 miles from the city line to the International Hotel in thirty-five minutes. General Manager Van Horn, who was of the party, has every reason to be proud of this result and of

the fine roadbed which permitted it to be made without that unevenness and rolling motion which comes with imperfect track. This roadbed, by the way, built as it was by Mr. White, might well have furnished a good illustration also for the many kind remarks which were made at the dinner about Mr. White's honesty and ability as a contractor.

President McCulloch made a strong and earnest plea for the personal attendance at the convention of those who are invited by the Executive Committee to prepare papers. He holds, and rightly so, that an invitation of this kind is an honor and privilege which should be sufficiently appreciated to warrant the necessary time and expense in personally reading the papers and answering such questions as may be asked from the floor.

Mr. Knox says:

"I would strongly advocate not getting too great a quantity of stock of any kind of material on hand, as the defects developing often require the complete changing of designs, with consequent scrapping of all material in stock."

One of the members of the association not represented at the convention was the Terre Haute Electric Railway Company, which is, at the moment, the victim of what appears to be the most depicable and high-handed political tricks which has been for some time attempted, an account of which is given in another column. Mr. Russell B. Harrison's many friends missed him on the convention floor and in the hotels, and were sincerely sorry to hear of the attack made upon his company, although in its results it is likely to be but temporary.

An extremely high commercial economy is shown by the two New Haven stations at Nantasket Beach and Berlin-Hartford, brought about partly by good engineering in the stations, and largely by the use of sparks costing but seventy cents per ton delivered. Mr. Heft states that for the first six months of full operation at Stamford the total cost of fuel amounted to but $.003 per horse power hour; at the Nantasket power station $.0042 per horse power hour, and at the Berlin station $.003 per horse power hour.

Mr. Hoopes lays down a rule applicable to all-copper circuits, or copper outgoing and iron track return circuit that "the maximum benefit in reduction of total resistance, due to the addition of a given amount of conductor, results when the addition is made to the parts in which the drop is greatest per unit of length."

In the storage battery plant of the Union Traction Company on its Chestnut Hill division, the manufacturing company guarantees that the depreciation will not exceed 5 per cent per annum. As a matter of fact, Mr. Hewitt states that after fifteen months of continuous operation the positive plates look as good as at first installed and show no depreciation whatever, while the negative plates have cracked a little, but in no way is their usefulness impaired. The total expense of maintenance has been only about $25, arising from the necessity of repairing two leaky tanks.

Notes and Comments on the Street Railway Accountants' Convention.

By A. O. Kittredge, F. I. A.

Street railway accountants in some respects find themselves in a peculiar position. Many of them are, in a sense, under the immediate direction of the various state boards of railroad commissioners, and yet most of the plans and methods of these state boards have been formulated in the light of steam railway operations and not at all in view of the special conditions existing with street railways. The law in certain states, therefore, requires reports of street railways to be made, based on a scheme of account classification which many of the accountants engaged in street railway work cannot approve. In view of these conditions, it was not at all strange that during the convention various suggestions of conferences with the state railroad commissioners should be made, looking to such amendments of their regulations as will cause them more nearly to agree with the conditions under which street railways are operated. That the accountants have the courage to point out to the state authorities whatever they think could be improved, speaks well for the spirit in which they have undertaken their special work.

From odd scraps of conversation with different members, I was led to imagine that some of them at least went up to Niagara with a feeling of uncertainty as to the treatment that was to be accorded to the Accountants' Association by the American Street Railway Association. If such uncertainty of mind existed at all, it was soon dispelled, for from the first day forward there were many indications in evidence of the extremely cordial feeling that the officers and members of the larger association entertained for those of the younger and smaller organization. The invitation extended by the American Street Railway Association to the accountants to visit its convention during one of the sessions, was a most graceful act and one highly appreciated by all of the accountants. The presence in the accountants' convention at different hours, of various prominent street railway managers was also welcomed by the accountants and received as evidence of approval of the work they were doing. First and last, there was much to show that the accountants' work in this case is being far better appreciated than it has been in many other instances that might be cited. The brief address made by John I. Beggs, of Milwaukee, on the second day of the accountants' convention, very happily expressed the feeling which the great majority of enterprising street railway managers have toward the accounting department. Altogether, the accountants went home in an excellent frame of mind. They will undoubtedly get together in their next convention under even more favorable conditions for carrying forward their special work, because in the interval they will have received still more substantial evidences of approval by their official superiors.

Manufacturers are learning to give careful consideration to depreciation and are writing off a certain amount each year on their factory plant, fixtures, machinery, etc., for depreciation, or are creating reserve funds sufficient to supply renewals whenever renewals are necessary. Street railway companies, as was pointed out by several speakers in the convention, will sooner or later give similar attention to depreciation of the properties under their control, and to the accumulation of reserves to make good the depreciation.

Much of the success of the accountants' convention was due to the ability, energy, tact and impartiality of the officer presiding. I feel free to speak of this matter because Mr. Duffy's success as a chairman is conspicuous compared with what prevails with accountants' organiza-

tions generally. Accountants, by their daily routine, get further and further away from executive and administrative work. As a rule, they become followers rather than leaders, and accordingly, when they get together in meetings, there is usually the lack of good leadership. The street railway accountants are to be congratulated upon having had able leadership in their convention, a fact which added greatly to the success of all the meetings.

From one point of view it would appear from statements made in the accountants' meetings, that the street railway has no friends, or that the hand of every one is against it. From remarks of some of the members it would appear that the conductors and other employes spend much of their time and energy in devising and practicing ways and means to beat the road. Even spotters and detectives were shown to be guilty at times of conspiracy to defraud, and the public came in for no small share of denunciation for efforts of the same kind. Several speakers, for example, gave accounts of the length to which passengers will sometimes go to obtain transportation without paying for it. On the other hand, another class of facts came to light which served somewhat to brighten the picture. One treasurer, as an instance in point, told how a conductor who had claimed a shortage in the money paid him, under circumstances that made the treasurer think best to make up the amount, came back a little later to refund the money, because he had found that it was he who had made the mistake. This would indicate that there is at least one honest conductor. Other speakers told how the public really appreciate certain accommodations that are being provided, how passengers discriminate in favor of that company which looks after their comfort, and how in many cases the people had sided with the company in various questions arising. Summed all up, it would seem that human nature is human nature, whether manifested in relation to the affairs of a street railway company or in other directions.

Speaking in the abstract and from the standpoint of an accountant only, without the thought of attempting to make the application at the present time, it seemed to me as the committee on Standardization of Accounts made its report, that the "trailer" brought in, or in other words the scheme of Deductions from Income, was ill advised, or at least in bad taste. The question arises, Why not have still another head in the classification of expense accounts, that shall include such items, as Taxes, Interest, Rentals of Leased Lines, etc., in proper debtor amounts to go into the general summary, instead of subtracting for these at the bottom of the report? Logically, it would seem that all the computations should be made through proper accounts, or else that everything should be done by the method of subtraction. It is the mixing of two plans that seems specially objectionable. I venture to suggest to the permanent committee, therefore, that a little thought be given to this matter, with the idea in view of preparing such a form of report as shall show the final result of operations without any subtractions. If legal requirements lean to the other form, so much the worse for the requirements, and the lawmakers should be labored with to make a proper change. And this leads me to remark that the requirements of the law in the matter of accountants' reports in other directions are not always beyond question. For example, until very recently it was obligatory upon the proper officers of the National banks, in making their quarterly statement to show taxes and expenses paid to date, as a *resource*. More recently the rule in this case has been modified, but in such a way, unfortunately, that it is still more or less ridiculous from the standpoint of the accountant.

Accounting is accounting, whether applied to transportation, to merchandising, or to other divisions of business. The problems which beset accountants in each of these several fields resemble each other in kind, although they are frequently so expressed in terms peculiar to the interest represented as to fail of recognition by outsiders. It is not difficult, however, for any one who has been in the habit of taking a comprehensive view of the accounting field to perceive the identity of effort and the close resemblance one to the other, of the problems that arise in the different fields. For example, the mercantile world is rapidly learning to divide what has been called Merchandise Account ever since treatises on bookkeeping began to be written, into two parts known as Buying and Selling, or as sometimes called Purchases and Sales, and a corresponding division in accounts of other names, but of similar uses, is to be noticed in transportation interests. The account called Buying in mercantile work is debited with the goods at cost as they come in, and is credited with goods at cost as they go out, thus causing the balance in the account to represent at all times the inventory of goods on hand at cost figures. In turn, it is the function of Selling Account to take on the debit side the goods at cost and record on the credit side the selling prices of the goods parted with, the balance in this account at all times representing gross profits. Having likewise kept an account with expenses of doing business, the difference between gross profits and expenses represents net profits, provided always that the business is making money.

Now for the parallel in street railway work. The storehouse system for taking charge of materials and supplies was referred to by a number of the speakers at the convention. Stores, it was pointed out, must be debited with the cost of materials and supplies as they are purchased. In turn, Stores must be credited with materials and supplies as they are withdrawn, also taken at cost prices, thus causing the balance in Stores Account to represent the inventory or cost value of articles on hand. Materials and supplies as withdrawn from Stores constitute part of the costs of operating a road, while the difference between total expenses and total receipts shows the profits (or loss) that is being made.

Again, in the commercial world, if labor is to be added to materials by way of assembling or finishing, the accountant in charge opens a Manufacturing Account, the function of which in brief, is to show actual cost of finished product. In the street railway world, wherever work is done on materials, etc., labor is charged to Stores, thus completing the cost record. In mercantile and manufacturing accounting there are certain general expenses like rent, superintendence and advertising, that have to be spread over the sum of the operations, and these have their exact parallel in the general expenses, including salaries of general officers, with which the street railway accountants have to do.

These contrasts were brought to mind in part by the discussion which followed upon the reading of that portion of the committee's report on the standardization of accounts where the sale of power was the special topic. The note under subhead No. 16 on the report, asserted that "income from sale of power is to be deducted from cost of operating power plant." Here was the evidence of a stumbling-block exactly the same in kind as that which has troubled many a manufacturing and mercantile accountant. As the discussion subsequently showed, it should not be "income deducted from cost" but "cost deducted from cost." By the latter plan there is shown the real cost of the power uctually used in operating the road, and also the cost of the power sold. Now, if, happily, there is a profit made on the power sold, the balance in the account that has been charged with its cost and credited with the selling price, will find its proper statement among the gains of the company. The rule is, expressed in common terms: "Let each tub stand on its own bottom."

While sitting in the meetings of the convention, I could not help drawing a parallel beween what the street railway accountants are doing and what the National Association of Credit Men are accomplishing. I attended the convention of the credit men in Kansas City in June last, and have also kept in touch with the work of many of the local associations since their formation, and therefore understand what they have in view. One of the most important classes of losses in a mercantile enterprise includes all that follows upon careless credits, the consequent slowness of collections and the inevitable bad accounts. The credit men, appreciating this fact as perhaps their employers, the merchants, have never appreciated it, have organized themselves into local associations holding monthly meetings, and into a national association having yearly conventions, all for the purpose of taking proper steps to prevent these losses and to reduce the drain in this regard to the lowest possible limits. The credit men take a broad and comprehensive view of the case, and, accordingly, are directing their efforts toward the enactment of better commercial laws to better business customs, to the dissemination of sound business literature, and toward a general awakening of the business conscience. They have already accomplished a great good, and there is still more before them. In the affairs of street railway companies, on the other hand, one of the chief causes of loss, or at least of diminution of profits, is an undue expansion of expenses. We find street railway accountants, therefore, getting together to devise means of so reporting expenses, so analyzing and classifying expense accounts and so arranging and adjusting their reports, that managers shall always be in possession of every possible fact and bit of information that bears upon the proper and economical running of the road. It does not require a specially vivid imagination to see that these two bodies of experts are working in the same general field, with practically the same object in view, and that each is justly entitled to a very large measure of success.

The situation was not without a dash of humor at times. In the division upon a certain motion, the vote lacked only one of being unanimous, and the solitary member representing the minority was for the moment made the butt of some good natured raillery. A member from the West subsequently said that the incident reminded him of a story. A man, much the worse for liquor, wandered into a church where the minister was setting forth the comparative advantages of heaven and hell. At last he called upon all those who wished to go to heaven to rise to their feet. All stood up except the stranger, who began to be dimly conscious that a vote was being taken. After the congregation was seated, the preacher called upon those who were willing to go to hell to stand up, whereupon the inebriate slowly rose to his feet, much to the amusement of all around him. In an unsteady voice he addressed the pulpit where, of course, the preacher was standing: "I don't know exactly what we are voting upon, but it seems to me, Mr. Preacher, that you and I are in a hopeless minority."

All of the papers read at this convention, in which references were made to diagrams and forms, could have been made much more attractive and far more useful by better management of the illustrations. I acknowledge that it is a grave problem how to illustrate an accountant's paper, and yet with a comparatively small number of hearers as in this case, the problem becomes very much easier of solution than in the case of a large hall filled by a miscellaneous audience. If the illustrations, even though not drawn to large scale for the purpose of being visible at a considerable distance, had been put upon the wall, and if, as the speakers proceeded, reference had been made to them from time to time, preferably with a pointer, thereby indicating the special features referred to, the value of the essays to the listeners would have been greatly increased. There was on the wall a map of St. Paul and Minneapolis, with lines showing the street railway system of the twin cities the accounts of which are presided over by Mr. Calderwood, and below this map was an enlarged representation of a transfer ticket. Yet Mr. Calderwood did not specially refer to these while reading. Thereby, in my estimation at least, he missed an opportunity of adding still further interest and value to the very able paper he presented. The small exhibits handed around were not a fair substitute. These remarks, I trust, will not be taken as harsh criticisms, for they embody only what is a friendly suggestion with reference to the preparation of future papers and the manner of their presentation. If, as suggested elsewhere in these lines, the papers are printed in advance, then the illustrations should be engraved and included in the proofs of the papers distributed among the members prior to the sessions. This, of course, obviates the necessity of putting them upon the wall. The essential point is to have before the member not only the text of the paper, but the illustrations explaining it, at the very time that he is giving attention to the suggestions that it contains.

A number of the members, acting upon the suggestion of the general officers in the announcement of the meeting, brought by the convention copies of their blanks and forms. The most complete and best displayed collection was submitted to Mr. Ross, of Montreal. The blanks in this case were neatly pasted in a large scrap book and so displayed therein as to be specially convenient for examination. Many of the members gave very careful attention to this collection while hastily passing by the others. Loose blanks dumped together indiscriminately upon a table and there left for the casual examination of those who may be supposed to be interested, serve a comparatively poor purpose, and certainly fail to accomplish the good that was in the minds of those who suggested the exhibit, but this description adequately portrays the facts in this instance. If all the members showing blanks and forms had followed the plan employed by Mr. Ross, a much better and more valuable exhibition would have been the result. But even more than this might be done in this direction to the advantage of all concerned, a fact which warrants me in offering one or two suggestions. If the Committee on Blanks and Forms were to give the different collections the kind of attention that is accorded by the managers of exhibits and fairs to the articles in their charge, arranging them, for example, around the walls of the room, with proper labels and placards in place, the display would have constituted a feature of great interest. In turn, if a portion of the time of one of the sessions had been devoted to a discussion of blanks and forms, wherein each member submitting specimens was called upon to say something with respect to what was displayed in his name upon the wall, answering pertinent interrogatories, still further good would have followed. There is an art in ruling and in proportioning spaces in bookkeeping work which some accountants possess in a very high degree, and in which others, on the contrary, are sadly lacking. Hence the good to follow upon a discussion of rulings and printings, after the general manner of the discussion of stated papers.

I was especially interested in studying the Association of Street Railway Accountants because of the bearing which its success has upon the general question of organization among accountants. Efforts almost without number have been put forth the past ten or fifteen years to get accountants and bookkeepers into societies for the advantages that association and co-operation always have. The attempts at organization have been based upon various foundations, ranging from mutual insurance and sick benefits on the one hand, to educational work and the advancement of the accounting art upon a very high plane on the other. With a few conspicuous exceptions all of the efforts at organization have failed. With the failures so nearly universal it would lead one to believe that the fault was

not so much with the schemes of the efforts or the special foundations upon which they were based as with the fraternity itself. Bookkeepers—and almost all accountants were formerly bookkeepers—by reason of their training and the influence of their work become something else than organizers and leaders, a fact that is made very patent whenever they attempt to get together in a society founded upon any of the usual lines. Since the rule is that accountants' associations must fail of success, and sooner or later drop out of existence, I studied the street railway accountants' organization with special interest and with the disposition to estimate its probable life.

It seemed to me that in contrast with almost all the other organizations with which comparison can be made, the street railway accountants have such interests in common, not only of a personal character, but belonging to the companies that they represent as well, that there is reason not only for the existence of this association, but for its development and growth. Further, it appears to me that the success they have so far achieved, and what is promised for the future may be taken as a safe indication of what can be successfully done in a similar way in other fields. If instead of accountants trying to get together locally, which efforts, as I have remarked, have not been permanently successful in the past, the accountants of certain branches of business should form themselves into associations, each devoted to a stated interest, there would be something to keep them together and make them useful bodies in the business community. Standardization of accounts is quite as possible in numerous other lines of business as for street railways. I came away from Niagara with the feeling that sooner or later accountants in various divisions of the business world will emulate the good example set by the Street Railway Accountants' Association.

The key note of President Wilson's address, as interpreted and explained by some of those who had heard it read, to those who came into the meeting later, was unselfish co-operation among the members, to the end that what any one knows in the realm of street railway accounting shall be at the service of all of his fellow members. Certainly the convention lived up to this advice, for nowhere in all the discussion was the least reluctance manifested upon the part of any one to contribute all that he had to the association's common fund of knowledge and experience. Other associations in technical branches have before now started out with similar high purposes, but it is rare indeed to find a complete exemplification of the principle in a meeting. In many instances speakers will go only to a certain point and by their manner clearly show that there is a certain reserve that they are not making known to anybody. Happily there was no indication of a reserve upon the part of any one in this convention. Instead, each speaker seemed eager to give to the meeting the benefit of his entire experience.

Some one suggested at Niagara that the Street Railway Accountants' Association would soon run out of work, that after a few more meetings the whole field of street railway accounting would be so thoroughly covered and the discussion so exhaustively made, that there would be nothing further to do, and that therefore the association would come to a natural, if untimely, end. The suggestion did not seem to worry the more active men in the organization in the least. From their point of view there is no danger of running out of work now, nor at any time in the future. A standard system of accounts may be an accomplished fact at an early date, but even then no one supposes that it will be so perfect that improvements are impossible. Accordingly, the association might exist only for the purpose of further adapting that piece of work to requirements and keeping it fully up to date. But taking a look ahead, and perhaps referring to some things which even the managers in this movement have not yet taken into consideration, there is abundant reason, so far as work to do is concerned, for the association continuing indefinitely. As a fact, there is no likelihood of its ever running out of profitable work to do.

If every other question were exhausted, there would still be enough to keep it together for a considerable period of time in a proper inquiry into the mechanics of office work. There is very much more involved in the equipment of an office, in the sense of adjusting it to the requirements of efficient and mechanical work, than any one would suppose who had not given the subject careful consideration. Further, the field of office equipment is one in which constant improvements are being made, and in which advancement is almost as rapid as in the electrical field. An office supplied with the very best that the market affords to-day would be a wonderful improvement over the best that could have been secured only a few years ago, but an office equipped to-day with the very best that can be obtained will not necessarily be the very best office for the purpose a few years to come. Again, take it in the matter of the control and direction of clerical help. Many of the offices presided over by the members of the association at present are comparatively small. With the natural growth and development of their lines, however, their employes are likely to be multiplied in the near future. What is a good scheme to-day in point of division of work and management of the office force, will not be necessarily the best when that force has been greatly increased. Transportation managers, field engineers, manufacturers and many others carefully study the disposition of their respective forces in a way to secure efficient superintendence and freedom from loss by one getting in the way of another, or by one workman waiting for another. With office employes increased to a considerable number, the same principles will apply; economies will be discovered which may be advantageously discussed. Before long the accountants may find it profitable to give attention to ways and means of office management, to details of office equipment, to schemes of supervision and to methods of securing the maximum efficiency of the force employed in office work.

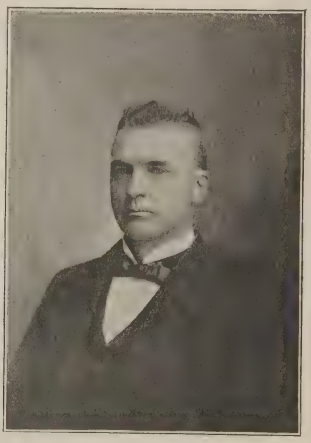
Some of the New Officers of the American Street Railway Association.

Albion E. Lang, the newly-elected president of the American Street Railway Association, was born in the year 1849, at Huntington, Lorain, County, O. He entered the street railway business in the year 1881 as owner of the Monroe & Dorr Street Railroad, in Toledo, O. There were five other railroad companies in that city at the time, and in 1885 he succeeded in uniting these roads into one company, under the name of the Toledo Consolidated Street Railway Company, and became successively the secretary, vice-president and general manager, and ultimately the president. Later on, the Consolidated Company, having acquired two other companies, a second consolidation ensued in 1895, under the name of the Toledo Traction Company, of which Mr. Lang has been president since its organization. He is also president of the Toledo Consolidated Electric Company, and these two companies control all the street railway and electric lighting properties of Toledo, a city of 135,000 inhabitants. He has been a regular attendant at all conventions of the association, since 1888, with the exception of the Atlanta and Montreal meetings, and has always evinced a quiet but deep interest in the association. Mr. Lang was president of the Ohio State Tramway Association in 1893.

Henry C. Moore, member of the new Executive Committee, was born July 2, 1852, in the city of Philadelphia. He was engaged in the mercantile business until June 1, 1890, at which time he was elected vice-president of the Newark Passenger Railway Company, of Newark, N. J. On June 1, 1891, he assumed the presidency of the Omnibus Company General, of Philadelphia. On May 15, 1893, he was elected president of the People's Passenger Railway Company, of Philadelphia, and on Jan. 15, 1895, was elected president of the Trenton Passenger Railway Com-

pany, Consolidated, of Trenton, N. J. Mr. Moore is considered one of the strongest street railway managers of the East, although his work is always quietly and modestly done. Since his acceptance of the position of president of the Trenton system, he has brought about a complete change of feeling on the part of the public towards the street railways of Trenton, the justice and wisdom of his decisions and his breadth of view in all matters of public interest being generally recognized. After but a single year's residence in Trenton he was elected president of the Board of Trade—a quite unprecedented honor for a comparative stranger.

Edward G. Connette, general manager of the Nashville Street Railway, Nashville, Tenn., who was elected third vice-president of the American Street Railway Association, was born at Austin, Scott County, Ind., Dec. 29, 1863. He studied telegraphy under the station agent at that place and was employed as telegraph operator at various stations on the J. M. & I. R. R. (now a part of the Pennsylvania system) when thirteen years of age. At the age of sixteen he filled the position of clerk in the master mechanic's office and operator for shops and yards at Jeffersonville, Ind., and from that time up to his connection with the street railway at Nashville, he filled various positions continuously in the transportation and

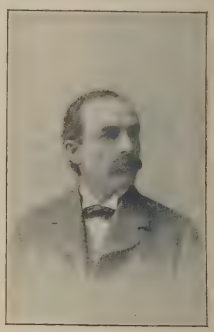


ALBION E. LANG

engineering departments of the Louisville & Nashville Railroad. He was assistant superintendent at Nashville when the various street railways consolidated and were equipped with electric traction, in 1890, and was then appointed superintendent of the consolidated system. It devolved upon him to organize and bring the five different companies into one complete system; in 1891 he was made general manager of the company, and has occupied that position ever since. He is now president of the Board of Education of the city of Nashville, and chief engineer of the Cumberland Electric Light & Power Company, and is considered one of the brighest and most promising men of the South.

J. M. Roach, member of the Executive Committee, was born in Virginia, and was educated in Athens, O. He was engaged in the mining business in Montana for about two years, in which business he was rather unfortunate, losing all the property he had inherited from relatives. Mr. Roach afterwards took a trip down the coast from Portland as far as Los Angeles, thence to White Pine, Utah Territory, prospecting during the entire trip (about 3000 to 4000 miles). He then went to Chicago, after the big fire, in October, 1872, and entered the service of the North Chicago Street Railroad Company. He worked his way through all the various positions in the offices of the company and is to-day vice-president and general manager of the West Chicago Street Railroad Company, second vice-president and general manager of the North Chicago Street Railroad Company, general manager of the Chicago Electric Transit Company and the North Chicago Electric Railway Company, president of the Cicero & Proviso Street Railroad Company, and president of the Suburban Railroad Company. Mr. Roach is forceful and aggressive

C. DENSMORE WYMAN

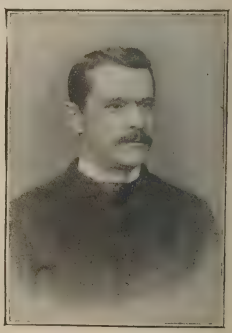


J. M. ROACH

in his treatment of street railway problems, and under his administration nearly all the principal street railway companies of Chicago have been welded into an immense, prosperous and strongly intrenched system.

C. Densmore Wyman, was born in Racine, Wis., Aug. 28, 1850. At an early age he moved to Rochester, N. Y., where he lived for a number of years, and where his education was for the most part gained. After spending one year at the University of Rochester, he went to Chicago and completed his collegiate course at the Chicago University, graduating therefrom with honors in 1872. Mr. Wyman's street railway work began in 1874, when he was elected secretary of the Central Park, North & East River Railway Company, of New York City, commonly known as the "Belt" line. He held this position until December, 1879, when he resigned to accept a directorship in the American District Telegraph Company, also becoming at the same time, secretary and treasurer. In the fall of 1880 he was elected a director and vice-president of the "Belt" line. Mr. Wyman afterwards accepted the position of general manager of the Milwaukee Electric Railway & Light Company, and under his management this property was

EDWARD G. CONNETTE



HENRY C. MOORE

greatly improved. Mr. Wyman resigned this position to take the office of general manager of the New Orleans Traction Company, Limited, of New Orleans, La., which position he now holds. Mr. Wyman has always been greatly interested in the work of the American Street Railway Association and has just been elected a member of the Executive Committee.

PAPERS READ AT THE NIAGARA FALLS CONVENTIONS

Municipal Ownership and Operation of Street Railways

BY P. F. SULLIVAN

The subject of this paper is one which cannot be treated properly or in other than a limited manner within the time and space permitted. What I shall write, therefore, is intended more to suggest lines along which others may follow rather than to attempt to treat it exhaustively.

The subject will be considered under the two following heads:

Municipal administration in American cities is so extravagant and unbusiness-like, that in the interest of the public, the powers and duties of municipalities should be reduced rather than be enlarged.

Municipal ownership and operation abroad are the exception rather than the rule, and were the reverse true, and such ownership and operation successful from a financial point of view, it does not follow that American cities could or should follow such examples or that if they did so success would result.

As to whether we should experiment with socialism, particularly under our forms of municipal government while still going through the experimental stage, and as to whether popular government should compete with private enterprises, I leave for other and separate discussion.

MUNICIPAL MALADMINISTRATION

Thoughtful men view with alarm the growth of American cities, and the maladministration of their affairs; some go so far as to believe that both conditions seriously threaten the future of the republic. So alarming have these become that patriotic and thoughtful men, and women, too, have organized in nearly every city in the country with a view of arousing public opinion, of devising ways and means to purify local politics, and to obtain a fair return for money expended.

In nearly every large city in every state in the Union, from Maine to California and from Oregon to Florida, such organizations exist under one name or another, and in some cities they go so far as to employ counsel and to instruct city governments in their duties. This is true of Boston, Providence, New York, Baltimore, New Orleans, Chicago, San Francisco and other cities. At the present time there are over fifty of such organizations in existence.

Not only are there local organizations, but such organizations also send delegates to national conferences to adopt methods of arousing public opinion, and purifying local politics in every city in the Union. Conferences for good city government were held at Philadelphia in 1894, at Minneapolis and Cleveland in 1895, at Baltimore in 1896 and at Louisville in 1897. To show how general and widespread are municipal maladministration and corruption throughout the country, I quote below extracts from the remarks of a few of the delegates:

PHILADELPHIA CONFERENCE, 1894

"On the other hand, a Chicagoan would have to be in full training, and at his very best, to attempt to do any boasting about his city politics. Indeed, he knows very well that when compared with the government of any but American cities, the government of his city, like that of so many other cities of his country, is simply a deep disgrace to republican institutions and to the great democratic idea." FRANKLIN MACVEAGH, Chicago.

"It is no exaggeration of language to say that saloons and gambling houses and brothels are here nurseries for 'statesmen,' that the active hostility of their keepers is, if not fatal, at least a grave impediment to success in public life, and that men and women who gain their living by habitually breaking the laws have a potent voice in selecting the public servants, who make, interpret and execute those laws." CHARLES J. BONAPARTE, Baltimore.

"It must be admitted, however, that there are public servants who are not burning with desire to discharge their whole duty to their employers, and who have no wish to keep the channels of communication open between themselves and the respectable classes. Their tastes and ambitions will lead them in other directions. They have great faith in the power of the corrupt and disorderly elements of the population, and their closest alliances are with those who represent these elements. Under management of officials of this class conditions have been established in many of our municipal governments, which are far from satisfactory. Unbusiness-like methods of administration have crept in; illicit relations with contractors and plunderers of all sorts have been formed; a thousand subterranean openings into the treasury have been discovered; the guardians of the peace are seen to be on the best terms with several classes of prosperous law breakers; many officials are using the patronage of their offices with small regard for the interest of the city, but with a constant reference to their own political fortunes. There are honest men in the government, but they find it difficult to resist the rapacious and anarchical tendencies. When any such state of things exists, it is difficult for individuals to bring any effective saving influence to bear upon the city government. The task is one that requires the united and sustained efforts of many good men."

REV. WASHINGTON GLADDEN, D. D., Columbus, O.

"There is no province where the American people need education more to day than in the province of municipal government.

But the governments of our great cities for the last thirty years have been our despair. Republican Philadelphia as bad as democratic New York, Baltimore as bad as Chicago. The character of the men at the head of our city governments, our mayors and aldermen and common councils, has startlingly deteriorated. The proudest of American cities must blush when it thinks who the men are in its common council, controlling its high interests, disbursing its millions of money, and representing its corporate life, when compared with the class of citizens who sit in the town councils of Birmingham and Glasgow and the great cities of France and Germany. In almost everything that touches municipal administration we are to-day behind Europe. We have everything to learn and almost nothing to teach. It is, I say, disgraceful and humiliating."

EATON D. MEAD, Boston.

"First. That we must keep more constantly before the people the perils to which we are exposed, and the menace to the safety of our free institutions, because of the corrupt governments of most of our large cities. In the light of the present day, was not Wendell Phillips right when he prophesied that the correct solution of the problem of our great cities would test our free institutions more severely than our struggle with human slavery. We all know that the cities are growing out of all proportion to the country districts. It is one of the phenomena of this century the world over. At the present rate of increase the cities will control this nation in 1920. Do we want these great cities as at present governed to hold this power?" SAMUEL B. CAPEN, Boston.

"The officials of our great cities are not elected, nor their affairs managed for the benefit of the members of the corporation, to reward men for, and to encourage them in, holding or gaining the local votes to swell the majority of one or the other of the great national parties, which have no more interest in or concern with the good government of a city than a mob with the good management of a bank which it loots and plunders for the purposes of its own."

JOHN A. BUTLER, Milwaukee.

CLEVELAND CONFERENCE, 1895

"The city of Indianapolis has had its share in emphasizing the failure of American municipal government. What with boodle aldermen, boodle councilmen and a loose financial system, with police and fire departments worth in votes to the party in control many times the number of employes, with a street department honeycombed with private and party snaps, boss ridden, party ridden and nearly wrecked by its servants, the city had all the decorations which entitled it to a place in the front rank of civic failures." LUCIUS B. SWIFT, Indianapolis.

"We have our machine, our political bosses, some unworthy men in office, the self seeking contractor, the dishonest officer of election, the spoil seekers in legion. The spoil system is the one great octopus which is strangling virtue, truth and honesty in public life. The weapon of destruction that must be used is the searchlight of public opinion, blinding and destroying the evils which

follow the creed that to the victor belong the spoils; that dishonesty is legitimate in politics; that the political party a man belongs to must be his infallible guide in municipal politics; that a public trust is no trust; that the political boss is *the* boss and that his mandate is the law, the right to the contrary notwithstanding."

FRANK N. HARTWELL, Louisville, Ky.

"All municipal offices are held by ward bosses or their followers, and their success so intoxicated them that hardly were they well seated before they commenced their carnival of plunder and corruption. The men composing this administration were mainly of small means, and some of the councilmen were dependent upon their daily toil for their support, but notwithstanding their salaries were meagre, or nothing at all, it was not long before they took on an air of general prosperity, ceased to labor at their usual vocations and waxed mightily in the goods of this world. In the Department of Public Works, for instance, at the present time, the inspectors and ward foremen almost equal in number the laborers they superintend. To recite the progress of the present administration is but to recount the sacrifice of the city's best interests and the complete prostitution for personal and political ends by its officers of their official powers. No private individual could obtain the most paltry privilege without being subjected to corrupt demands, and unless he complied his request was promptly refused. The lesson taught the people by this administration has proved a most profitable one and will, it is hoped, help to bring about the end of boss rule in this city." WALTER B. SPENCER, New Orleans.

"The investigations of the Committee of One Hundred have conclusively demonstrated that the first evil tendency of personal greed as opposed to the public welfare, instead of being sternly checked in this city of Portland, has been actually encouraged by its political managers. If a contractor voted his men aright, work was given him liberally, and the pay was prompt and excessive. Honest performance of the work itself was, however, a matter of little consequence. Miles upon miles of defective sewers and streets bear eloquent witness to the evil effect of political control in business matters. The contractor and the city officer felt their first duty was to each other's selfish interests, and contractors and officers cannot well serve two masters. From the far West we send you greeting. Our city is no worse—is perhaps better—than some of yours, but our cause is a common one, and until our municipalities are honestly and economically managed upon business principles, the war both in the East and in the West should neither falter nor fail." THOMAS N. STRONG, Portland, Ore.

"The Board of Public Works consists of three members. Under the original charter this was simply a supervisory board, the various branches of the city work being under the charge of separate superintendents. As usual in large cities, this department was for a time the chief center of jobbery and intrigue in the city's affairs, appointments on the board were sought and used for political ends, and its patronage was used to promote the political fortunes of its own members or their political backers."

EDWARD O. GRAVES, Seattle.

"It is, therefore, exceedingly unfortunate that a very large proportion of our office seekers are unfit or unworthy to fill the places they contend for. Men of character and ability are repelled by the conditions imposed or the services expected by those who control the nominations. Men who lead or belong to the vicious or predatory classes are eager and persistent in their efforts to secure the positions which enable them to increase their power, or to defraud or oppress the people by such methods as those which have been so thoroughly exposed by the Lexow Committee in New York." CHARLES RICHARDSON, Philadelphia.

BALTIMORE CONFERENCE, 1896.

"In the first place we had everywhere enormous taxation, a taxation which produced a revenue sufficient, if it were honestly and wisely applied, to furnish every city in the land with every possible comfort and convenience, and even to adorn them with the triumphs of architecture and art. But all this was, in great part, misapplied and the consequence was we had very little return for it. Our streets were miserably paved and everywhere in a filthy condition. The schools were poor; the police were corrupt from top to bottom, and in collusion with evil doers. All departments of government were affected by the demoralization, and the official force, from the mayor down, in our principal cities, was of a character which we could not exhibit in the face of the world without a feeling of disgrace. These were the consequences which flowed from this demoralization." JAMES C. CARTER, New York City.

"I cannot here attempt to describe at any length the rise and rule of the despotic oligarchy which for twenty years dominated political life in this city and state, ground down our people, endeavored to crush out independence, cheated us of our suffrage and ate up our substance." CHARLES MORRIS HOWARD, Baltimore.

"Our municipal condition, however, is far from satisfactory. Our administration is neither judicious nor economical. Questions of appropriation do not receive mature deliberation; results in nearly all departments are not the best of their kind, and the disposition of the council has been, and now is, to exceed annually the current revenues of the city." VIRGINIUS NEWTON, Richmond, Va.

"The interests af the people must be conducted by those who are entrusted to manage them, with the same wise, careful and conservative judgment that a competent business man should use in the transaction of his own affairs."

A. V. S. LINDSLEY, Nashville, Tenn.

"The abuses of administration were intrenched by law; the heads of departments had just been re-elected for four years, the ring organization was perfect in every detail; its members were held together by the cohesive force of public plunder, and its managers had ample sources on which to draw for all the money which might be needed for any purpose, and had the influence which flows from the absolute power to distribute the public patronage, franchises and improvements; and it was supported by thousands of voters who were dependent on city work and knew that active, willing and efficient service was the price they must pay for the opportunities to earn a living for themselves and family."

GEORGE W. GUTHRIE, Pittsburgh.

"The development of an active, intelligent, civic spirit, the practical exclusion of the most ignorant and purchasable classes from the lists of voters, and the absence of political influences in the matter of appointments, in foreign cities, are in brilliant contrast with our deficiencies in these respects."

CHARLES RICHARDSON, Philadelphia.

Under the conditions disclosed by the foregoing extracts—extracts, too, from American citizens, is it not strange that men will be found who will advocate enlarging the opportunities and powers of our city governments? Surely no business man would advocate it. On the contrary, he would have our municipalities conduct the business in hand in the same manner as the same business could be conducted by private enterprise before he would approve enlarging their powers and opportunities.

But the theorist says, enlarge the responsibilities of the government, and you will improve it. Acting upon that theory the doors of every house of correction and penitentiary in the land should be opened and every evil doer therein sent back to the community whence he came. He should then be restored to his former position in the community, and instead of looking after his conduct and affairs more closely, he should be given carte blanche to do as he may wish.

OWNERSHIP AND OPERATION ABROAD

According to the returns of street and road tramways to Parliament, July, 1896, there were 153 distinct street railway undertakings in Great Britain and Ireland, subdivided as follows:

Number of companies owned and operated by private capital	116
Number of undertakings where tracks are constructed by the municipalities and leased to private parties	31
Number of undertakings owned and operated by the municipalities	6
Total	153

The six cities where the properties are owned and operated by the municipality are as follows:

	Population	Miles of Track
Glasgow and suburbs	840,000	73
Leeds	400,000	27
Sheffield	380,000	19
Huddersfield	100,000	21
Plymouth	90,000	5
Blackpool	35,000	5
		150

GLASGOW

Of the above cities Glasgow is the only one wherein the undertaking may fairly be called successful. And with reasonable economy it could not well be otherwise than financially successful. For a population of over 800,000 Glasgow has only 73 miles of track, whereas St. Louis, with a population of less than 700,000, has over 335 miles of tracks. It does not follow therefore, that if the government of St. Louis were conducted equally as well as the government of Glasgow, that it could also operate the street railway system of that city successfully financially.

It is well to remember, however, that Glasgow boasts of a "continuity of existence of over nine centuries." We may therefore safely place it within the limits of possibility that when our American cities survive a "continuity of over nine centuries," that they may be so far advanced in methods and morals that they, too, may be intrusted with additional power and responsibilities.

LEEDS

The city of Leeds had operated its street car system for nearly three years. The first year showed net earnings of approximately $15,000, less than 1 per cent upon the capital invested, whereas private capital earned and paid 7 per cent the previous year. The second year showed net profit of $35,000, not quite the interest upon the sinking fund. And such results, too, with a population of nearly 15,000 per mile of track.

SHEFFIELD

Previous to the acquisition of the street railway by the municipality, July 1896, private capital received from 5 per cent to 8 per cent dividends from the operation of the property. Under municipal management there was a loss the first year, the property not even earning the interest upon the capital invested. And such results in a city which has over 17,000 persons per mile of track.

HUDDERSFIELD

This was the first city in England to attempt the operation of its street railway, and for the fourteen years which it has operated the property there has been a loss of $311,000, varying from $3300 to $83,000 in a single year.

This loss has been met by drawing $105,000 from depreciation account and the balance by taxation, varying from one-ninth of a penny to five pence in the pound. It may seem strange that the municipality should thus continue to operate under such conditions. The fact is that Huddersfield is a manufacturing city and the non-property and small tax paying voters are in a majority.

PLYMOUTH

In the last fiscal year there was a loss of $5430. This city did not acquire the property voluntarily. On the contrary, the operating company intentionally forfeited its charter and abandoned the operation of cars.

BLACKPOOL

This operation shows a net profit for four years of $992 after paying interest and charging off to depreciation.

And yet in Plymouth, Huddersfield, Sheffield and other cities in England, boys of from fourteen to sixteen years of age, receiving $2.50 per week are employed as conductors. Notwithstanding such conditions, some of those cities have not earned the interest upon the capital invested. Does any one suppose that American cities if operating street railways could employ such conductors at such rate of wages? In Germany there are only three cities which own and operate their street railway systems, and two which own the tracks and lease them to operating companies. In France, none.

The facts as they are before us are, that there are a few cities abroad which own and operate their street railway systems with more or less indifferent results, and only one of which, viz., Glasgow, which can properly be called a financial success; and yet there are those who would have American cities, regardless of the differences of conditions and institutions, plunge blindly into the acquisition and operation of 15,000 miles of street railway tracks because Glasgow operates 73 miles successfully.

It seems to me that those who honestly advocate the acquisition and operation of street railways by municipalities do not look below the surface. They find that an occasional city abroad does such things and they immediately jump to the conclusion that we should do likewise. They do not study the conditions with respect to accommodations furnished abroad as compared with those in this country; the methods of administration there compared with those here, and the civil service abroad compared with ours.

DIFFERENCE IN CONDITION

In a previous paragraph, I showed the difference between St. Louis and Glasgow. Below will be found a comparison of other cities of nearly the same population, taken from the *Yale Review*, for May, 1897.

	Population	Area in Sq. miles	Street Railway Mileage	Mileage per 1,000 of Population	Mileage per sq. mile of area
Birmingham	497,000	20	33	.066	1.65
Boston	494,000	37	295	.597	8.00
Edinburgh	289,000	14	21	.072	1.50
Detroit	300,000	28	202	.673	7.21
Leeds	400,000	34	27	.067	0.79
Cleveland	350,000	32	205	.585	6.40
Liverpool	641,000	21	66	.103	3.14
St. Louis	644,000	62	216	.320	3.50
Manchester	530,000	20	54	.102	2.70
Baltimore	512,000	34	262	.511	7.70
Bradford	228,000	17	21	.091	1.23
New Orleans	250,000	40	169	.676	4.22
London	4,400,000	105	230	.052	2.19
New York	1,851,000	59	357	.203	6.05

Compare any one of the above foreign cities with an American city of the same population and you will find that the area of the latter is greater and the street railway accommodations greater in proportion than the former. The English cities average over 15,000 persons, and the American cities, over 2600 per mile of track. And yet there are those who would state that because Leeds could operate 27 miles of track successfully that Cleveland with nearly the same population and area could also operate 205 miles of track, nearly nine times as many miles of track, also successfully. If therefore, the methods of civil service and administration were the same in both cities, Leeds could be eminently successful and Cleveland a monumental failure.

COMPARISON OF ADMINISTRATION

(City Government in the United States, by Alfred R. Conkling.)

"The Right Honorable Joseph Chamberlin, in an article on 'Municipal Institutions in America and England,' in *The Forum*, for November, 1892, makes an interesting comparison between Birmingham (his residence) and Boston. He says the total annual municipal expenditure (excepting the appropriation for schools and alms houses), of Birmingham is but $1,665,000, while that of Boston is $10,194,000 or more than six times greater than the expenditures of Birmingham. The two cities have much in common. They have about the same population and are both large manufacturing towns.

"The public works of American cities are perhaps the field of more swindling than any other department of the municipality. Brooklyn furnished us with an object lesson. For example, the Commissioner of City works found nearly fifty sinecures in his department, and he has begun by abolishing these offices, at a saving of $50,000 a year to the city. The result is that he has that additional sum to expend upon actual work for the welfare of the public. Fifty other idlers in his department are marked for early discharge and the Commissioner of Public Parks has also dismissed seventy-five men whose only occupation was drawing a salary!

"The comparative cost of municipal government in Europe and America is easy to understand. Any person who inspects the annual budget of the chief cities of the Old and the New World will be startled at the economy of the one and the extravagance of the other.

"Financial statement of representative cities.

	Population	Fiscal Year	Net Indebtedness	Capita Indebtedness	Annual Interest Payment	Annual Expenditure	Cost of Education per Capita	Annual Expenditure per Capita
London	4,221,452	'90-91	$225,000,000	$53.29	$10,801,675	$54,601,965	1.58	$12.93
Glasgow	782,728	'93-94	39,620,770	50.61	1,321,890	9 046,000	1.62	11.54
Birmingham	429,906	'92-93	36,146,440	88.73	1,335,125	7,330,025	1.45	16.36
Berlin	1,579,244	'92-93	68,275,000	43.23	2,430,000	29,915 950	2.16	18.31
New York	1,515,301	'94	101,428,481	66.93	4,889,383	37.362,065	3.04	24.65
Chicago	1 438,010	'94	17,722,950	12.32	851,421	32,020,184	4.24	22.26
Boston	494,205	'95	37,131,423	75.13	2,443,716	22,099,543	5.09	44.71

"The average per capita expenditure of the foreign cities above mentioned was $14.79; of the American cities, $30.84.

"The new Mayor of Chicago (1894) has said that the greatest danger of cities is that of being robbed by their own officials, in the sense of being burdened with expensive and superfluous office holders. In one month he directed the City Treasurer to reduce his salary 10 per cent and transfer it to the general fund.

"A law was passed in 1883 to build a new aqueduct from the Croton River watershed to the city of New York. This stupendous public work became a harvest for politicians; large sums of money have been squandered upon it, and much of the work had to be done over. The defective work, was in part, owing to corrupt inspectors and engineers, who approved work that was not only contrary to specifications, but done in a most scandalous manner.

"The public works of American cities are, perhaps, the field of more swindling than any other department of the municipality. Mr. White in his suggestive article in the Forum for December, 1890, says, 'The city halls are the acknowledged centers of the vilest corruption.' In that connection this remark applied chiefly to the Aldermen, and occasionally to the Mayor. But the public works that are controlled by the officials in the city halls of the larger towns are generally as badly and corruptly done as the proceedings of the city legislature. I could give many examples, but I shall simply remind the reader of the "Tweed" court house in the city of New York, which cost untold millions, and the new city hall of Philadelphia. The visitor to the Quaker City is at once struck with with the prominence of this public building. The gigantic tower is a monument to the extravagance and corruption that formerly existed in the city government.

"Unfortunately, the inspectors of public works in large cities are often political appointees 'out of a job.' They must be taken care of by the ring, and are put upon the pay rolls to the detriment of the citizens. Their salaries are so low, and their 'assessments' or contributions to the ring so large, that they are often forced to approve of defective public work, or blackmail the contractors of private dwellings in order to support themselves and their families. These inspectors learn from their superiors lessons in the practice of blackmail. Their political employer or overseer has probably extorted money from the contractors on public and private buildings, so that he is not surprised when his clerks and underlings in turn pursue the same practice. These inspectors show discretion in levying tribute on citizens.

"In the cities of Europe millions have been spent on the quays and docks. Take, for example, the magnificent Victoria Embankment on the Thames at London, the quays of the Seine at Paris and the embankment on the Neva at St. Petersburg. Few American cities have been willing to improve the water fronts properly. If our water fronts were improved, economically and carefully, they would meet with the general approval of the intelligent citizen, but so many large cities are cursed with ring rule that the suggestion of a general system of stone embankments and docks (either on bays or rivers) arouses universal objection and indignation.

"Several years ago a dishonest contractor was constructing a sewer near Central Park, in New York. He was in great haste to obtain his money, and, instead of using pipes, he laid barrels in the ground, for which he received the contract price.

"As I write, municipal officers of all grades in many of the large cities are now under indictment, and many more would be added to the list if it were not for corrupt police magistrates, packed grand juries and negligent attorneys."

(Municipal Reform in the United States, by Thomas C. Devlin.)

"The science of municipal government in this country is crude. Our methods are expensive and our governments inefficient. The burden has become oppressive, and nearly every city in the land is making some efforts for reform, and there are no cities where the same are not necessary.

"That there are able and well meaning men in all these reform movements no one will question, but there are also 'sore-head' politicians who nourish the rancor of defeat, and hare brained theorists who have never had one practical thought in matters of personal interest.

"In summing up the shortcomings of American cities, it has been very easy to make comparisons with European cities and to suggest the adoption of the same principles of government and methods of administration under which those cities have been made models of efficiency and economy. It is, however, the opinion of those who have studied most carefully the municipal problem in the United States that no material aid can be had from the adoption of European methods in matters of city government.

"The matter of franchise is one of the most distinguishing features between American and European city governments, and which in a measure renders the adoption of European methods impractical. All the powers of government in Europe are in the hands of the property owning class. In Germany, the three class system of voting, while affording the masses a pretense of power, gives to the wealthier classes absolute control of municipal affairs. A study of the franchise in American cities shows that the non-taxpaying voters are a large majority. Taking Boston, for instance, the registered vote of Boston in 1892 was 73,000. There were 32,407 taxpayers, of whom 3200 were women having no vote and about 700 aliens or non-residents. Deducting the taxpayers who are non-voters, leaves 28,507 as the number of property holding votes out of a registered vote of 73,000. If every taxpaying voter voted, this shows the non-property vote at 46,693, against a pr perty vote of 28,507.

"It is said that cities are business concerns in which every taxpayer holds an interest, and there is a persistent demand that its affairs shall be conducted on business principles. Then it seems not unfair that representation in the city should be limited, as in a business corporation, to the stockholders, if the same results are desired. If this hypothesis is correct, we must admit that no business would succeed under management similar to that of cities. It is also true that the ignorant, vagrant and purchasable element comes almost wholly from the non-taxpaying class, and their only interest in an election is the price they may receive for their votes. They are an element of especial solicitude to the ward politician, and are often the decisive power in partisan contests. Indeed, it may be further said, that integrity, honor and ability will never prevail, in city councils particularly, until the candidates may safely disregard the demands of the worst elements of society and know that their election depends upon citizens who hold those virtues to be their chief qualfications.

"Every large city is practically in control of the non-taxpaying element, and from this class the intemperate, vicious and purchasable vote is mostly composed, and it is through his influence with them, and his ability to handle them, that the ward politician secures his own election and achieves success for, and standing with, his party. He is often one of this party which he controls, and if not, affiliates with them, which amounts to the same thing. He extends to them so far as he can, the same patronage which he and his colleagues in other wards have received from higher authority. He promises the creation of new offices, clerkships in others, and jobs in parks and streets without number, and thus crowds every department of the public service with incompetency and unworthiness, which would never be tolerated in any private enterprise. Through all the avenues of patronage he looks forward to paying campaign obligations and of maintaining his prestige with the party. Surely the alliance of the business of cities with national politics, and its control by the party machine, is a serious evil. It opens the way for every form of dishonesty and mismanagement which avarice and ambition can suggest.

"The power of the legislature to meddle in city affairs is corrupting both to the legislature and the city. The city 'professionals' will be in attendance at each session of the legislature and when the city charter is acted upon, or special acts concerning the city are passed, they will be marked by their cunning and avarice. The Hon. Seth Low tells us that in every year of his term of office he was compelled to oppose at Albany, the seat of the State Legislature, legislation seeking an increase in the pay of policemen and firemen, without any reference to the financial ability of the city or the other demands upon the city for the expenditure of money. . . . . New and useless offices were sought to be created and the Mayor found that not the least important of his duties as Mayor was to protect the city from unwise and adverse legislation on the part of the state. Edward W. Bemis, writing in *Public Opinion*, says: 'A recent chief of the Chicago Sanitary Department assured the writer that there were not six of his hundred subordinates whom he could trust. It was useless to dismiss any one, for the chief must take in his place, whomsoever some alderman may desire.' Not infrequently new offices with chiefs and many deputies are created for no real purposes other than the positions they offer. The pay is often out of all reason for the service rendered, but it is expecting too much of human nature to hope for any

change while the system which makes it possible prevails. To cut off the salaries or positions of one's friends who labored during the long siege of an election campaign, requires a degree of courage and ingratitude not attainable by the average councilman. Francis G. Peabody, in comparing municipal service in the United States with service in the cities of Germany, says: "With us municipal offices are the spoils of successful politicians; in Germany they are the prize of experts. It seems to a German as incredible to hear of a city governed by men who are just pausing on their way to some higher place as it would be to hear of a railroad or of a cotton mill thus superintended. Good city administration with us is an accident."

The advocates of municipal ownership point with pride to the postal service of the United States, and would have us infer that in all things the national and municipal governments could do likewise. In this they speak as partisans, yet we should not deny them such comfort as they may get. They do not refer to the annual pension appropriation, now $150,000,000 per annum, nor to the fact that the late General Grant and the late General Garfield, both good authorities, stated that $40,000,000 would be amply sufficient. They do not refer to the river and harbor appropriations, of which the late President Arthur wrote in one of his veto messages, "as the measure (river and harbor bill) became more objectionable it would secure more support." They do not refer to the National Government's experience in Union Pacific or to the experience of the state of New York in the Erie Canal.

STATE OWNERSHIP OF RAILROADS

The experience of France and Brazil with government ownership of railroads is not encouraging to the advocates of the idea that railroads should belong to the people at large, and should be operated by officers appointed by the Government. The South American republic has determined to abandon state ownership of railroads, after a thorough test of the theory, and is now negotiating with European capitalists for a lease of the entire system, comprising 14,000 miles of track. When Brazil took charge of the Central Railroad, that corporation had paid as high as 9 per cent dividends, but under government control it has not only failed to earn its expenses but has cost the people $2,000,000 or $3,000,000 a year above its receipts. The experiment of state ownership of railroads has been tried longer in France than in Brazil, and under more favorable conditions. The model road there runs through well populated districts, with large cities as terminals, but the results in France are discouraging. Eighteen years ago a railroad system was constructed which was to furnish cheap rates for passengers, cheap freight for shippers and abundant profit for the state. It has done none of these things. At first the advocates of the enterprise insisted that only time was required to prove the wisdom of the project. Eighteen years have passed and the results may be briefly summarized. Theoretic methods have been abandoned, and the railroad is now managed substantially as are those in the hands of private capitalists except its tariff of rates is a little higher, and its cost of operation is considerably larger. The last report shows that the net return on the whole capital expended is $1\frac{85}{100}$ per cent, and even the state cannot borrow money for less than 3 per cent. The Government has every year a considerable deficiency to settle, and the people who use the line pay somewhat more than they would have done if the enterprise had been left to private capital.

Canada has had an experience of state ownership also, but upon a more limited extent. There the Government owns about 10 per cent of the whole, upon which it loses about $500,000 annually. The railroads and their equipments and fares, of France and Germany operated by the Government cannot be compared with those of England operated by private capital; and the manufacture of tobacco and cigars by the Government of France has produced such vile stuff as to be an object lesson to enthusiasts of government monopoly.

PUBLIC OWNERSHIP AND PRIVATE OPERATION.

Some of the advocates of changing the present state of things stop short at the operation of street railways by the municipalities and advocate that the municipalities own the tracks and lease them to private capital. They are aware of the present condition of our administrations and dare not go to the logical length of their position. If our municipalities are so unbusiness-like and corrupt in their methods as to be incapable of operating a street railway property, then they are also unfit to manage the construction of the property and to make contracts for its use. You cannot stop half way. The motive for public ownership abroad is twofold. The first has reference to the conditions of the streets and street surface. They have, as a rule, finely constructed and maintained streets, and in their very proper regard for keeping them so, they desire to control all construction and maintenance of tracks. The second has reference to controlling and regulating the method of operation. That has proven a failure, and can be accomplished better when granting a franchise. In nearly every case in England where the municipality has acquired the operation of the property it did so involuntarily.

The city of Toronto, Can., is the only instance in America of public ownership and private operation. The conditions and contract there please the theorists and the street railway company, and all are happy. While I am neither a prophet nor the son of one, I will state that, in my opinion, before the contract period shall have expired, Toronto will have cause to regret that it adopted some English methods under almost American conditions. The municipality constructs the concrete bed for the tracks, supplies and does all paving, and removes all plowed snow. The compensation which it receives per mile of track is much less than that paid in some states by one company for running over the tracks of another company. Percentage of receipts, rates of fare, etc., should be looked upon as nothing more or less than a premium for which the operating company receives a monopoly. Competition and the fear of it are completely shut out. Single fare and transfer carry a passenger only to the suburbs. Those going to and from the suburbs pay extra fares, and as the city grows in population, it will become as congested as foreign cities, or the people will be compelled to pay extra fares to get to and from suburban homes. Such conditions exist nowhere in the United States. The conditions with respect to Toronto and its suburbs suggest a practical problem in the United States, should municipalities desire to acquire street railway properties. Usually abroad, street railway systems are operated within the limits of the municipality, as at Toronto. Should the systems be extended further additional fares are charged. In the United States, on the contrary, in nearly every instance the street railway system extends beyond the city or town limits, and usually only a single fare is charged. Should a city obtain the street railway system within its own jurisdiction an interesting problem is opened with respect to the owner of the balance of the property; and in case the balance of the property should be acquired by the other towns through which the system may be operated, as to divisions of "spoils," profits and losses. It may result as it did in Birmingham, England, in the price of gas. That city provides its own gas, and charges suburban towns 50 per cent more than it charges its city consumers

Some of the Difficulties Existing in the Construction and Operation of Electric Street Railways

BY GEORGE W. KNOX

With the smaller street railways during the panic period, which it is to be hoped we are about emerging from, it has been a struggle for existence, and a road that has pulled through these times without running behind, may be considered fortunate. The railway management has often during these times been called upon to make a good showing in dividends, having at the same time a decrease in earnings to contend with; how to do this has been a most perplexing problem for many a street railway manager, and by his not being equal to the emergency has resulted in there now being a long list of roads in the hands of receivers. I do not charge up to the stock manipulators or the hard times, all the crime of the necessity for receivership of these railways. Many an electric road now in the hands of a receiver could be making neat incomes for the investors had a closer study and practice of the economic principles governing the details of construction and operation been made and thereby done away with the many wasteful measures which are sapping the very life out of what might have been paying investments. The keynote of doing this does not lie altogether in the ability to make any one or two large reductions or savings, but rather in lopping off here and there the many unnecessary extravagances existing in the various departments of the system.

The first and most important step in working out economies is in selecting a corps of operators from the head foreman down to the

man sweeping out the depot. If they are interested, and are working for the good of the company, scarcely an hour of the time in which they are engaged can go by without their effecting little savings which in time swell the item of economies to mammoth proportions. The examples of how this is done are very numerous. For instance, had a certain motorman been the man for the position and exercised more care in operating his car, he could perhaps, have averted an expensive accident case for his company. In a minor matter an armature winder by being interested and more painstaking in his work, could, by insulating an armature coil with perhaps a $\frac{1}{32}$ in. more insulation, have saved a burnout and an expense of $25 or $30. These are only examples of the many instances where a reduction in expenses is made possible.

In considering the question of our engines and electrical machinery, we have reached a state of comparatively high efficiency and economy, and there is not the chance of making the saving on these lines, in either the designing or operation, that there has been in the past. There is also but little chance, in a broad sense, for argument upon questions as to feeder requirements, the necessity of ample and absolute return, cars, motors, etc., as a general idea of what is required is so well understood that these problems narrow down to a study of how to accommodate the conditions as found, which the man in charge should be fully able to meet.

In the management of railway work, the greatest opportunities for economy will be found in the details of construction and operation. It is totally out of the question for anyone to lay down a code of rules to be followed, owing to the varying conditions. The success attained in both construction and operation depends wholly upon the practicability of the man in charge of the work. What is greatly needed by those directly in charge of the equipment and operation of electric railways, is a better opportunity for meeting each other to discuss matters of detail in construction and operation. One of the mistakes into which we are most liable to fall is the rut of self satisfaction with our own style of work. Then it is that the manifestations of decay and inefficiency begin. Those who are most satisfied with their own work are often the ones making the poorest showing. It is imperative, in order to eliminate the difficulties with which we meet, that we brush up against the other fellow and get his ideas. To be better able to do this, the plan now adopted by the electric railway companies of several states of having state meetings for the discussion of plans for better methods of carrying on the work should be made general. There are a few of these organizations for the purposes mentioned, but there are not enough of them. The American Street Railway Association has, I believe, too much of a National character to afford the time to take up and discuss details, of which the work is principally composed. To these state meetings the companies should send the men at the head of the different departments for which all concerned would be well repaid by the benefits derived therefrom. By keeping a man isolated, back in some dingy old shop or barn, he cannot be expected to be bristling with the bright ideas that bring forth the efficient service which characterizes the other fellow's road, and makes it a good dividend payer.

Following up the idea—that it is the first wrong step that counts—our whole aim must necessarily be to make as few mistakes in the construction as possible, for it is an easily demonstrated fact that the cost of operation depends largely upon the method of construction. It is an absolute necessity that we look ahead and plan against all kinds of speculative disaster, ignoring if you please, in this case, the teaching that "we should not cross the bridge until we come to it." A little foresight, which results in preventing an accident, will probably mean the saving of the profits for many days' operation, one of the examples being, with ordinary conditions in the installation of overhead work, is the use of but one insulation between positive and negative. For the first year or so, this will be found sufficient, but a little later on the insulation begins to deteriorate, and there follow frequent short circuits and burnouts, which stop traffic and entail an expense many times the cost of the additional insulations, which would insure, to a reasonable extent against, such leakages and burnouts. It is not fair to owners of the majority of the electric railway properties to say that they have worked on the retrenchment idea as regards expense in putting in the system, as universally they have been liberal with their money, but where they are to be censured is in the fact that they have not familiarized themselves more fully concerning the methods of installation. They have been inclined to leave the question entirely to the honesty of the contractor or supervising engineer, who was was not necessarily dishonest, but a man who knew a good thing when he ran across it, and perhaps slighted the work accordingly.

Among the most important matters to study for economy connected with construction and operation is the supply department. There is an immense sum of money needlessly squandered in supplies and repairs for an electric road in a year. One of the causes of this waste lies in the fact that the roads have not yet arrived at a standard in the design of the apparatus which they use, to which too much importance cannot be attached. Every road should be its own designer of all articles used, for why should the manufacturer be better able than you to determine what is required. You are on your own grounds, know exactly the conditions to be met, are in constant touch with the difficulties as they arise, and are far better able to devise the remedies than is the manufacturer miles away, who perhaps has only his own experiments and a confusion of theoretical speculations to rely upon. I mean in no wise to decry the assiduous and most excellent work of the manufacturers of electrical apparatus. It was and is a field of necessary inventive development, and the manufacturers are sparing no effort or expense in their endeavors to supply the trade with the improvements in demand, but the unwary railway man has had an immense amount of experimental clap-trap machinery inflicted upon him, all of which has cost dearly, and which is still maintained at a sacrifice. It is a lamentable fact that we have not done more than we have towards correcting this evil.

Along this line another evil for which the railway man in his efforts to save money is in part accountable, is in the shaving of prices on material to the extent that it has resulted in competition being so sharp among the manufacturers of electrical supplies that they have adopted the piece work plan in order that cheapness may be secured, thus turning out upon the market apparatus that was not gotten out for efficiency, but to fill orders. Of course, these articles have been built according to specifications, and stood the shop test, but there is demonstrated an entirely different proposition when this apparatus is put to actual use; it is then that we see the bad effects of the hurried and slighted work of the piece-workers. To free ourselves of these troubles we must be more careful in getting out the specifications and checking up the material received. The most carefully prepared specifications in detail should go out for every piece of apparatus used. You will then find that your supplies are coming to you made up in the proper manner, your supplyman knowing, that should he send out a mixed up and defective lot of material it will be promptly returned to him with charges "Collect."

To be able to get out the specifications needed it requires a certain amount of experimental work, and how far to go with this experimenting is a problem requiring the keenest discretion. Experimental work should only be encouraged and allowed by a company to the extent of having in view the elimination of an existing money wasting evil. The testing, making of new designs and patterns, with perhaps the subsequent throwing in the scrap heap of the article gotten out to conform to some pet theory, when kept track of, is found to be tremendous waste of money. Experimental work should, however, be encouraged as far as it is profitable in the way of stimulating sagaciousness and promoting adaptability on the part of, the men handling the work, but all experiments should be allowed only as passed upon by the management of the road, who should be fully competent to determine the probable practicability of the theory proposed. In making up and buying supply parts, one of the factors of economy lies in the bulk to be used. Of course, the greater the amount purchased, the greater the saving. I would, though, strongly advocate not getting too great a quantity of stock of any kind of material on hand, as the defects developing often require the complete changing of designs, with consequent scrapping of all material in stock.

Another serious difficulty to be considered in connection with operation is the inefficiency of the motormen. I concur with a railway manager who once said: "Motormen, like poets, are born, not made." There are motormen who will operate a car day after day, year in and year out, without the slightest accident or complaint while others are constantly having wrecks, and their cars are always being run in the depot out of order. In the calling of a good motorman, we have a position with more responsibility attached, perhaps, than the position of an engineer of a steam railroad. A motorman, of course, has not in trust property that has the value of a steam railway train, but his field of operation lies where there is greater

menace to life and property (for which his employer is responsible in case of injuries), than with a steam railway engineer. A trustworthy motorman should be required to pass a physical examination, possess a cool, collected temperament, judgment in cause and effect of ideas in general, and have a fair amount of mechanical ability. He should be obliged to undergo the most strict examination as to his fitness in these requirements, and in addition be thoroughly conversant with the correct methods and rules of how to handle the equipment. The Board of Examiners for the fitness of employes on street railways, will be able to make a better showing in efficient operation than most other departments, by giving more attention to the examination and instruction of operators, and that there is needed improvement in this particular, is evinced by the magnitude of the accident account, which is due mostly to the operators not being properly schooled in the work they are handling.

I do not believe in attempting to educate motormen to any extent in electrical knowledge, as it has been proven that it is a waste of time, and nothing is accomplished by giving them an insight into, and encouraging them in determining the cause and remedy of some electrical trouble with which they may meet on their cars while on the road; you have men with all kinds of theories, wasting the company's time in tearing apart and dissecting the equipment and perhaps not then locating the trouble, at the same time they are undoubtedly blocking the line; where, had they, after failing with the simpler methods of locating the trouble, called for an emergency crew, or been pushed into the depot, they would have been doing much better service. There are, of course, some cases where it is excusable for men attempting the locating of trouble on their cars, but, as a rule, it is found to be the wrong practice. If they understand the brake mechanism, the proper manner of applying the power into their motors, how to cut out a disabled motor, and the rules as given in the rule books, they will have about all they are able to master. A good, bright, interested motorman, or other operator on the system, upon noticing anything wrong with the equipment should be educated and made to feel that it is his first duty to report everything coming under his observation that is working to the detriment of his company, and he should have this so impressed upon him that he will feel uneasy about his position until he does so.

It may be asked, what is to be done with employes in cases of carelessness and consequent losses through their actions. Of course, it is out of the question to always avert accidents or mishaps, and specific rules cannot be laid down defining what is to be done in handling every case, other than by saying it depends mostly upon the ability to get the right kind of men and to instruct and impress upon them that the burden of preventing such losses rests entirely with them. It is well to remember in disciplining men for offences or carelessness in their work, that if they have clean records in the way of good intentions, they should be given another chance; as they will in all probability improve as a result of their experience and make valuable employes for the company.

In placing a man in charge of work or a department, he should be given the full responsibility of his position; then he will take an interest in what he is doing, have a little company of his own, so to speak, wherein he tries to save the dollars to the extent that he would were it his own. That is the way he should feel and act, and if he does not, his place cannot be filled too quickly. A company should, however, be governed with all cautiousness in making changes with heads of departments, also operators in general. A man assuming a new position usually comes loaded down with fertile ideas. They may have fitted perfectly the conditions existing at his former location, and believing that it is a poor rule which does not always work, he immediately proceeds to put into effect his ideas. Some of them may be good, but as a whole, by the time he has tried all of them, the company is, in the long run—unless heretofore there existed a deplorable state of affairs—liable to lose money by his practices. I know of an excellent piece of railway property which should be paying good dividends. The company was born at a time when the experimental stage in electrical apparatus was well under way, thus enabling the selection of a fairly first class equipment. They spent plenty of money on their installation, but as soon as the road was equipped, the practice of changing management every three or six months was adopted. This resulted finally in their having about every style of apparatus. One of the managers came to the conclusion that he could make money by scrapping a style of motor he found on the road, so back in the corner they went. When his six months had expired, and the other fellow came on, he said he could make those motors go all right by changing their windings and otherwise fixing them up, and they were dug out of the scrap pile, the rust scraped off, new windings of field and armature substituted and the motors are now in operation. This practice cost money. There is nothing at all strange that this road should be struggling along for existence in the hands of a receiver, and I will not believe that overstocking or the hard times had all to do with its being in this position.

As a rule, the general condition of affairs out on the line and in the depots and stations of street railways is in a much shabbier state than exists in other lines of business. This is partially on account of the apparatus used being out in the middle of the street, or back, may be, in an old, dark barn, where no one really expects to see good order and cleanliness prevail; but it is a most serious mistake to allow this state of affairs to exist. Besides being directly wasteful of itself, it has the effect on every man connected with the company, of making him generally careless and neglectful in his work. Out on the line it breeds contempt for the whole system in the public eye, and will act as a barrier to getting further concessions for lines. I can call to mind a repair depot, where the floor of the shop part is as clean as the floor of a Dutch kitchen, the walls and ceilings are neatly whitewashed, and there is an individual place for every repair part used, from the cotter pin of the trolley wheel to the truck wheels of the car. Any repair man could be blindfolded in this depot and yet he would be able to go straight to and get any article of repair needed. There is no time lost in pulling out and hauling over material to find what is wanted. The results obtained by reason of these practices are highly profitable, and wonderfully gratifying to the management. In point of neatness of cars, a minimum in the number of car trouble reports and amount of material used in repairs, while the car expense per day is no greater, and in most cases less than that of other depots working under like conditions. Much valuable time is lost and money thrown away by roads which are keeping so many records on matters pertaining to operation. Where a few records may be gotten out with a view of demonstrating that a leak is going on in some line of the work, or for the purpose of comparison in spurring some of the departments up when they are inclined to be negligent, there is, of course, money in it, and in fact it is necessary in order that the work may be handled intelligently, but where you have your men spending their time in keeping track of how long a certain armature ran, the length of time it takes to make repairs of a certain part of the motor, etc., which records are rarely referred to, and should one want to use them, it would be necessary to spend as much time as it originally took to get them out in looking them up for use—it is all a waste of time and money. The man in charge of a department should be able, when called upon, to show exactly what it is costing to perform any part of the work under his charge, but he should be able to have this knowledge without the constant keeping of a lot of records.

One of the most commendable practices employed in the maintenance of a street railway is the regular calling together of the heads of the different departments, for consultation on matters pertaining to their respective departments. The details and new complications constantly coming up concerning the work are so varied and numerous, and the men actually handling the work have such an excellent opportunity of observing and dealing successfully with the difficulties arising, that their reports at once place the situation of affairs panoramically before the management for action. Some serious trouble with the equipment or operation may be going on; some one man, perhaps, has a way of remedying the difficulty, which the others had not thought of; and again, practices that are extravagant may come to light during these meetings; so that those who have not tried this plan will find it a most valuable adjunct in methods of operation.

The subjects mentioned are, I know, being constantly thought about and worked upon by all street railway men, and are well understood by them, but there is no denying the fact, that there exists with us in our work at times an unjustifiable and inexcusable amount of carelessness which results in the property depreciating as a money earner, to the extent that the holders of street railway securities become disgusted, withdraw their holdings, the receiver is appointed and the road is branded as a failure. The way of preventing the most of these cases rests with the men who are actually handling the equipment, in assisting the management in keeping down expenses; how far this is accomplished resolves itself into the

extent to which we go in getting the most practical men who will be able to adapt themselves to and handle efficiently the conditions existing in their respective lines of work, and there must be constant vigilance on the part of heads of departments in taking advantage of the advancements being made, and in thoroughly and constantly checking every man and his work.

Application of the Storage Battery to Electric Traction

By Charles Hewitt

To give a history of the application of the storage battery to electric traction would only be turning over dry bones. The long series of remarkable failures is no doubt familiar to all. To say that the storage battery has no place in electric traction is an error, and on the other hand to say that it will supplant all other means of applying power to the cars, is, I believe, only the dream of the enthusiast. We are sufficiently acquainted with the possibilities and limitations of the storage battery of to-day to be able to make installations whose success will be certain; improvements in manufacture have certainly been made during the past few years, but the cause of past failures has been due quite as much to errors in installing and in manipulation as in manufacture. In preparing this paper I have made an effort to obtain accurate information from parties in Germany, France and England, but all such attempts have been of no avail. As far, therefore, as the state of the art in Europe is concerned, we must rely upon what we have been able to gather from current literature.

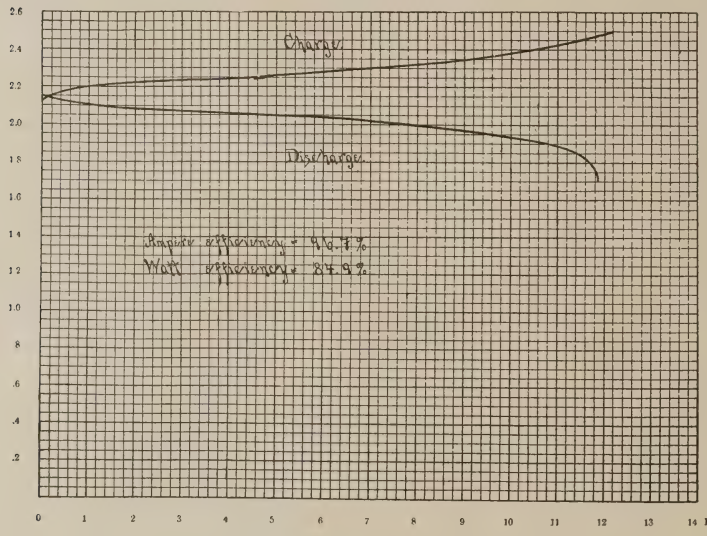


FIG. 1.—CHARGE AND DISCHARGE CURVES

The most important applications of the storage battery to electric traction are:

1. The application of the battery direct to car or locomotive. 2. The application of the battery at points on the line distant from the generating station. 3. The application of the battery in the power house.

The application of the battery direct to car or locomotive

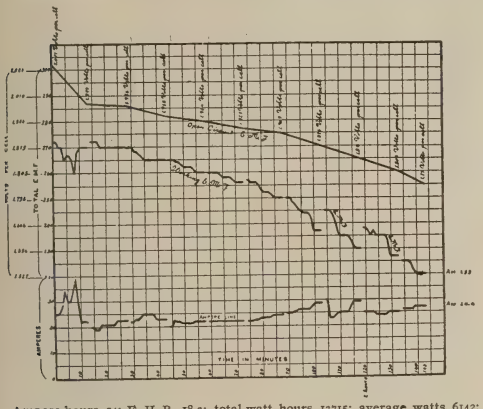
We are led to consider this form of application first, not on account of its successes, but rather on account of its conspicuous failures. From our investigation we can see nothing in this form of installation to commend, except for certain local conditions, which are peculiar to the large cities on the continent of Europe.

The first cost is greater than our present overhead form of construction, and the expense of operation is considerably greater; in fact, it is doubtful whether the expense of operation can be brought below that of horses. It is less reliable, and more objectionable to passengers on account of the gas given off. But very little reliable data are obtainable from all the various experiments which have been made. Most of such experiments, in this country at least, have been made by battery manufacturers, and the results obtained have been most carefully guarded. Mr. Dawson, in an article, published in *Engineering*, Oct. 16, 1896, says: "Two principal causes have so far prevented the successful use of accumulator cars; their great weight, and rapid deterioration of plant owing to these causes; the manufacturers of storage batteries only have seriously taken up accumulator traction, and although they have been working on the problem since 1880, little reliable information has ever reached the public."

In a paper read by the writer before the Engineers' Club, of Philadelphia, Dec. 5, 1896, I gave in detail results of a test made by me of a certain battery car. The main results agreed quite closely with data which have come to us through European publications, and I feel confident in stating that the battery car requires considerably more power to operate than an ordinary trolley car of the same size and under the same conditions, and, further, the battery car will require a larger investment in generating machinery. The unreliability of the battery car, and the disadvantages due to the necessity of constantly changing the batteries are familiar to you all, and we have no facts which would warrant us in holding out any hope of improvement in this line. In fact, unless some form of battery be discovered with entirely different characteristics from the lead battery, I should advise leaving such experiments to those who enjoy spending money on this kind of a hobby. When the action of the battery is thoroughly understood it is not difficult to understand the cause of failure. Every battery has what may be termed a critical rate of discharge. From zero up to the critical rate the working e. m. f. remains practically constant. Above the critical rate the e. m. f. decreases as the rate of discharge increases. On the other hand, the e. m. f. increases with the rate of charge and the length of charge. For any particular battery there is a rate of charge which cannot be exceeded without useless waste of energy. In Fig. 1 I have shown typical curves for charge and discharge at normal or critical rates and the portion between the curves represents lost energy. In Fig. 2 I have shown the discharge curve taken from a traction battery test. With a fairly constant discharge at the average rate used by the car, with rests of one minute every fifteen minutes, the fall of e. m. f. is very marked. You will appreciate therefore the remarks of Sir David Salomon, "that it takes power to get current through the battery, and it also takes power to get the current out." These critical rates of charge and discharge seem to be partly due to the time required for the chemical reactions in the battery to take place. The physical limitations of a car require the battery to have a large output for its weight and bulk. To obtain this it is necessary to increase the surface of active material as much as possible and to decrease the inactive supporting grid. In consequence the battery plates become mechanically weak. The conditions seem to prevent the making of plates large enough to prevent exceeding the critical discharge rate, and which are at the same time time light enough and small enough to be carried on a car. The inherent characteristics of the lead battery are such that it is very doubtful whether it will ever be successful in propelling cars unaided by other sources of power. Great results are expected from the experiments now being made in Chicago, but great results have been expected before, and I do not look for results in Chicago much different from those that have preceded.

It is claimed that the batteries in use in Chicago will show a much longer life than any that have as yet been tried. But even if the life of the plate were all that could be desired, we should not feel warranted in recommending the system.

There is another phase of this method of application which is used somewhat extensively in Europe. In some of the larger cities



Ampere hours, 54; E. H. P., 18.3; total watt hours, 13715; average watts, 6142; average E. H. P., 8.23.

FIG. 2.—BATTERY DISCHARGE THROUGH RHEOSTAT

on the Continent there is a prescribed area within which overhead lines are not allowed to be erected. To overcome this difficulty the cars are supplied with batteries sufficiently large to propel them at a low rate of speed for a distance of 3 or 4 miles from the point where the overhead line ends, into the city and return. While the cars are completing the trip the batteries are charged from the overhead wire. I am sure such an arrangement would not commend itself to any practical railroad manager, except as a makeshift in such government ridden cities as exist in Europe. There are only two cities in this country where such an arrangement might reasonably be considered, and in those cities the slotted conduit has (and, I believe, wisely) been adopted. The advantages

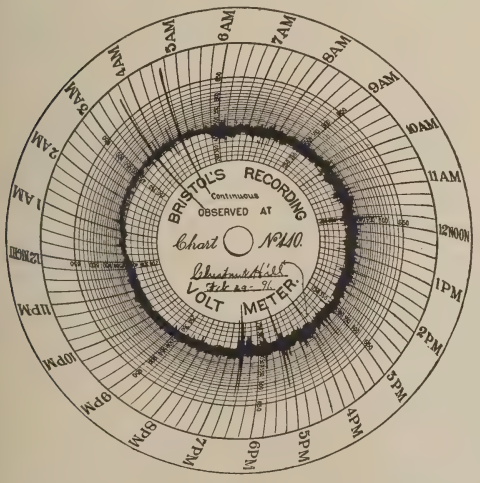


FIG. 3.—VOLTMETER CHART TAKEN AT CHESTNUT HILL BEFORE THE BATTERY WAS INSTALLED

of this method are apparent. Aside from the lack of overhead lines in the crowded city center, which is purely æsthetic, the most marked advantage is the lack of necessity for changing the batteries for charging. But this advantage is offset by the fact that as the charging is done en route the current for charging must be transmitted over the feed wires in addition to the current necessary for propelling the car with its extra weight of battery, thus increasing the loss due to charging. The power transmitted may be divided as follows: 1. To propel the car without battery. 2. For propelling extra weight of battery. 3. For charging battery.

I regret that I have been unable to get accurate data showing the relation of these items to each other. But I feel satisfied that the extra cost of feeder cables due to the extra power transmitted and the decrease in efficiency will more than offset any saving in cost of line work, while the cost of operation must be, and is acknowledged to be in excess of the less complicated system in common use in this country. The fact that overhead lines are in use up to the prescribed limit and that the battery is only used where it is compulsory, speaks volumes. It is also significant that the commission appointed by the larger roads in England and Scotland to investigate the various methods of traction in vogue throughout Europe and America have vetoed any form of battery car.

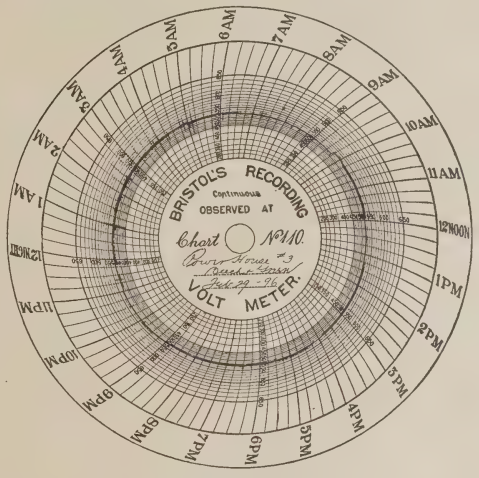


FIG. 4.—VOLTMETER CHART TAKEN AT BEACH AND GREENE STREET POWER HOUSE

The following data are taken from the writings of Mr. Dawson and others:

COMPARATIVE DATA OF ACCUMULATOR CARS

	Paris Lead	Berlin Lead	Wien Cop. Zinc
Passengers carried	50	31	32
Empty car, weight in pounds	18,081	19,845	16,097
Loaded " " "	25,799	24,630	21,036
Weight of cells	3749	7270	3969
Number of cells	56	88	136
Capacity of cells in ampere hours	230	130	300
Power per car mile required at power house in Board of Trade units	1120	1072	1280

DATA OF ACCUMULATOR CARS RUNNING IN PARIS

Number of cells	108
Number of plates per cell	11
Size of plates, in inches	7⅞ × 7⅞
Thickness of negative plate, in inches	.236
Thickness of positive plate, in inches	.315
Weight of plates, in pounds	39.69
Capacity in ampere hours	250
Efficiency per cent	70
Average discharge rate	35
Maximum discharge rate	100—200
Life of negative plate in car miles	93,750
Life of positive plate in car miles	8,750
Passengers carried	50
Weight of loaded car, in pounds	30,870
Weight of cells, in pounds	6,615

DATA OF ACCUMULATOR LINE AT THE HAGUE, 1891—JULIEN ACCUMULATORS

Length of line	3.5 miles
Maximum grade	1.50
Weight of car, loaded	14 to 16 tons
Number of cells	192
Weight of cells	4 tons
Maximum speed in miles per hour	12.5
Maximum distance run with one charge	44 miles
Average " " " "	35 "
Capacity of cells in ampere hours per lb. of plate	4.5
Positive plate can run without renewal	9000 to 11,000 "
Cost of maintenance of cells per car mile	8.5*d*
Cost of handling cells per car mile	2.3*d*
Board of Trade units consumed per car mile	1.080
Probable maximum discharge rate	130 amperes

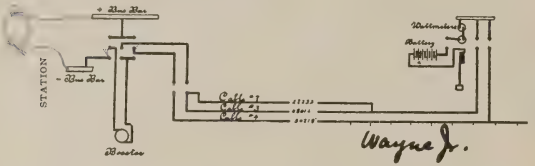


FIG. 5.—DIAGRAM OF CHESTNUT HILL CABLES

COST OF RUNNING ACCUMULATOR CARS IN BIRMINGHAM, ENGLAND, PER CAR MILE IN 1893

Wages	3.37	pence	6.74	cents
Fuel	1.76	"	3.52	"
Stores	.68	"	1.36	"
Water and gas	.12	"	.24	"
Sundries	.17	"	.34	"
Repairs and maintenance	5.49	"	10.98	"
Total	11.59	"	23.18	"
Car miles run			140,993	

WORKING EXPENSES OF ACCUMULATOR TRACTION IN PARIS IN 1893, PER CAR MILE

General expenses	.204	pence	.408	cents
Cost of power	2.828	"	5.656	"
Maintenance and handling of accumulator	2.537	"	5.074	"
Motormen and assistants	1.210	"	2.420	"
Maintenance of motors and trucks	1.410	"	2.820	"
Heating, lighting and various	.138	"	.276	"
Total	8.327	"	16.654	"
Miles run			144,718	

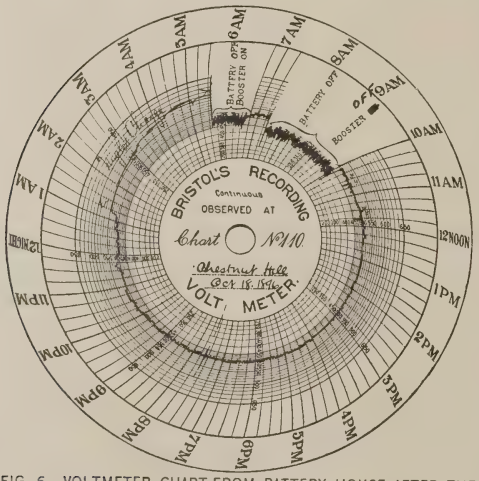


FIG. 6.—VOLTMETER CHART FROM BATTERY HOUSE AFTER THE BATTERY WAS INSTALLED.

COMPARATIVE COST OF VARIOUS SYSTEMS OF TRACTION IN PARIS IN CENTS, PER CAR MILE

Horses	17.10 cents
Accumulator	16.66 "
Hot water locomotives	10.78 "
Overhead trolley system	9.24 "

A third phase of the battery car system is the battery locomotive. Aside from special forms such as the Heilman locomotive the one most worthy of mention is the experiment on the New York Elevated Railway, in which the battery is connected in multiple with the motors and charges or discharges according to the demands of the train. When the demand of the motors is sufficient to lower the pressure on the line to or below that of the battery, the battery will then discharge into the motors, thus relieving the feeders. When current is shut off from the motors, the battery will charge. No results of this experiment have been made public yet, but it is difficult to see how much is to be expected. It has the advantage of maintaining a fairly constant pressure at the motors, but this can be accomplished better in other ways, as I shall show later. It subjects the battery to usage which history has proved to be disastrous to its life and efficiency. In this method

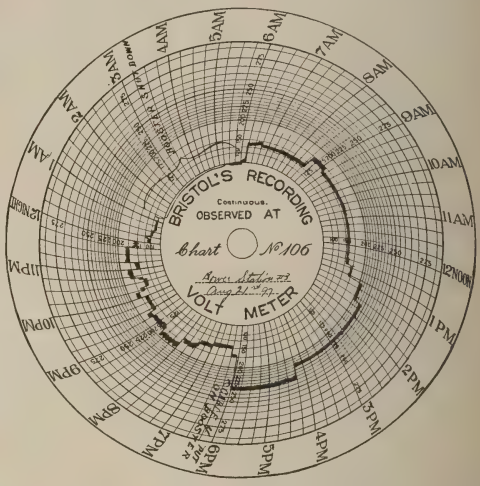


FIG. 7.—BOOSTER VOLTMETER CHART

the extra weight of the battery has the certain advantage of giving additional adhesion to the rails. While not wishing to seem pessimistic, I must confess that to me the outlook for the battery car is not bright, and I do not look for much improvement unless some combination of elements be discovered whose characteristics are entirely different from the lead battery.

THE APPLICATION OF STORAGE BATTERIES ON THE ENDS OF LONG LINES

In such applications the conditions are entirely different. The battery in this case acts essentially as a pressure regulator. The conditions do not restrict the size of the plates, so that the plates can admit of such a size that the current density on discharge can be kept well within the limits of normal discharge; and in consequence of this, the battery is not subject to the great loss of efficiency, due to the fall of e. m. f. on discharge. Only a few such installations have been made, two of which are on the Isle of Man; one has been installed by the Anaconda Mining Company at Butte, Montana; there is also a small plant at Merrill, Wis. The first installation, however, that has been made for any large city road for its suburban service, I find, is the one installed by the Union Traction Company, of Philadelphia, Pa. The road was originally a horse car line which ran as far as the depot at Pelham, a distance of 7.3 miles from the power house. Conduits and cables were installed for operating a number of cars which were supposed to be amply sufficient. The phenomenal increase in the travel, however, necessitated a large increase in the car service. In addition, the success of the line warranted its extension to Chestnut Hill, 2.3 miles further. More recently the line has been extended down a long grade to Hillcrest Avenue, and from Hillcrest Avenue to the Wheel Pump on the Bethlehem Pike, 1.6 miles further, making the line 11.2 miles from the power house. With the first extension of the line to Chestnut Hill, the underground cable was also extended, but the drop in pressure over this long line made it impossible to run the

requisite number of cars, as the speed of a trolley car is approximately in the direct ration to the applied e. m. f. The cables for feeding this section consisted of one cable extending to Chestnut Hill, one to Chelten Avenue and one to Wayne Junction, about 5 miles from the station; all these cables were 1,000,000 c. m. copper, rubber covered and leaded, laid in terra cotta ducts. The investment in feeders for this line had reached a point considerably above $100,000, not including the conduits. To have increased the cable system so as to have supplied this section properly would have required about 336,000 ft. of 1,000,000 c. m. cable. At $1.05 per foot laid, this would amount to $352,800; deducting the value of cables which were already laid, and which are estimated at $79,000, we find that the extra cost for cables without conduits would have been $273,800; this figure is, of course, prohibitive.

In order that you may appreciate the condition of the line previous to the installation of the battery, I would call your attention to Fig. 3, which shows a recording voltmeter chart taken at Chestnut Hill, and to Fig. 4 which shows the pressure at station bus bar on the same day. 350 volts were frequently touched. The average was a little over 400 volts with 530 at bus bar. It was necessary, therefore, to furnish some means of keeping up the pressure. If a station had been built at that point, it would of necessity have been small and inefficient. From records taken at the main power house, it was found that it would be necessary to provide a station of about 750 k. w. capacity; such a station would have cost about $85 per horse power, or a total of $85,000. A battery station, on the other hand, required but little real estate, and would be inexpensive to operate, and its cost would be considera ly less than a power station. In the Chestnut Hill plant the entire cost of real estate, battery and building was approximately $25,000; to this must be added the cost of a booster in the main power house. This required a 200 k. w. generator, which with its engines would cost about $8000. The total cost of battery and booster would, therefore, have been $33,000. In this installation, however, they simply adapted a 300 k. w. generator at their power house to this service, so that they were put to but little extra expense in the power house for adapting it to booster purposes. We find, therefore, that deducting $33,000, the cost of the battery and booster, from $85,000, the cost of a station, that the difference in first cost is $52,000, in favor of the battery. In addition to this, they were put to an expense of a little over $13,000 for changes in the cable. In the estimates that follow I do not include any cost or interest on the cable, as the investment would have been about the same whether they had built a station or installed a battery. It is very apparent, therefore, from the facts given, that on the score of the first cost, the battery was by far the cheapest installment which they could make. In order that you may better understand the results which I propose to give in reference to the operation of this battery, I beg to describe the plant somewhat more in detail.

You will see by Fig. 5 there are three cables concerned in this work, which are numbered No. 3, No. 4 and No. 7, all of 1,000,000 c. m. capacity; the lengths of these cables are shown on the diagram. Cable No. 4 is the only one which supplies the trolley wire direct, or, in other words, all the taps from the underground cable to the trolley wire are tapped on cable No. 4; this cable runs all the way from the bus bar at the power house to the end of the line on the Reading Pike at Chestnut Hill. It feeds in all about 12 miles of trolley wire. Cable No. 3 runs direct from the power house to the bus bar at the battery house, as shown in the diagram. Cable No. 7 simply augments the capacity of cable No. 3. In ordinary operation the current on cable No. 3 passes through the booster at the power house, by which the initial pressure is raised 150 volts more or less above the ordinary bus bar pressure of 550 volts (Fig. 7). By this means the drop in the cable is overcome, so that the pressure at the battery house can be adjusted to a point where the battery varies but little to either side of the zero point, or in other words, it charges and discharges continually, maintaining the load on cable No. 3 nearly constant, and consequently maintaining a constant e. m. f. where the current passes out from the battery house through cable No. 4, as shown in Fig. 5. This cable (No. 4) is therefore fed from two points, namely, from the power house end at 550 volts and from the Chestnut Hill end at about 515 volts. As a consequence, the distribution along the line from Wayne Junction to the end at Chestnut Hill is comparatively uniform and is now very satisfactory.

At first the battery was allowed to discharge during the day about three times as much as it charged, making up the charge at night between the hours of 1 A. M. to 5 A. M. Later, the amount of day discharge was decreased until the charge and discharge were about equal. The first gave a very even voltage of a little over 500. With the present method the voltage is somewhat more irregular, but the average is somewhat higher. By keeping the battery continually up to full charge, the night man has been dispensed with. Fig. 6 is a copy of an average voltmeter chart after the battery was installed. When the load in the line is low, the current going over the cable No. 3 to the battery house, divides at the bus bar, one part supplying the necessities of the line, the other part charging the battery. When the demand on the line is heavy, the pressure drops a little at the battery house; all the current going over cable No. 3 will pass out over cable No. 4, and in addition, the battery will discharge sufficiently to make up for the extra demand for current. This has the effect, as I have stated above, of keeping an almost constant load on cable No. 3. At times the load on cable No. 3 has become so heavy as to exceed the cable's capacity. At such times by an arrangement of switches at the power house, shown in Fig. 5, cable No. 4 is put on the booster as well as cable No. 3. In doing this, the current through the booster is largely increased, but the pressure can be reduced from about 250 to 125 or 130 volts (see Fig. 7), and, in addition, better pressure is obtained at the Wayne Junction end of the section.

COST OF OPERATING

From volt and amperemeter readings taken from the power house in October, 1896, we find that 136,576,919 watt hours were delivered to the line at the battery house. These figures, I may explain, do not include the watt hours generated by the booster. since we have assumed that this entire amount is lost in transmission. As a matter of fact, this is not strictly correct; but if a station were operated at Chestnut Hill, it would be run at a bus bar pressure a little above the battery pressure, and therefore for our present purposes the assumption is correct. From our experience in operating power houses of various capacities we find that a power house operated at Chestnut Hill under conditions which I have described would cost about 1½ cents per kilowatt hour. We therefore get the following as the cost of generating the number of kilowatt hours required by the Chestnut Hill branch during the month of October, 1896, if furnished by a station at Chestnut Hill:

134,848 k. w. hours at 1½ cents	$2,022.73
Interest on $85,000 at 5 per cent per annum.	354.17
Depreciation on machinery, etc., at 5 per cent per annum	354.17
Insurance, taxes, etc	200.00
Total cost of operation for the month by direct method...	$2,931.07

Actual cost of operating the battery and booster.

Watt hours delivered to cable No. 3 by bus bar	136,576,919
Watt hours generated by booster.	34,234,648
Total watt hours delivered to cable No. 3	170,811,567

The cost of operating the power house for the month of October, exclusive of interest and depreciation, was 7 mills per kilowatt hour; therefore, we obtain the following:

170,811,567 k. w. hours at .7 cent	$1,195.68
Cost of labor and supplies at battery house	179.73
Total.	$1,375.41
Depreciation of battery at 5 per cent per annum.	83.33
Interest at 5 per cent per annum on $33,000.	137.50
Taxes, insurance, etc	32.00
Total cost of operation	$1,628.24

Deducting this from the cost of operating by a station at Chestnut Hill, we find the difference in favor of the battery for the month would be $1.302.83. Since Oct. 1, 1896, the method of operating has been somewhat changed, and by installing wattmeters more accurate data have been obtained.

During the month of May, 1897, the following results were obtained:

Delivered to cable No. 3 at 550 volts	101,750,000	watt hours
" " by booster	28,960,380	"
Total delivered at station	130,710,380	"
Total delivered at battery house	103,673,448	"
Less amount lost in battery	620,000	"
Total output at battery house to line	103,053,448	"
103,053,448 watt hours at 1½ cents per k. w.		$1,545.80
Interest on $85,000 at 5 per cent per annum.		354.17
Depreciation at 5 per cent per annum		354.17
Insurance, taxes and miscellaneous		200.00
Total cost for May, 1897, by direct method		$2,454.14

Actual cost of operating battery:

130,710,380 watt hours at .6 cent per k. w.	$ 784.26
Cost of labor and supplies	163.67
Total.	$ 947.93
Depreciation of battery at 5 per cent per annum	83.33
Interest at 5 per cent per annum on $33,000.	137.50
Taxes, insurance and miscellaneous.	32.00
Total cost of operation.	$1,100.76

NOTE.—Cost of operating power house for May, 1897, was .6 mill per kilowatt hour. 5 per cent depreciation of battery is amount guaranteed by makers. Deducting $1,100.76, the actual cost of operating battery for May, 1897, from $2,454.14, the cost if station had been built at Chestnut Hill, we find a saving of $1,353.38 in favor of the battery.

We may safely say, therefore, that the saving by using the battery is about $1350 per month or about $16,200 per year.

RECAPITULATION

Saving in cost of installing battery over a new power station for Chestnut Hill	$52,000
Saving in operation per annum	16,200

These results speak for themselves, and need no further comment. The following data may also be of interest:

	October, 1896	May, 1897
Highest charge for 24 hrs	456,000 watt hrs.	300,000 watt hrs.
Lowest " " 24 "	312,000 "	150,000 "
Average " " 24 "	385,161 "	218,380 "
Highest discharge for 24 hrs.	456,000 "	250,000 "
Lowest " " 24 "	216,000 "	150,000 "
Average " " 24 "	329,419 "	198,380 "
Average efficiency for the month,	85.5 per cent.	90.8
Average day charge in amperes	46	45.8
Average night " " "	155	
Average discharge " "	50	43.7

Ratio of the night charge to the day charge { Highest 4 to 1; Lowest 1½ to 1; Average 2.63 to 1

Ratio of day charge to discharge	October, 1896	May, 1897
	Highest 1 to 4.45	1 to 1.5
	Lowest 1 to 1.86	1 to .78
	Average 1 to 2.95	1 to 1.10

SPECIFIC GRAVITY

Maximum specific gravity at 6 A.M	1.200
Minimum " " 6 "	1.2
Average " " 6 "	1.207

The above are the specific gravities at the end of full charge:

Maximum specific gravity at 6 P.M.	1.201
Minimum " " " 6 "	1.184
Average " " " 6 "	1.192
Maximum specific gravity at 12 P.M	1.194
Minimum " " " 12 "	1.182
Average " " " 12 "	1.188

At a specific gravity of 1.16 the battery would be about empty; so that we find at no time was the battery more than half discharged. At the end of fifteen months of continuous operation, we have only had to repair two leaky tanks at an expense of about $25. The positive plates look as good as when first installed, and show no depreciation whatever; the negatives, on the other hand, have contracted somewhat and some of the plugs have cracked, but this in no way impairs their usefulness.

This method of power distribution cannot be considered economical *per se*, but where the conditions are such as we have described, there is no question as to the economy in favor of the battery.

APPLICATION OF BATTERY TO POWER HOUSE

This form of installation has not become very generally appreciated in this country, and but few installations have been made. As its advantages become better known, I feel confident the practice will become more general. The wide fluctuations in load in railway power houses are now well known. The average daily load varies from 50 per cent of the maximum in small stations to 70 per cent of the maximum in the largest stations. From a very large number of observations in all parts of the country, I find that in the majority of stations the average load is very close to two-thirds of the maximum load. Now, it is also a well known fact that the maximum economy of the steam engine exists for a very small range of load, and that on each side of the point of maximum economy the efficiency falls off; rapidly on the overload, somewhat less rapidly on the underload. The result is apparent. In most stations the engines, at the best, have an average load of only two-thirds their most efficient load, and as a consequence consume over 4.5 lbs. of coal per kilowatt hour. With badly regulated engines, and especially with water power plants, the changes in load are accompanied by variations in speed and consequently in voltage. These troubles may be entirely corrected by installing a battery.

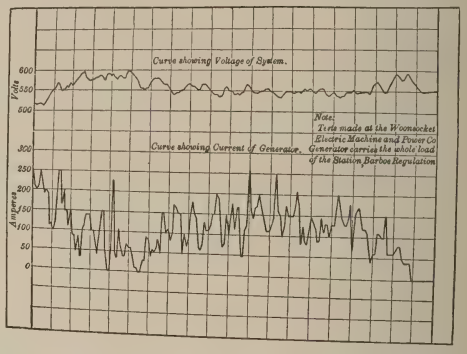


FIG. 8.—CURRENT AND PRESSURE CURVES AT WOONSOCKET BEFORE BATTERY WAS INSTALLED

The battery in this case becomes distinctly a load regulator. Figs. 8 and 9 show results obtained at Woonsocket, which is a water power plant. In Fig. 8, the load is carried entirely by the generators and, as is to be expected, the potential curve is very irregular, varying almost 100 volts, while the current varies from zero to 250 amps. The action of the battery is shown in Fig. 9, where the generator load varies about 50 amps. and the potential curve is most regular. Fig. 10 shows the results obtained at Easton, Pa. In this case the battery is quite small and the advantage is not quite so marked as it would be if a larger battery were used. Instead of using four generators, however, they are able now to operate the same number of cars with three engines. No cost figures of these

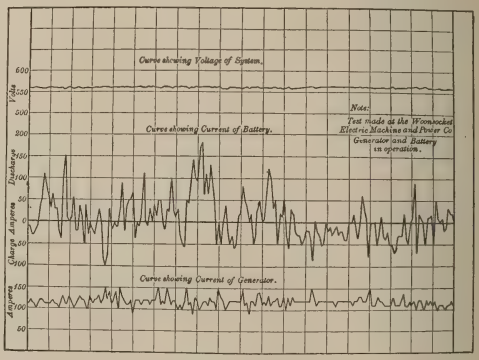


FIG. 9.—CURRENT AND PRESSURE CURVES AT WOONSOCKET AFTER BATTERY WAS INSTALLED

plants are made public, but the increased efficiency is made apparent. It is necessary that the capacity of the battery should bear a larger ratio to the output of the station than is necessary for potential regulation as described in the previous section of this paper. In potential regulation a comparatively small battery is necessary, since by changing the potential of booster from time to time during the day, the charge and discharge can be kept very low. In the case described a battery rated at 120 amps. has successfully regulated for a total output of 1400 amps. For load regulation, how-

ever, the battery should have a capacity equal to one-third the maximum output of the station. The average load of the station may then be made the maximum load of the engines, the battery taking care of the fluctuations. As in the previous case, there are no physical limitations to be placed on the size of the plates to be used, and the charge and discharge may be kept well within the normal

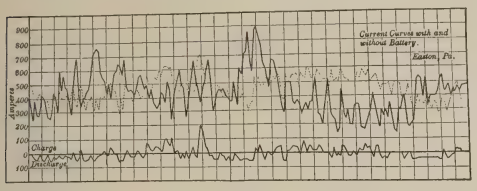


FIG. 10.—HEAVY LINE SHOWS OUTPUT OF FOUR GENERATORS WITHOUT BATTERY. LIGHT LINE SHOWS OUTPUT OF THREE GENERATORS WITH BATTERY—EASTON TRANSIT COMPANY, EASTON, PA.

rates. Under such conditions the efficiency of the battery is high—85 to 90 per cent—and the deterioration very low. In most cases no additional labor will be required.

"Power Distribution and the Use of Multiphase Current Transmission for Ordinary Street Railways

BY MAURICE HOOPES

The subject that has been assigned to me for discussion is one that has received considerable attention in recent years. Aside from the demands of what is usually considered steam railroad service, the business of the ordinary urban and suburban railways has grown lately in a way that requires some means of augmenting the usual method of power distribution. Lines have been extended to greater distances from power stations, and traffic has increased on lines which always have been remote from their points of power supply. These conditions have arisen at places where disadvantages of location or lack of sufficient load would render additional power stations unprofitable. To meet such demands, several methods have been devised. The consideration of the comparative merits of these systems is the principal purpose of this paper. Before undertaking this task, however, the writer desires to discuss some of the conditions met with in the operation of the ordinary 550 volt distributing system. Some of the points raised have been frequently made. For these an apology is offered in advance, the excuse being that they are sufficiently important to bear reiteration.

The usual electric railway distribution system, with its copper network as one, and its iron network as the other half, offers rather more complicated problems than does the ordinary form of all copper circuits. The latter system is symmetrical, whereas the former is likely to have greater resistance in the copper than in the iron portion. A rule that holds good of both systems is that *the maximum benefit in reduction of total resistance, due to the addition of a given amount of conductor, results when the addition is made to the parts in which the drop is greatest per unit of length.* An observance of this rule is important in adding to distribution systems. This demands a careful analysis of existing conditions. Before adding feed wire to a railway circuit, it is important to know the drops, under usual load, of the parts of the circuit. These may be found by the use of pressure wires, or by short circuiting the trolley wire to the rail, and passing a given current through the circuit, measuring the total drop and deducting the calculated overhead resistance from the total resistance thus found. Private telephone lines serve the purpose of pressure wires to measure track drops, and public lines connected through the exchange may be used without interference with the service. An exception to the general rule, that the copper should be added to the part of the circuit showing the greatest resistance is the case of a poorly bonded track that may show less resistance than the overhead. Re-enforcing such track with overhead copper connected to each end of all special work may result in the greater decrease in the total resistance of the circuit. This is really a special application of the general rule, rather than an exception to it, however.

Means for regular and easy measurement of track joint drops should exist. For tracks having frequent high resistance joints, there is no better way than walking over it with a low reading voltmeter connected to prongs on the end of a stick, that it may be bridged across joints. For detecting poor joints in good track, where they are far apart and for the general inspection of the condition of track wiring, a car is convenient. A box trailer with each wheel insulated from all others, and a voltmeter connected between the two wheels on each side of the car may be used. A third meter connecting the two opposite wheels will indicate defects in cross bonding. The writer considers that it is unnecessary to complicate the measurements by attempting to measure the resistance of the joint. His experience is that, if a bond is loose enough to have abnormal resistance, it will get worse rapidly, and show excessive drop with even small amounts of current. It behaves very much as did the fellow's little girl, and is either "very, very good," or "horrid."

It is universally recognized that the maximum efficiency is obtained from a distribution system when it is operated as a whole, and not divided into sections. The liability of accident to railway trolley wires makes it necessary to separate them in such a way that trouble at one point will not block the whole road. These sections should be as few as possible, while accomplishing the purpose for which they are designed. Where one road has two or more power stations, the sections approximately equidistant from each of the two stations should be connected with both. They may then serve to equalize load between stations, the common section being cut loose from the station needing to decrease load. Two feeders to such a section, one from each station, constitute a tie line between stations. If desired, the potential may be raised in one station to a point that will deliver current into the other. Unless the drop in the combined feeders is excessive, it will probably be safe to allow the section attached to take the increased potential. Tie lines between stations which serve none but emergency purposes, are expensive, especially if the stations are distant from each other.

Where the ordinary methods of distribution are not applicable because of the prohibitive amount of copper necessary, some one of the following systems is commonly used to care for the particular section:

1. A "special generator" run at increased voltage and usually overcompounded as much as possible, handling the section and no other load.

2. A "booster," consisting of a series wound generator, connected in series with the feeder as it leaves the main station bus. The field turns of this generator should be such as to make the e. m. f. of the armature as nearly as is possible equal to the drop in the feeder, throughout all ranges of current.

3. The "three wire system." This requires the division of the section into two. One-half is then supplied from the regular bus, and the other from a special generator, with the polarity reversed, to bring the trolley wire opposite in potential to that of the rest of the system. The trolley wire should be so divided into the two half sections as to leave, as nearly as possible, equal loads on the two at all times. With this arrangement, the current in the track is only that flowing from the cars on one half section to those on the other. If these half sections are located near each other, this path through the track is very short. For this reason it is usual to make one track of a double track road one half, and the other track the second half section. Unless conditions are such that the cars are likely to be bunched on one track this seems the better way of dividing. In addition to conducting current between cars, the track has to conduct back to the power station the excess in current used on one half section over that used on the other.

4. The "alternating current transmission system." The only form of alternating current system desirable for railroad work consists of high voltage, multiphase generators (or low voltage generators with step-up transformers) in the main station connected with one or more substations containing step-down and rotary transformers. There are some half-dozen such systems in use in this country, of which the best known are those from Lowell to Nashua, and from the station of the Niagara Falls Power Company to Buffalo.

With any of the foregoing systems, the storage battery may be applied as an auxiliary. In a railway power station, a battery is useful to the extent that it improves the station capacity and fuel economy by removing the *immediate* fluctuations. The writer con-

siders that there are few instances where a battery can be installed, with resulting profit, where its function is the storing of power one hour for use the next. Except with very short time peaks, the battery costs as much as the additional generating apparatus. Particularly in small stations, however, there is such a variable load that it is impossible to average full load from the station for a period of time, because of the inability to handle the very great short time overloads that such an average load demands. In such a station, a battery may result in a considerable increase in station capacity, and by allowing the engines to operate at practically constant loads, reduce the fuel consumption greatly. While a battery may do these things in the station, it may do even more remote from the station. In the latter location, it will keep the potential near it practically constant, and will also maintain uniform current flow between the station and the particular point, thus adding the advantages of regulation and greatly increased copper efficiency.

One side of the story makes a pretty good case for the storage battery; unfortunately, the other must be told. The first cost of a battery is so very great that reasonable interest and depreciation on the amount invested will more than consume the apparent saving in many cases. Especially is this so in the case of a battery located on the line, where it has been shown that the gross saving is the greatest. This is true because it requires a very much larger investment in battery to care for the load variations of a given station if the batteries must be divided up among several substations, the load factor of each of which is necessarily lower than that of the main station. The sum of the maximum variations of the several stations is always greatly in excess of the maximum variations in the main station. If, however, a power station were to be located at a considerable distance from a single center of distribution, through which all feeders from the station passed, it is quite probable that a battery placed at the latter point would result in a net saving, due to its giving each, the station and copper, an uniform load.

When it becomes necessary to select from the foregoing list the most suitable system for a given case, there are many conditions to consider in the decision. Either of the first three, the special generator, the booster or the three wire system, may be arranged with the apparatus in any railway power station, assuming that it includes a reserve generator of the necessary size. It is better to use standard railway machines for these purposes and, if possible, to arrange the station so that any one of the regular station machines may be used. It frequently occurs that one or more sections of line fed from a certain station have copper enough leading to them to care for them properly at all times, excepting a few hours on each ordinary day, and for longer periods on heavy days. While the work may be quite variable at times of light load, when the load increases it becomes more nearly uniform. Such sections may be satisfactorily supplied over the copper designed for the lighter load, by raising the voltage on the station end of the feeder during heavy loads. Usually, the margin in the field rheostat will allow the increase of voltage on any one of the generators, to a point considerably above the normal. When this is not so, it is possible that the generator speed may be increased, unless limited by the requirements of safety in the driving engine.

In one or both of these ways, it is often possible to get from 700 to 750 volts from a standard 550 volt machine. This increase enables the heavy load on the section to be handled very satisfactorily. The voltage at the feeder end necessarily varies with the load, and with ordinary fluctuations there may easily be 100 volts difference between the minimum and maximum. A recording voltmeter placed at the feeder end will show a very inky piece of paper, after a run. In practice, on a line which the writer finds it necessary to handle in this way, he gets variations from 450 to 550 volts. The minimum is infrequent, however, and the schedule is made apparently as well as though the potential were absolutely uniform. Considering the question of abuse of apparatus, the increased voltage is not likely to injure a generator of modern construction. Practically, the only additional care that seems necessary is of the generator fields, noting that the increased current in the shunt windings does not heat them above safe temperature. So long as the potential at the car stays under 600 volts, there is little probability of trouble with equipment. Although the writer has had no such experience, he has known of cases where higher voltages have caused the arcs at controller contacts, when breaking, to jump to the iron frames. This difficulty has been experienced more particularly on small roads using boosters, where one car might constitute the entire load on the booster. At times of throwing off the power, the booster holds up its potential for a sufficient time to result in a very greatly increased voltage during the time of the controller opening.

The method just described has the advantage of simplicity and economy. Cases arise, however, when the very great fluctuations in load make its use impracticable. With a line which, at certain times, carries very heavy current, as compared with the average, there must be some means of automatically raising and lowering the voltage at the station end of the feeder, to properly compensate for the variable drops. To accomplish this, a booster is used. As has been said, this machine is a series wound generator, connected in the feeder as it leaves the main bus, and so proportioned that a given current through it will give sufficient field strength to induce an e. m. f. in the armature equal to the fall of potential which the same current causes in the feeder. In practice, this condition is only approximated. Were the generators to have a perfectly straight characteristic curve, of proper pitch to match that of the feeder drop, the feeder and potential would exactly coincide with that of the power station. The curves of all dynamos droop away towards the horizontal as the magnets approach saturation. This results in the booster failing to compensate wholly for drops of current above a certain amount. In practice, however, boosters are used which raise a feeder potential to 1000 volts, and care for variable loads without allowing the light load voltages to rise, at the feeder ends, to dangerous amounts. The system has the advantage of caring for extreme overloads on particular feeders, and is useful in cases where, for short periods of time, the feeder load is such as to cause excessive drops, and the time is not great enough to justify increased copper investment. On the other hand, it is expensive in operation, due to the fact that it wastes considerable energy, and that it generates this wasted energy in rather an extravagant way. If the booster is engine driven, the engine has widely fluctuating loads to handle, the load varying as the square of the current in the feeder. These variations necessarily result in a very low economy for the engine. With a motor driven booster, there are the constant losses of the two machines to meet. These are not so great as those of the engine and booster, but the necessity of keeping a particular generator for use as a booster limits the flexibility of the arrangement as compared with one which permits the use of any of the regular station generators, and, moreover, the addition of a motor booster does not increase the capacity of the station, as the power to drive the motor must come from the engines. The compounding of the standard types of railway generators is usually such that, when full load current is passed through them, the series turns alone will raise the fields to a point that will induce nearly normal e. m. f. in the armature. This adapts the machine for use as a booster on almost any line, excepting one requiring more than 100 per cent increase of potential at times of full load. As lines when so overloaded would be much better provided for by the addition of more copper, they need not be considered. In most cases, it is necessary to *cut down* the e. m. f. of the standard generator in order to secure the proper ratio of e. m. f. to current for boosting, and this may be done by decreasing either its speed or the number of field turns. The former method has the advantage with an engine driven unit of improving the engine economy by lessening the friction losses and keeping the cut-off at a less wasteful point, whereas, the latter is the simpler way. To accomplish this, the writer uses a long German silver strip of sufficient section to carry the proportion of current that it is desired to shunt out of the fields. This strip is fastened to the generator frame, connected across the terminals of the series field, and doubled on itself in such a way that a clamp may be slid back or forth on it, raising or lowering its resistance. Knowing the resistance of the feeder upon which the machine is boosting, the clamp may be shifted to the point where the ratio between the reading of the voltmeter and ammeter is equal to the feeder resistance, and the proper adjustment reached.

For temporary uses, it is possible to make the necessary switchboard connections with flexible cables as the only adjuncts to the apparatus on the regulation board. A cable which may be attached to the positive lead of any of the generators, at the switchboard, and to any feeder, answers the entire purpose. With some boards, it is only necessary to have terminals on the cable that may be inserted into switch jaws. If the generator leads and the feeders happen to terminate in switch blades instead of jaws, the cable must have its ends fitted to clamp quickly to these blades. With this preparation in order to transfer a particular feeder to a special generator for the purpose of increasing the voltage upon it, the cable should be

attached to the positive generator terminal, the other end hung convenient to the feeder switch, the generator built up all ready for use, the feeder opened and attached to the cable, and finally, the circuit breaker and negative generator switch closed. If it is desired to extend this system to booster working, it is necessary to have a second cable leading from the positive bus bar and capable of connection to the negative terminal of the booster. It is best to include a circuit breaker in this cable to protect the booster, as the regular generator circuit breaker will be cut out.

At best, however, cables are troublesome appliances and allow only comparatively slow transfers. Moreover it is impracticable to arrange cables so that two generators may be run in parallel on the special high voltage service. Where a new board is being installed, and where the circumstances justify the alterations in an existing board, such a one as is shown in Fig. 1 meets the required conditions. The two equalizing bars make it possible to run two or more machines on each, the regular and high voltage at one time. With this arrangement, any two combinations of feeders and generators desired may be had. When running the "special generator" the negative switches are thrown up, and the positive and equalizing switches on the special machines thrown down. The switches on

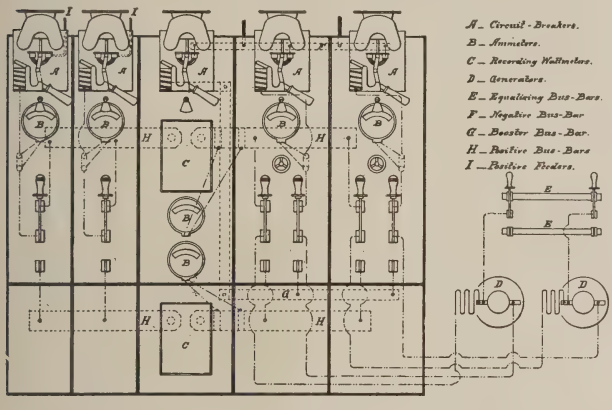


FIG. 1.—DIAGRAM OF SWITCHBOARD FOR USING "SPECIAL" GENERATOR, AS BOOSTER

the feeders needing the increased voltage are likewise thrown down If it is desired to use the auxiliary bus for booster purposes, the equalizing switch is left open and the adjustable field shunt applied, the negative generator switch is thrown down, after closing the booster circuit breaker, and the feeder is transferred down to the auxiliary bus. This puts the booster generator in series with the particular feeder. One very important thing in this connection is to make sure that the shunt field circuit is open on the boosting generator. It might be advisable to interlock the field switch with the negative generator switch in such a way that the latter could not be thrown down except with the former open. The drawing of the board shows a wattmeter and an ammeter in each bar. By providing a double throw switch connected in such a way as to open the lower wattmeter from the feeder board, and connecting it to the upper bus bar on the generator side of the ammeter shunt, the four instruments will be in series between the generators, all running on the lower bus, and the feeders all running on the upper bus. This offers convenient means for checking meters, care being taken to see that current passing through the diagonal bar, on the back of the instrument panel, does not introduce an error into the wattmeter indications.

In a modern station of few large units, it is improbable, were the necessity for booster service to exist, that one of the large generators could be spared or would be desirable for the purpose. In such stations, however, it is usual to install a smaller machine to carry the all night and other light loads. This machine might be relied upon for the booster work. If the engine driving it has its governor arranged to adjust for a large variety of speeds, both above and below normal, and the unit be designed to run safely at the increased speeds, the combination will be found very convenient for meeting all classes of demand. The speed may be dropped for booster working, and raised when the generator is run at high voltage on a particular feeder. With this arrangement of dependence upon an individual unit for the special service, it is, of course, unnecessary to equip the whole switchboard with the extra negative bus. The double positive bus will be found convenient in any station, however.

The "three wire system," although very useful in lighting work, has been of little service in railroad distribution. Its value for the latter purpose has been considerably overestimated, although there are places where its use has resulted in the maintenance of satisfactory potential on sections of track, using the same copper, when the usual system could not approach doing it. The advantage of the three wire system is based on the fact that it enables the use of double the usual potential for distribution, thus in the perfect case requiring but one-fourth the copper to transmit a given current at a given loss.

This law, that the amount of copper varies inversely as the square of the potential, is due to the fact that doubling the voltage halves the current for a given amount of energy. The same percentage of loss allows a loss of twice the number of volts, and this, with but half the current, admits of the use of copper having four times the resistance, hence one-fourth the weight. The "perfect case" just cited is one in which no third or "neutral" wire is necessary. Such a one does not exist in practice, and this neutral wire has to be supplied to conduct the excess of the current used on one side of the system over that used on the other, between the generators and the motors. In railroad work the rail is used as the neutral conductor. It is seldom that a whole road is operated on this system, the common practice being to apply it to only those parts on which the ordinary system is insufficient. Where there are but one or two sections to operate with the reversed potential, the switchboard described may care for them satisfactorily. If one generator is made to build up with reversed polarity, and is coupled into the auxiliary bus, it will handle such feeders as may be thrown upon it as the negative side of a three wire system. The generator may have its residual charge reversed in a number of ways, one of which is to have the shunt field wired through a double throw switch on the machine, arranged to disconnect the field coils from the armature and connect them in the reverse direction to a pair of charging wires fed from the switchboard. The machine may have its residual charge brought back to the usual direction by the commonly used means of throwing in the positive and equalizing switches, with the negative open, and allowing the current shunted from the series coils of the other machines to energize its series coil. Where three pole switches are used on the generators, the shunt field double throw switches may be omitted, and the field reversed through the series coil by using an X shaped pair of contact pieces insulated from each other at the point of intersection. These may be pressed against the switch jaws in such a way as to reverse the current shunted from the other series coils through that of the machine to be reversed. Where the three wire system is the regular system of operation, and the sections are divided equally between the two sides of the system, a regular three wire board is preferable. For a less general use of the system, the method described answers as well. The arrangement then becomes the same as that of the "special generator," with the polarity reversed, and the potential on the machine may be raised above normal, and the advantage of greater allowable drop in the copper added to that of the saving in track drop, due to the reversed current flow.

The writer has said that the value of the three wire system in railroad service has been considerably overestimated. This statement probably needs explanation. In lighting work, the three wire system saves 62½ per cent of the copper. Each wire has to be but one-fourth as large as with the two wire system, but it is usual to make the neutral of the same size as the other wires, thus requiring three wires, each of one-fourth the size of those of a two wire system; hence the use in the three wire system of three-eighths, or 37½ per cent of the copper necessary in the two wire system. Because this is true of lighting work, it is often assumed to be true of

railway work. It is not, however, and in no case where the track renders any appreciable service as a conductor, can the saving from the adoption of the three wire system approach the above figures. In general, its use will make a gross saving of the loss in track (assuming that there is no copper paralleling the track that may be used as a positive feeder). The net saving will be this gross loss in track less the track losses due to the passage of current from car to car, and of the excess of current due to lack of balance, back to the power station, and the increased overhead loss due to the greater drops in the divided feeders than in them when combined. The sketch (Fig. 2) may present this more intelligibly. It illustrates the simple case of an unbalanced three wire system, and shows that its losses aggregate 4100 watts under the particular load. If this system were changed to a two wire one by throwing the two feeders in parallel, it would save 400 watts in the feeders, and lose 800 more in the track, leaving a net loss of 400 watts, or about 10 per cent of the total loss. Such a difference as is shown by this hypothetical case would not justify the complication introduced by the system. The only conditions where the method seems to be applicable, are those of excessive track losses with fair opportunities for balanced load. Such a case existed on the Lowell & Suburban road. They have a heavy business over a double track line to their park, some 6 miles from the power station. By changing to positive feeders those formerly used as overhead returns, and operating the line as a three wire one, they very greatly improved the efficiency of the distribution system.

In the selection, from the various system of distribution, of the one best adapted to a particular instance, there is always a large number of variable factors to consider, and usually more or less speculation as to the values of certain ones on which no accurate data are accessible. This makes it impossible to work from fixed laws, and demands individual consideration of each case. For these reasons, there is considerable room for divergence of opinions in the matter. The writer has given his ideas as to the comparative infrequency of cases in which the three wire system is desirable. The booster has a very much more general application, and is suited to a greater number of cases than in any one of the other systems. Nevertheless, wherever work can be handled by a special generator, it should be, unless the change involves abandoning existing apparatus. The last method saves considerable over the booster, and is preferable for its simplicity. The only limiting condition to its use is satisfactory regulation. The alternating current system, with rotary converter substations, competes with the booster system and special generator in cases where the load factor (the ratio of average to maximum load) is high, and where the regular 500 volt transmission will suffice during only a few of the twenty-four hours. In such a case, the copper losses, because of the length of time during which they are excessive, are so great that they may often exceed the entire expense of an alternating transmission system. The latter system also enters into competition with the independent power station for that class of business that is too remote from an existing station to admit of satisfactory handling by the other transmission methods, and too small to furnish load for such a station as may approach in economy the station from which the alternating transmission would be operated. Cases of each kind arise with city roads in their needs for transmission to suburban centers of load, and with interurban roads. The roads which the city station receives from the suburban centers have usually a very low factor. At morning and night they are excessive, and through the remaining hours comparatively light. Were an alternating transmission system installed for such use, it would probably lie idle for a large part of the time, its copper being used to transmit direct current. During the heavy hours it could be called into service. This same service might be rendered by raising the voltage on the direct current feeders by use of the special generators, and allowing the loss, which has been from 5 per cent to 10 per cent during the light load, to become 25 per cent to 30 per cent. In this way, the line may carry three or four times as much current, and maintain the voltage at the distant end.

LOSSES IN WATTS

	Two Wire System	Three Wire System	Saving
+ Feeder	$60^2\times1=3600$	$20^2\times2=800$	-400
− "		$40^2\times2=3200$	
Track	$60^2\times\frac{1}{2}=900$	$20^2\times\frac{1}{2}=100$	800
Total	4500	4100	400

In comparing the systems, it is necessary to compute the annual cost of each, including the items in the following list.

Alternating Current	Direct Current
Fixed charges and repairs on main station static transformers, if any, and on sub-station static and rotary transformers, and accessories.	Interest, depreciation and repairs on such increased cost of engines and generators, as is occasioned by their being fitted to furnish increased voltage.
Fixed charges on substation, land and buildings.	Cost of fuel to produce output representing difference between losses in direct current feeders and those in alternating current feeders and transformers.
Sub-station labor.	

This assumes that the same amount of copper is used in each system, that the alternating system does not remove the need for sufficient copper to handle the load with direct current during a part of the time, and that this amount of copper will suffice for heavy loads by means of the increased direct current potential transmission. Should the load be of such a nature that the alternating transmission would be operated throughout the whole time, there

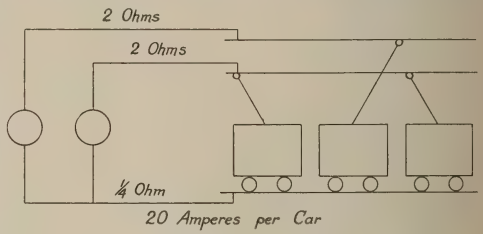


FIG. 2.—DIAGRAM OF UNBALANCED THREE WIRE SYSTEM

may be a correction made in its favor of the annual cost on the increased amount of copper necessary for the direct current system over that for the alternating system. It is probable that the direct current generator and engines need not be increased in cost more than 10 per cent by the requirements of the increased voltage. The writer has said that he is operating satisfactorily with machines designed for the standard voltage. Points which should be made against the alternating current system, which cannot be given exact money values, are the danger to life from the increased voltage, lack of uniformity in equipment, making lack of flexibility in stations (where, under the other arrangement, any generator may serve any demand), and the danger of delays due to the increased complication of the system, it sometimes requiring fifteen or twenty minutes to start the sub-station machinery and get it into service after it has been stopped in the midst of load by accident. These points of disadvantage are very important ones, and operating companies can well afford to expend considerable money to avoid them. Especially is it undesirable to install for railroad work a system which may be disturbed by the extreme overloads such work introduces, and which cannot be restored to an operative condition immediately the load is brought within bounds. With the rotary transformer system, any short circuit or extreme load, which is not relieved by the sub-station direct current circuit breakers, may stop the rotaries and shut the power off the line during the long interval it takes to start them and put them into service.

In the comparative estimate, the results depend more upon the load factor than any other condition. With it sufficiently high, the alternating transmission may show an economy over the direct current for areas within a very few miles of the power station. Unfortunately, however, the yearly load factor is usually very low on railroad work. With such a condition, it is cheaper to have excessive losses in copper at times of heavy loads than to carry the necessary equipment of alternating transmission apparatus to keep the losses down at such times. The railroad manager naturally insists that the voltage be maintained reasonably near its normal value over the

whole road at times of heaviest business. Estimates that show immense costs for copper to accomplish this under the regular distribution system make him turn to the consideration of additional power stations and multiphase transmissions. If he can be shown that he may care for his maximum loads over the existing copper by simply raising the voltage on the station end of the sections of heavy loss, and pay for the loss with coal instead of with interest and depreciation on a great amount of additional machinery, he is likely at least to determine carefully which he can better afford to do. While, in the writer's opinion, the majority of cases may be best handled by direct current distribution, there are many instances of need for a distribution system where none but the alternating current system is applicable. Where water powers are used, they are almost always so remote from the center of load that very high potentials must be used for economical transmission. Long interurban roads operating so few cars that load can be had for only one power station, bring a condition where distribution must be so accomplished by substations, on the alternating system. The Lowell transmission presents a case where it was a problem whether to care for the new territory with a separate station, or to transmit from the existing station. So much has been written about the multiphase current system that was decided upon and installed there, that it is unnecessary to attempt a description of it. Mr. Sullivan, the general manager of the company, has kindly furnished the writer with a copy of the estimates from which the choice of systems was made. He states that operation justifies the estimate in its statement of the cost of the multiphase system. It showed the cost of power delivered to the trolley wire to be, for the transmission system, 70 per cent of that for the separate power station. There were no figures showing what this work could have been done for with a booster system. Inasmuch as the latter method has been used successfully in place of the other, temporarily, it would be interesting to know its comparative cost. Tests of the Lowell system extending over eighteen days show an all-time efficiency of 76 per cent as measured from alternating generator output to rotary converter output, the losses being those of two sets of static transformers, line and rotaries. The maximum efficiency for any one day was 73 per cent. The voltage regulation at the substation is about equal to that of a well governed steam driven power station.

The writer has said that the use of alternating currents for ordinary electric railways is limited to the rotary converter system. This is due to the fact that alternating current motors, in their present state of development, are not adapted to the needs of such railways. As yet their use for traction purposes is limited to a few European roads, of which the best known is in Lugano, Italy. Alternating motors have the disadvantages of limited torque and tendency to synchronism. This makes them poorly adapted for the uses of any line but one having long runs at practically uniform speeds, and few stops. These conditions are those of a through express service between cities. Accommodation and ordinary street railway services are such as can only be handled satisfactorily by direct current motors. At first notice, this fact seems rather contradictory to one's ideas of the flexibility of alternating currents. The ideal system has been thought to be one composed of a generating station containing large multiphase generators, with lines distributing current at a potential high enough to require but a comparatively small amount of copper, static step-down transformers, and motors that may be regulated throughout all desired variations of speed by merely changing the impressed e. m. f. with a controller depending upon the use of various ratios of transformation. This dream included the freedom from the care of commutators, and pictured a car equipment that would need a minimum of attention. Were it possible to realize all of these advantages, it is probable that the somewhat serious complication introduced by the necessity for two trolley wires might be tolerated. There seems to be little probability, however, of an early solution of the problem of adapting the alternating motor to the intermittent work of the street railway.

In conclusion, the writer desires to say that the title of this paper may have led some to expect rather more particular attention to the multiphase transmission system, and less about direct distribution. He has, however, given the various systems the same relative importance in the paper that he considers them to have in application. Hence, the subordination of the alternating current system in the consideration of the general subject of power distribution.

Discipline of Employes

By GEORGE H. DAVIS

Discipline is universally recognized as a necessity in every important industrial undertaking. It is as thoroughly essential to success in the operation of railways, as are the plans and specifications in their construction. In the broad sense, it means the government of operatives through whom the equipment is made to do its work, and the efficiency of the equipment varies in direct ratio with the efficiency of its operatives. A road has good discipline when all employes respect and kindly regard each other, when the officers do their best for the men and *vice versa*, and when both officers and men sacrifice everything to the interests of the company. It is a somewhat difficult task to maintain the conditions as defined, but the nearer this standard is approached, the greater the surplus earnings. Discipline should never be interpreted in the narrow sense that a man is to work as a machine. It is true that "cars should run like clockwork," but, to arrive at this result through the constantly changing circumstances that arise, requires the services of men of thorough training, presence of mind and good judgment.

There is no fixed method of maintaining good discipline. It is frequently the result of the natural personal characteristics of the man in charge. There are, however, certain principles which are probably of universal application. First of all, a railway manager must gain the implicit confidence of his officers and men. To do this he must, in general, know the details of the design, construction, operation and maintenance of railways. He must have a universal reputation among his men of being shrewd, vigilant, industrious, honest and perfectly fair in his dealings. He must know them all personally, stand by them, and respect them as gentlemen upon all occasions. He must be thoroughly popular and able to create among them a spirit of loyalty and enthusiasm in regard to the road and its interests. A thing of greatest assistance in discipline is complete organization. Every man engaged in railway operation, from president to track greaser, should have before him in printed form, a full synopsis outlining all the essential features, the exact limit, scope and character of service that he is to render. All officers should have their exact relative rank in the service, which should be thoroughly known among all employes. In this way if conflicting oral orders are given, the order given by the officer of superior rank will be obeyed without question.

Another feature of discipline is the issuance of orders. Many failures to obey orders are due to a misunderstanding or misinterpretation. It is therefore important in railway operation to issue all orders in printed form, clearly and definitely stated. These orders should be sent in explanatory personal letters to all superintendents, foremen, inspectors and starters, and be published on conspicuous bulletin boards at all stations. An order should never be issued except that it meets with the approval of the best officers and men, and after once issued, it should be an infallible law, applicable to all employes alike, and if broken, it should in all cases be followed by a prompt, severe penalty. Satisfactory discipline cannot be maintained unless employes in all ranks are worked to their full natural capacity and physical strength. Idleness and easy positions in railway operation will undermine the best system of government that could be established. Again, constant watching is a most important factor. The general manager, or whoever is responsible for the receipts, expenses, maintenance and discipline, should spend at least eight hours a day directly on the lines of the company. There should be trusted starters at both ends of all lines at all times, and at least one inspector for each thirty cars operated.

Written reports for the smallest details of both good and bad features of the service should be insisted upon from all officers of the company, and a false report or statement from any employe should be sufficient cause for his instantaneous discharge. Nothing good or bad in a man's service should be passed without the manager's recognition. One of the strongest incentives to good work among men who are trying to do their best, is praise. When a motorman saves a pedestrian from mutilation or death from an electric car, his act should be recognized by a complimentary personal letter, thanking him for his skillful work. In general, a manager should have only praise for his officers and among the men ninety per cent of them should be above censure. However, when a man is censured it should be severe and the final preliminary to his discharge. A man should never be discharged except his case is given a thorough investigation, and he is given abundant op-

portunity for defense. When he is once discharged he should never be reinstated. Railway employes as a rule, admire a policy which is open, fair and generous. When an unusually large day's work is done in handling a great crowd of passengers, it is no more than fair for the company to share its profits with the men in giving them a few hours' extra time, the number of hours being in proportion to the extra receipts. The amount of money thus invested will in the future, return to the coffers of the company a hundredfold and more. Perfect management is something beyond human effort, still, if the problem is earnestly and industriously studied, railways may be operated to the complete satisfaction of the public, the stockholders and the employes.

As a partial solution of the different questions arising in connection with discipline, a competitive civil service system is offered as a suggestion. There are no new principles in this system as commonly understood. It is only a way of carrying out what every successful man has always followed in his business career. He selects the man whom he believes most efficient. He promotes the man who is of the greatest service to him, and discharges the man whose services are of the least value. All civil service methods employed by the Government, take account only of a man's ability in successfully passing the initial competitive examination. In reality a man's work in the service after employment should have for greater weight in regard to his retention or promotion, than the mere fact that he was able to answer correctly a series of questions, at best having only an auxiliary connection with the work to be performed. Another serious weakness in municipal or government civil service methods is that often questions are prepared and answers examined by commissioners who know nothing of the business, trade or profession for which they are conducting the examination. In all cases questions should be prepared and examinations conducted by the head of the department under whom the candidate is to work after entering the service. To insure perfect fairness, commissioners may be delegated to criticise the questions, witness the examinations and judge of the relative merits of all answers. Any successful competitive civil service system for railways must take into account: 1. The previous history of the applicant, including his railway experience. 2. His knowledge and skill in railway operation, which is covered by competitive examination. 3. His physical condition. 4. The quality of his work after entering the service.

The quality of his work after entering the service is the best criterion by which to judge of his relative value. However, before a man is employed it is impossible to judge of his work, and the only alternative is a broad, practical, competitive examination, which covers a sample of his work under the observation of the examiner, together with answers to the most practical questions that may be framed. In applying these methods to railway operation and maintenance, it is necessary, so far as practicable, to classify the positions of each of the various departments, so that there is a fixed line of promotion from the lowest to the highest rank. This does not mean that a man shall have worked in all ranks of a given branch of the service, or even in all branches of a given department. It does mean, however, that he shall have started at the lowest round of the ladder in some one branch and have learned some one department to perfection, and all departments in general. Railway companies vary widely in their classification of positions and the relative importance which they attach to the services of each department. It is not intended at this point to discuss the organization of railway operatives. A classification, so far as civil service methods are concerned, may be compared to a river and its tributaries, where the waters of all branches, if they are not evaporated, may reach the desired terminal. In short, it is a question of all being given an opportunity, and the survival of the fittest.

There are, apparently some difficult features in the general policy of promoting men according to their relative standing, from one department to another, or even from one branch to another of the same department. The skill and experience required in one may be totally different from that required in another, and again a man may show marked ability in one position, while in another he would prove most inefficient. However, if a man is industrious, bright and faithful in one position, he will maintain the same characteristics in another, and, as every practical man knows these qualities of character in an employe are more desirable than all others. A competitive civil service system if correctly applied, is a most advantageous solution of the question of advancement of employes, and does not interfere with a practical line of promotion. For example, if a vacancy occurs at the head of a given department, all employes ranking highest in the various branches are eligible to compete for the position. In deciding upon the successful candidate, two things should be taken into consideration: the previous standing and record of the competitors with the company, and the result of their competitive examination.

In all departments of the Canal & Claiborne Railroad Company employes are placed upon a basis of competition. Men are employed who have the best standing according to a broad competitive examination, and are placed in the lowest rank of any given branch of the service. Promotions in the various branches, so far as practicable, are made consecutively from one rank to another. The company fills every position from among its own employes, provided there is anyone in the service competent to take the place. To illustrate; if the position of chief dispatcher were vacant, all starters employed by the company would be eligible to compete for the position. The chief dispatcher prepares all schedules, knows the exact position of every car on the road and the crew that is operating it. Now, if, upon competitive examination, it was found that no starter employed by the company was able to prepare a thoroughly practical, satisfactory and economical schedule, then no one in the direct line of promotion would be given the position. In this case another examination would be held, in which the employes of all departments would be eligible, together with the employes of other companies or outside persons. In this way, merit alone is recognized as a basis for advancement, and also the highest standard of efficiency is maintained in the various positions. So far as practicable, the same regulations apply to the transportation department, the maintenance department and the accounting department. In the transportation department, in the employment of motormen and conductors, when an applicant presents himself, if he is worthy of consideration after a preliminary conversation and inspection, he is given application and recommendation blanks. To be eligible for appointment as motorman or conductor, the applicant must be between the ages of twenty-five and forty; for the position of motorman he must weigh at least 160 lbs., and not exceed 210 lbs., and must be at least 5 ft. 8 ins. in height, he must have had at least one year's experience in the position he seeks, and should be recommended to the service by at least three officers of the company, including foremen, inspectors and starters, and also by at least seven motormen and conductors, who are already in the service. He then obtains the company's physician's certificate with regard to his physical condition. If his certificate, application and recommendations fill the requirements and are apparently satisfactory, they are then given to an inspector, who personally investigates his previous record among the employes with whom he has worked, and also among outside persons who know the applicant. If the inspector's report of investigation is satisfactory, the applicant is placed on the lines of the company with motormen and conductors who have the best standing in the service. He rides with these men until he is familiar with the special features of the lines of the company. He is then given the competitive examination. This is intended to be extremely practical, and consists of two parts: First. The applicant takes charge of a car with an inspector, who estimates the quality of his work for one trip over each line of the road. Second. He answers a list of questions covering the various things connected with this department of railway service. Finally, the applicant presents himself at the office of the general manager, where he is questioned in regard to all orders and instructions previously issued by the company, and his understanding of the conditions under which he will be expected to work.

Based upon the above, applicants having the highest standing are given the positions as extra motormen and conductors as fast as vacancies occur. If inexperienced men are employed at all in the service, they are taken on as conductors and kept in this position for at least six months, and for three months they work without pay. After this work as conductors they break in as motormen, with motormen already in the service who have the highest standing. After six months' service of this kind, they are given their examination and are placed on the lines of the company as extra motormen. To determine the relative standing of employes a system of marking has been adopted, which takes into account, first, the general quality of a man's work, according to the judgment of the foreman in charge; second, the value of the special acts in his service as reported by foreman, and marked in the record of the employe according to a fixed scale kept in the main office. To illus-

trate; in the department of transportation, for motormen and conductors, blanks are prepared which contain the name and number of every motorman and conductor in the service. At the head of these blanks there is a personal letter addressed to the general manager which is as follows: "Dear Sir:—According to my best judgment, the quality of service rendered by each employe coming under my observation in my department of the service, being fairly and honestly estimated for to-day is as follows:" Opposite the name of the motorman or conductor there is a blank space left for the mark of the foreman. Each foreman, inspector and starter has one of these blanks, and marks after the conductor's or motorman's name the quality of his work for the day, and sends the blank to the main office the next morning. He marks "v. e." for very excellent, "e" for excellent, "g" for good, "f" for fair, "p" for poor and "v. p." for very poor. In the main office these marks are reduced to an arithmetical basis and placed in the record of the employes. In determining the marks to be placed in the record, the marks of all foremen, inspectors and starters for a given man are added and the mean taken, which is considered the final mark. In this way the average judgment of perhaps ten different foremen in regard to an employe's work is obtained.

The marking of the special acts of an employe is on a more definite basis, and has no connection with the judgment of the foremen, inspectors and starters. They simply report the acts. Based upon bulletins, instructions or orders issued, and also upon experience in good railway practice, two lists of acts of employes are made, one delineating all the desirable or commendable features of the service of an employe; the other all the undesirable or intolerable features. For each of the acts in the commendable list, a certain number of points of merit are always given. Similarly for each of the acts in the uncommendable or intolerable list, a certain number of points of demerit are given. To illustrate more thoroughly; a few of the acts mentioned in the merit and demerit list may be given. In the merit list for motormen we have: skillfully avoiding accidents, assistance on minor road repairs, suggestions as to best speed of cars, helping to clear blockades, assistance rendered on special occasions, obtaining names in accident cases, etc. In the demerit list for motormen we have: running with hands off of brake and controller, looking around while car is in motion, not running on schedule time, feeding car too fast, untidy condition of dress, accidents to persons (serious, medium, slight injury), accidents to cars (serious, medium, slight injury), accidents to vehicles (serious, medium, slight injury), etc.

In the merit list for conductors we have: complete and perfect accident reports, reports as to where the company is gaining or losing traffic, reports as to what passengers say, kindness to aged and infirm persons, assistance rendered on special occasions, obtaining names of witnesses in accident cases, etc. In the demerit list for conductors we have: incomplete accident reports, insufficient number of names in accident cases, no change, not announcing route, streets and transfer points, leaning against door conversing with passengers inside, short register, bunching fares, ringing up fares when officer boards car, register not turned, shorts and overs, untidy condition of dress, etc.

The marking for general daily reports, together with reports of special acts, is kept in a record book, which allows four pages to each employe, each of the pages being numbered to correspond with the employe's badge number. The first two pages of each employe's record are made up in blank form, allowing space for each day of the month, together with each month of the year. The next two pages are plain ruled, and are used for explanations of each mark given. The margin of the first page is divided into blank form, giving the information regarding an employe, which is usually covered by headings placed in application blanks. Each month the points of merit and demerit are balanced. If an employe's record falls below zero, he is discharged. The estimation of the value of a man's services according to the above method, is based upon two foundation principles, one being a check upon the other. Every officer of the company has his own ideal, and, due to the fact that every human being sees the world from a different standpoint from every other human being, the chances are that an employe's work is estimated upon by the thoroughly experienced railway operatives, the average judgment of these men should be correct. Acting upon this principle, favoritism among officers is almost completely eliminated. Some men might be favorites with two or three officers, due to outside circumstances, but this would never extend to the whole ten, or even five. A car operative's life is not filled with opportunities to render brilliant services in behalf of the company, and for this reason some method of estimating his work must be adopted which will give credit for every day's efficient, satisfactory conduct. The method employed has proven by experience to be simple, just and effective.

The second principle used in the estimation of the quality of the service is embodied in the fact that a more just and unbiased decision can be reached in regard to the merit or demerit of an act, if judgment has already been passed on an exactly similar case. Now, by the system of marking mentioned, a list of all possible cases is prepared, and judgment passed upon them, by the general officers of the company, the relative number of points of merit and demerit being fixed. Now, when an act occurs, it only remains to locate it in the list to pass judgment. Hasty or snap judgment passed in a fit of anger on an employe's offense usually results in the greatest injustice to the employe. The reaction among employes is such as to practically destroy their confidence in the company, and always proves detrimental to the best interests of the road. Promotions among motormen and conductor are always made according to their standing as determined by their records without examination. The "extra" motorman or conductor having the best record is promoted to a "swing" run. Similarly, the "swing" men to "half-and-half" and the "half-and-half" men to "straight-day" runs. "Straight-day" motormen and conductors are promoted to the positions of inspectors, starters and transfer agents on their records alone. No account whatever is taken of the relative date at which the employe entered the service. As mentioned before, the same general methods are employed in all departments, but owing to the fact that the transportation department is the most important of all, the details of the civil service system are carried out most thoroughly in this connection. To insure perfect accuracy and fairness each employe is invited to examine his own record or that of any other employe at any time. He is also at liberty to inspect the scale of marking by which the records are adjusted.

It is evident that a system of bookkeeping resulting from the methods as described would be more expensive to maintain than other forms of discipline which have been generally employed. It has been found, however, that the extra expense attached to this system is trifling in comparison with the results obtained. The larger a street railway the more thoroughly applicable are civil service methods. This comes from the fact that, on small roads the general officers of the company come more in contact with the employes, thus being able to judge personally of the quality of their service, regardless of records kept, and too on small roads the same employe may fill several positions in comparison with a thoroughly classified organization which must be maintained in large street railway systems. Regarding the general results of a thoroughly enforced competitive system, it may be stated that there is as much difference in the quality of work rendered by men engaged by a road operated on a competitive basis of promotion, and a road on which promotion is made according to the position of a man's name in the list, as there is between two railway companies, one having a monopoly of the traffic and the other having a direct paralleling competitor. It has been found by experience in the operations of roads where employes work on a competitive basis, that they invariably do their best. They are gentlemanly in their treatment of passengers, neat and tidy in their dress and skillful and prompt in the discharge of their duties. They take great pride in the company's fine equipment, its large business, its management and principles of fair dealing. They never fail to praise the company and its service to patrons, and are only too glad to answer, in behalf of the company, any adverse criticism offered by patrons or the public. They feel from the start that their present and future positions in the railway business depend upon the quality of their work, and nothing else.

Legitimate competition is one of the most powerful incentives that can be employed. Men under these conditions are forced to make their best efforts. This is illustrated constantly in all professional, mercantile and manufacturing industries. The piece work system in vogue in New England factories is only one method of competition by which a man is paid according to the quality and quantity of his work. On a competitive basis the standard of excellence is constantly being raised. When a large number of men are engaged in the same kind of work, there are always a few who will accomplish most extraordinary results, and their work stands as a most effective object lesson to the others. If a man has anything in him, competition will bring it out; if he has no redeeming features,

then his services are not required. Another advantage of the civil service system is that it effectually debars all outside influence and eliminates the "bug bear" commonly designated among the men as a "pull." It also completely obliterates political interference which is the greatest bane to the efficient services of American street railways. In conclusion, it may be stated that this system is not urged as a panacea for the ills of railway management, but is merely offered as a suggestion, with the hope that it may be of some slight assistance in improving the successful methods which have always been employed.

The Best Method of Settling Damage Cases, and the Prevention of Accidents by the Use of Fenders or Otherwise

By Willard J. Hield

It is hard to handle, in a short paper, this most difficult subject which is to day perplexing the officials of all large street railway systems. However, as the study of these questions is made imperative by reason of their serious importance, I venture to offer a few ideas which I trust may prove of some interest, if not of value. Like all other professions, the law has in late years given rise to many specialists, among whom the personal injury lawyer is most prominent to the street railway manager. His untiring efforts have wrought such a change that the question of settling damage cases to-day is vastly different from what it was a few years ago. The general manager or superintendent can no longer personally adjust the claims against his road, but must employ men for that particular purpose. It is now necessary for him to have a claim department, the system of which should be perfect in detail and work in true harmony with his operating department, both for the prevention of accidents and the settling or fighting of damage cases.

The secret of success in handling damage cases, lies, no doubt, in their being properly looked after from the start, i. e., from the time they are first reported. How to do this varies as do the different cases, but no case should ever be handled by any one but an honest, careful and experienced claim agent. For such work men must be naturally qualified; they should ever have the interests of their road at heart and yet not be blinded by too great a prejudice in its favor; they should have sound, shrewd judgment and be painstaking and careful of detail to the highest degree. Like the true physician, they should be of a happy, calm temperament, and also like him, should ever be ready to answer a call. The successful claim agent should have the faculty of handling all sorts of people without friction. His keen perception should reveal to him the nature of each case, but he should never betray anxiety for settlement. Every claim department should have a good system for securing reports of accidents, for obtaining evidence, and for keeping such files and records as may be necessary for its work.

The only accidents which demand serious consideration are those in which personal injury is involved. These may be divided into the three following classes:

First. Those in which there is an undisputed liability and which, as a rule, should be settled as soon after their occurrence as possible.

Second. Those in which there is a doubtful liability and which, generally, should be settled after careful investigation.

Third. Those in which there is clearly no liability and which should therefore never be settled.

Frequently cases may prove exceptions to these rules, but in handling them under such a classification or any other, the following suggestions would seem to be of importance:

First. It is of great value in every case to acquire a knowledge of it as early in its history as possible. Procrastination is ever dangerous and the claim agent should have for his motto,—"Time is the essence of success."

Second. Evidence should be carefully secured in every case soon after the accident. Too much can never be reported to the department, and what may seem of little importance at the time of the accident, may prove most valuable in preparing the case for trial.

Third. In nearly all unsettled cases (particularly in serious ones), an examination by one or more surgeons in behalf of the company is desirable.

Fourth. Assistance and kindly tender of services, immediately after a serious accident, are more in place than advances for settlement.

Fifth. Admission of the company's negligence is seldom necessary, but the true rights of the claimant should not be denied; as by antagonizing him all chances of settlement may be lost.

Sixth. Whenever possible, a sworn statement should be secured from the claimant, giving his history of the accident and stating as nearly as possible the damage done. Such an affidavit, carefully and truthfully drawn and signed before witnesses—who should also attest it—may often prove most valuable either in settling or fighting a case. By it the claims of the interested party are clearly defined and limited, so that any subsequent intention to change them may be checked.

Seventh. In every case the claim agent should be fair, but firm. Too cheap a settlement is not the best settlement, but one too expensive is quite as bad, and perhaps worse. However, the claim agent can generally keep the claimant good natured and insist upon his acknowledging that the settlement is a fair one at the time it is made, and thus prevent his feeling or talking ugly about it later.

Eighth. A full release of all claims should be taken from the claimant, and its contents explained to him fully. This is of great importance, as the validity of releases is often disputed, and it is then quite necessary to show that they were properly taken. On this account, it is best to explain the release to the claimant before witnesses (who should also attest it) or to make him acknowledge later before them that he executed it of his own free will, understanding its nature.

From these suggestions one may deduce that the method best adapted for the handling and settling of damage cases is to be prompt, thorough and careful, with a liberal use of sound common sense. Whether a case should be speedily settled, or not settled at all, is a matter which must be decided from the peculiar circumstances which it presents, and not by any fixed rule. As a general thing, however, it is well to settle all cases where the injured parties are inclined to be fair, according to the merit each case contains, and fight all cases in which the claimants are very unreasonable, or where fraud is apparent. This rule carried out with the right spirit will prove a valuable policy for any road. If a case be settled, let it be done with due consideration of justice, and if it be fought, let every effort be made to fight it in the fairest and most efficient way possible.

It is not usually desirable that the claim agent should make offers of settlement, but rather it is advisable for him to draw his man out and get him to state definitely, if possible, what sum he really thinks he should be paid. Generally, such a sum can be considerably cut down no matter what the case, but if it is not an unfair amount, in consideration of the injury, it should be paid. Seldom pay more to a lawyer than to the injured party himself and do not settle a case simply because suit is threatened or commenced. Never settle out from under an attorney who has been professional and courteous in his relations to the road, yet when an unprincipled damage lawyer is interested in a case, do not hesitate to disregard him in settling it. When a good one to fight, the case should not be settled simply because it will cost less. It is ever well to remember, both that victories in court are a great benefit and that defeats are a great loss.

While as a strict matter of law it may not be correct, yet it is always well to give some consideration, when settling a case, to the circumstances of the injured party and allowing such personal interest to enter into the transaction as will not be inconsistent with good business. As a general thing, the claim agent should listen with apparent indifference to the claims of such persons as Jewish peddlers, loud talking and bulldozing men, sharp tongued women and all others whose claims have either the appearance of fraud or unreasonableness; with apparent interest and sympathy to those other few cases which seem to merit it.

The gist of the foregoing may be expressed in these few words: have good claim agents of sound judgment, who will not settle cases by arbitrary rules, but who will rather consider them each in its peculiar details, weighing well the seriousness of the injury, the manner of the accident and hence the liability involved, as well as the circumstances of the claimant.

The old saying that "An ounce of prevention is worth a pound of cure" was never better applied than to the accident features of a modern street railway system. The rapid transit now in vogue upon the busy thoroughfares of our cities, whether by means of the trolley or the cable, has greatly increased the number of street railway accidents, and hence has caused the question "How to avoid them?" to be of very serious interest.

For this purpose the following points seem to be of particular interest:

1. It is very important for the prevention of accidents, as before stated, that the operating and claim departments work in perfect harmony and unison with each other to this end.

2. The employing of none but good men is most essential, and having employed good men, it is quite important to keep them good in the fullest sense of the term.

3. Carefully drawn, explicit rules for operating cars, made with due regard to the various local conditions should be rigidly enforced and intelligently observed.

4. Speed on various lines should be regulated according to the chances of accident presented.

5. Every car should be equipped with the best controlling apparatus, gong and headlight, and also be provided with such devices for the prevention of accidents as may seem practical.

By this last statement several good devices for the prevention of accidents are rather indefinitely referred to, among which the fender and the safety gate should be placed at the head. Experience has shown that the fender is seldom a nuisance and is frequently of great value. A simple type will be found to be very practical which, while it does not insure against injury, yet very often prevents serious results. The dropping or lowering of the fender is seldom of any benefit, as motormen are generally too much occupied in stopping their cars when a collision is imminent to pay attention to the fender. In many cases where the speed of cars has been reduced from a fast to a slow rate the fender will pick up with no harm resulting to persons who without it would surely go under the car. Where the collision occurs while the car is under great speed, serious injury is not unlikely, but even in these cases loss of life and limb may frequently be prevented and money saved in the long run.

The safety gate, with which all motor cars in Minneapolis and St. Paul are equipped, and which was not generally approved upon its introduction but a few seasons ago, has demonstrated its great value and practicability by almost annihilating those accidents which occur through boarding or alighting from cars. The danger of these accidents increases with the number of passengers carried and on nearly every road they cause a large part of the injury and damage expense. They present to the fakir the best opportunity for making a case, and always give the jury a good chance to give the plaintiff the benefit of a doubt. The safety gate is practical for any city. In fact, we have seen its best use when our road was earning over three times its ordinary receipts. With it the conductor has but one part of his car to watch while giving the starting bell, and in case there is reason for passing persons at crossings, there is no danger from their trying to board the moving car. It also affords protection to people standing on the rear platform in case of a car rounding a curve at high speed, or on other occasions, when a passenger through his own condition or carelessness, or the operation of the car, is liable to fall off.

As the gate is operated by the motorman it should never be opened until the car is at a standstill, and should always be closed just before the power is applied for starting. After the public becomes accustomed to the safety gate, its operation demands no change of running time from that used before its introduction. The most timid, whether old or young, will walk without fear to the gate while the car is stopping and thus take but little time to alight. The gate is also of great service in handling large crowds at the parks where people seem to lose their common sense, as well as all ideas of propriety, and try to board and hang on to cars regardless of the danger involved. In such instances the value of but one entrance to the car is quite obvious, as at any moment the crowd may be checked by the closing of the gate and the car started.

The value of both the fender and safety gate can best be understood by closely watching their use. Both are eminently useful and practical. Both have also a good moral and instructive influence; they caution both the public and the trainmen against accident, and also cause the community to realize that a soulless corporation has some regard for life and property and sincerely desires to avert accident to them. They also give to the trainmen an assurance in operating the cars, which is of itself of considerable benefit.

Screens for the side of cars (when the trolley posts are between the trucks), sand boxes always filled with sand, and many other devices are also of considerable importance, and tend, each in its way, to reduce the number of accidents to the minimum. It is not possible, however, to operate cars entirely without accidents, and in studying the problem we should not look for perfect results.

The above presents roughly a few ideas suggested by long experience after trying nearly all the remedies known, and gives one the firm opinion that it is essential, so far as possible, to have the best equipment, including practical safety devices and the best men obtainable for operating the cars and for the claim and other departments, governed and aided by the best rules and supported by the best policy.

Report of the Committee on a Standard System of Accounts

NIAGARA FALLS, N. Y., Oct. 21, 1897.

To the President and Members of the Street Railway Accountants' Association of America:

GENTLEMEN—At the organization meeting of your association held in Cleveland, Mar. 23 and 24, 1897, a resolution was adopted appointing a committee to consider the question of a "Standard System of Street Railway Accounting," covering the classification of operating expenses, accounts, classification of construction and equipment accounts, and form of annual report. The character and scope of the work assigned to this committee, as understood by it, is expressed in a circular letter mailed on June 15, 1897, to 717 street railway companies of the United States, Canada and Mexico, asking for copies of their blanks and forms and for suggestions as to classification.

The following gentlemen responded to the circular letter, forwarding blanks, forms, etc., which were of valued assistance, and materially aided the committee in the work of preparing its report:

H. C. McJilton, auditor Baltimore Traction Company, Baltimore, Md.

Dana Stevens, auditor The Belt Railway Company, Washington, D. C.

S. A. Frazier, secretary and treasurer Centralia & Central City Street Railway Company, Centralia, Ill.

Frank R. Greene, secretary Chicago City Railway Company, 2020 State Street, Chicago, Ill.

H. P. Bradford, general manager The Cincinnati Inclined Plane Railway Company, Cincinnati, O.

P. V. Burington, secretary and auditor The Columbus Street Railway Company, Columbus, O.

E. D. Hibbs, auditor Consolidated Traction Company, Jersey City, N. J.

C. Wuestenfeld, manager Elgin City Railway Company, Elgin, Ill.

E. S. Doud, secretary Lehigh Traction Company, Hazelton, Pa.

F. E. Smith, auditor Lynn & Boston Railroad Company, Lynn, Mass.

Edward Daniell, secretary, treasurer and superintendent Menominee Electric Light, Railway & Power Company, Menominee, Mich.

W. G. Ross, comptroller Montreal Street Railway Company, Montreal, Can.

John Mahoney, vice-president and general manager People's Railway Company, St. Louis, Mo.

Robert Lehman, secretary and treasurer St. Louis & Suburban Railway Company, St. Louis, Mo.

W. B. Brockway, auditor Toledo, Bowling Green & Tremont Railway Company, Toledo, O.

H. L. Wilson, auditor West End Street Railway Company, Boston, Mass.

Geo. S. Rolins, auditor St. Joseph Railway, Light, Heat & Power Company, St. Joseph, Mo.

Proper acknowledgement was made to each gentleman who responded, but we desire to take advantage of this opportunity to again thank those gentlemen for the interest manifested and the co-operation extended.

In this connection, we desire to express our thanks to the *Street Railway Review* and the STREET RAILWAY JOURNAL for their kind offers to do everything in their power to help the committee in its work and promote the success of the Accountants' Association. Both papers rendered the committee and the association valuable assistance in publishing the circular letter and commenting on same in their editorial columns. We are also indebted to Edward E. Higgins, editor of the STREET RAILWAY JOURNAL, for the valuable suggestions contained in his editorial, which appeared in the August number of the STREET RAILWAY JOURNAL, on "A Standard Distribution of Street Railway Receipts and Expenses."

The committee also desire to thank the representatives of the

State Boards of Railroad Commissioners of New York and Massachusetts, for their courtesy in responding to requests for the classification of operating expenses and form of annual report, as prescribed by each state board respectively.

In taking up the subject of a "Standard System of Street Railway Accounting," there are many points that present themselves for consideration. Without intending to go into an exhaustive discussion of them, your committee deemed it wise to bring to your attention some of these points, as they have an important bearing on the subject.

The adoption and use of a standard system of accounts for street railways is entirely practical, notwithstanding the objections that may be urged to the contrary. The argument may be advanced that there would be serious objections to changing present methods and systems on the part of the accounting officer, manager, officers, directors, or stockholders of some roads, for various reasons; objections may be raised on the ground that special ruled account books, forms of reports, etc., would have to be discarded, because they would be useless with a change of system; it may be urged by the street railways of Massachusetts and New York, that they are obliged to keep their books and accounts as prescribed by their respective State Boards of Railroad Commissioners, and for that reason they would object to using any other system. In answer to these or any other objections that may be raised, your committee submits that they should not be allowed to stand in the way of adopting a standard system. If the difficulties referred to above prove to be insurmountable, it should be remembered that a standard system could be *conformed to*, without changing the methods and system now in use on any one road. Unquestionably it would be far better for all to follow, from beginning to end, any standard system that would be adopted. As far as our Massachusetts and New York friends are concerned, your committee suggests that this association should confer with the State Boards of Railroad Commissioners of Massachusetts and New York and secure their co-operation in the framing, adoption and use of a standard system. We firmly believe that this can be done. What has been accomplished in the steam railroad field, can be accomplished in the street railway field. We appeal to you to see that it *is* accomplished. Your committee desires to impress upon the members of this association, the value and importance of the adoption and use of a standard system. We do not consider it necessary to advance any arguments in support of this proposition, as it is assumed that this association is unanimously in favor of it. We most respectfully urge that the proper action be taken by this association, now in convention assembled, to successfully overcome all difficulties, so that the desired results may be accomplished *now*.

With that end in view we would recommend that a permanent committee be appointed for the promotion of the adoption and use of a standard system. In order to bring this about we would suggest that the report of this committee be placed in the hands of the permanent committee with full power to make such additions or alterations as it may deem proper; with authority to confer with the proper officials of any state prescribing a standard system of keeping street railway accounts, and with street railway companies, whether members of this association or not; and to submit a printed report at the next annual meeting of this association, with instructions to have a printed copy sent to each member of this association at least sixty days before the annual meeting takes place.

There are many other questions concerning the adoption and use of a standard system that could be discussed at length; for example, the method of making charges in operating expenses; the pro-rating monthly of the yearly expense of water, taxes, insurance, interest, or any other charge that it would be desirable to pro-rate; the extent that detailed and statistical information should be furnished, so that the management of the road will profit by such information; the difficulty of putting into practical operation, any standard system that may be adopted, because of the dependent position occupied by the accountant, with reference to relying upon subordinates and heads of departments for information as to the basis of charges; the extent to which conditions of operation affect results and comparisons, and the necessity of taking them into consideration; the proper unit as a basis to figure from, whether per car, per car mile, per passenger, or per mile of single track operated; the care that should be exercised in making charges to construction and equipment accounts; the necessity of charging off annually a certain amount for depreciation; and the creation of a sinking fund or surplus account, that will really be what it means, with the amounts credited invested in a safe, interest earning investment. These, and many other questions could be gone into here, but your committee has thought it best not to do so, further than presenting them to your notice. It was supposed that the exhibits accompanying this report would furnish ample matter for discussion, and that all such questions would be taken care of, in discussing the exhibits.

Appreciating the magnitude and importance, as well as the delicacy of the work undertaken by your committee, as outlined in its circular letter, realizing the difference of opinion and practice that prevails among street railway accountants, as to the methods and systems used, as evidenced by the blanks and forms sent to your committee, we invite careful consideration, full discussion and the most severe criticism of the following report.

Very respectfully,

C. N. Duffy,
W. F. Ham,
J. F. Calderwood,
} Committee.

The following classifications are prepared to meet the requirements of a street railway constructed and operated as an overhead electric road. They could be easily arranged and adapted for use on an electric railway using an underground or third rail system, and could also be easily changed to meet the requirements of a cable railway or one operated by any other power. All that would be necessary to make the classifications practical for use on any other than a street railway constructed as an overhead electric road would be to change the technical names of the appliances used on any one of the other systems mentioned.

CLASSIFICATION OF OPERATING EXPENSE ACCOUNTS

"A" Maintenance of way and structures

1. Repairs and renewals of track and roadway construction.
2. " " " " electrical track construction.
3. " " " " buildings and improvements.

"B" Maintenance of equipment

4. Repairs and renewals of steam plant.
5. " " " " electrical plant.
6. " " " " cars.
7. " " " " electrical car equipment.
8. Renewals of horse and vehicle equipment.
9. Repairs and renewals of miscellaneous equipment.
10. " " " " shop tools and machinery.

"C" Conducting transportation

OPERATION OF POWER PLANT

11. Power plant wages and superintendence.
12. Fuel for power.
13. Water for power.
14. Lubricants and waste for power plant.
15. Miscellaneous supplies and expenses of power plant.
16. Hired power.

(Note.—Income from sale of power is to be deducted from cost of operating power plant.)

CAR SERVICE

17. Superintendence of transportation.
18. Wages of conductors.
19. " " motormen.
20. " " other car service employes.
21. " " car house employes.
22. Car and motor supplies.
23. Miscellaneous transportation expenses.
24. Cleaning, watering and sanding track.
25. Removal of snow and ice.

"D" General Expenses

26. Salaries of general officers.
27. Salaries of clerks.
28. Printing and stationery.
29. Miscellaneous expenses of office.
30. General stores expenses.
31. General stable expenses.
32. Advertising and expense of park properties.
33. Miscellaneous general expenses.
34. Legal expenses.
35. Injuries and damages.
36. Track rentals.
37. Rental of land and buildings.
38. Insurance.

CLASSIFICATION OF CONSTRUCTION AND EQUIPMENT ACCOUNTS

1. Organization.
2. Engineering and superintendence.
2. Right of way.
4. Track and roadway construction.
5. Electrical track construction.
6. Real estate used in operation of road.
7. Investment real estate and improvements.
8. Buildings and improvements used in operation of road.
9. Power plant equipment.
10. Shop tools and machinery.
11. Cars.
12. Electrical car equipment.
13. Miscellaneous equipment.
14. Interest and discount.
15. Miscellaneous

FORM OF ANNUAL REPORT SHOWING INCOME ACCOUNT

Gross earnings from operation	189 .	189 .	Inc.	Dec.
Passenger receipts.				
Chartered cars.				
Freight.				
Mail				
Express				
Total earnings from operation				
Less operating expenses				
Net earnings from operation				
Income from other sources				
Advertising				
Track rentals				
Rent of land and buildings				
Interest and dividends on securities owned				
Interest on Deposits				
Miscellaneous Income				
Gross income from all sources				
Deductions from income				
Taxes				
Interest on funded debt				
Interest on floating debt.				
Rentals of leased lines				
Net income from all sources				
Deductions from net income				
Preferred stock dividends				
Common stock dividends				
Betterments and additions charged to const. and equip. acc				
Sinking fund				
Surplus for year				
(If deficit be shown, substitute word Deficit for Surplus).				
Surplus for year ending				
Surplus carried forward from January 1, as per balance sheet				
Surplus December 31, as per general balance sheet				

In attempting to establish a uniform and standard system of street railway accounting, your committee has constantly kept in mind that it was trying to establish a system which would be applicable not only to the large roads, but to the small ones as well; to the road that runs a thousand cars as well as to the road that runs a half dozen.

This requires an elastic system of accounting, a system which rests on a common foundation, with details so arranged that they can be made to meet the varying requirements of any and all roads. Most important of all, we must have a foundation upon which all can work to advantage, which will not require more than the customary amount of bookkeeping and accounting, and which will contain the general features which the street railway manager has been accustomed to look for.

It has been our aim to make the classifications so distinct and so clearly defined that there can be no mistake and that the same constituent elements will at all times be embraced in these different classifications.

The fundamental principle underlying the efforts of your committee was found in the determination to agree upon a minimum number of accounts consistent with furnishing the necessary information to place the management at all times in touch with not only the operation of their particular system, but with that of any other system.

Classification of Operating Expense Accounts.—We have divided the operating expenses into four general divisions; A. Maintenance of Way and Structures. B. Maintenance of Equipment. C. Conducting Transportation. D. General Expenses. The first two divisions have a direct effect on the physical condition of the property; the last two include only such items as are strictly operating expenses, and have no direct effect upon the physical condition of the property.

With reference to the first two divisions covering maintenance accounts, the important consideration seemed to be whether or not it was desirable and practicable to make a separation between repairs and renewals. In the operation of electric street railways, offering as they do many opportunities for adopting a variety of electrical and mechanical devices with variance in the economy of maintenance, this separation would seem of value and importance, especially so when we consider the repairs and renewals of the larger and more expensive units of our large apparatus, such as generators, etc. As an abstract proposition this looked very feasible, and recognizing the many advantages of such a separation, the committee attempted to work out a plan which would embody this separation. A closer and more careful analysis of the component parts of each of these two divisions led the committee to believe that in very many cases such a separation would be nothing more than a distinction without a difference. While it might be possible to make such a separation in the larger units, it did not seem to be practicable to make this separation throughout without causing a great deal of confusion and an endless amount of work in arriving at results which in the end would be both unsatisfactory and incorrect.

As it is essential to have information as to the amounts expended in renewals, the committee suggests and recommends that the most feasible way to present this information would be in the form of an analysis of the maintenance accounts showing the items properly chargeable to renewals, distinct from repairs.

As an illustration of the point: assume that the account of repairs and renewals of track and roadway construction amounts to $10,000 for a given period, an explanation would be made showing that of this amount $5000 was expended in constructing a certain length of track and the balance consists of ordinary repairs. While the separation shown in this case is comparatively easy, the task becomes more difficult and results more unsatisfactory in attempting to make such a separation with reference to electrical car equipment.

Coming to a consideration of the accounts under the general heading of Conducting Transportation, we have grouped these into, first, Operation of Power Plant, and second, Car Service. In the former the only feature which requires special mention is the deduction of income from sale of power from the cost of operation of power plant. This is probably a radical change from the present method, as this item is usually shown under miscellaneous income.

As the cost of producing any power that may be sold has been included in operating expenses, and as all amounts received from sale of power may be assumed to represent approximately the actual cost of the production of that power, it seems proper that it should be shown as a deduction from the cost of operating the power plant. To show the logic of this proposition an illustration may be made of two electric roads, one of which has no power plant and buys its power outright from another company. In this case the first company would have no expense of operation of power plant other than hired power; the cost of operation of the power plant of the second company would be increased by the amount of power which it had furnished to the first company, throwing it out of all proportion of what would be produced for the operation of its own cars; and the actual cost of producing power for the second company can only be shown by deducting from the cost of operating the power plant of the second company the amount received for power furnished the first company. To make this even more clear, suppose in the above instance that each company operates 100 cars, making a total of 200 cars; the cost of power for operating these 200 cars is, say, $100,000, of which $50,000 is shown as hired power on the books of the first company and $100,000 less the deduction of $50,000 for sale of power, leaving $50,000 on the books of the second company.

With regard to the accounts Cleaning, Watering and Sanding Track and Removal of Snow and Ice, the committee has recognized the wide diversity of opinion and practice in classifying these accounts. The point at issue is whether they should be treated as

maintenance charges or as transportation charges. In deciding this question the committee has followed the general principle that all maintenance charges have a direct bearing upon the physical condition of the property, while transportation charges do not. The physical condition of the property is not in any way benefited by either of these accounts, and therefore they properly belong to transportation.

Coming now to a consideration of the accounts under General Expenses, the committee has thought it best to provide the account Printing and Stationery, and to include in that one account the cost of all printing and stationery of every description, except the cost of printing transfers and tickets charged in Transportation; printing of law briefs, etc., charged in Legal Expenses; and the cost of printing posters, dodgers, handbills, etc., for advertising purposes charged in Advertising and Expense of Park Properties. With this arrangement all printing and stationery except the above items, would be charged in a general printing and stationery account. Your committee deemed it preferable to do this rather than distribute the cost of printing and stationery over a number of other accounts, the result of which would be that the total cost of stationery and printing would be lost sight of. Furthermore, the amount expended in printing and stationery would not justify the expense of accounting in order to distribute it among the various accounts, although the amount in the aggregate is an important item. Should the question be asked why the cost of printing transfers and tickets has been charged to conducting transportation and the cost of conductors' trip sheets, envelopes, etc., left in General Expenses, the reply is that the former have no connection with accounting, and the latter have.

The committee has thought it best to have the account General Stores Expenses to provide for such expenses in the case of roads that operate a general stores department. If such an account were not provided it would be difficult to charge such expenses to any other account.

The committee has also provided the account General Stable Expenses, for the reason that it was deemed advisable to have all general stable expenses in one account rather than to attempt to distribute such expenses among the various accounts benefited thereby. Such a distribution would be difficult and unsatisfactory, and besides, the total cost of general stable expense would be lost sight of. In the case of construction work causing an abnormal increase in this account, such charges as are proper should be taken out of this account and charged in construction accounts.

The committee has recognized the wide difference of opinion and practice in the matter of Injuries and Damages, with reference to placing it in Conducting Transportation, or in General Expenses. Many arguments can be advanced in support of the disposition of Injuries and Damages to either, and the committee has fully and carefully considered the question from all points of view. It has finally decided to place it in General Expenses for the reason that a large portion of the account is not properly chargeable to transportation. In the first place, the measure of damages assessed in many cases rests upon the prejudices and whims of juries, and their findings are beyond the control of the manager of the road and therefore should not be charged in transportation. Again, damage claims may be settled or judgments paid as the result of accidents occurring in which there is no connection with transportation. Again, it it appears to be both reasonable and consistent to put damages under the same general heading as Legal Expenses, where the latter unquestionably belongs, on account of the close relationship of one to the other.

With regard to Track Rentals, the committee has recognized that this is another account concerning which there is an equal difference of opinion and practice as to where it properly belongs. Some hold that it properly belongs to Conducting Transportation, others to Maintenance of Way, on the ground that track rentals are really an avoidance of maintenance charges, and others still to General Expenses. As a matter of fact the occupation and use of the tracks of one street railway company by another in cities is attended by varied conditions, and in arriving at the compensation to be paid, there are many questions that have to be taken into consideration. For example, the amount of revenue that the lessee will take away from the lessor by reason of operating its cars over the tracks of the lessor; the portion of the franchise taxes on a mileage basis that the lessee should bear; the interest on cost of construction and the cost of maintenance and renewals of not only the track and roadway construction, but the electrical track construction as well; the expense of cleaning, watering and sanding track and removing snow and ice, which should be borne proportionately by the lessee; and the hinderance to the lessor in the operation of its cars that may result by reason of conditions under which the cars of the lessee are operated. For these reasons as well as for others that might be advanced, your committee has determined to place the account in General Expenses.

In the above discussion, the committee has dwelt only upon such features as seem to require special mention. Appended to these remarks is a detailed classification of operating expense accounts intended to show clearly and beyond question the items to be charged to each account. Incidentally the committee calls attention to the fact that any money received from the sale of old material or scrap should be credited to the account to which the material was originally charged. The committee has worked under the disadvantage of prosecuting its work by correspondence and has been limited in time. For this reason it may be that improvements in phraseology and in expression will suggest themselves. We believe, however, that the classification of operating expenses as submitted contains the essential features required in a simple, concise and elastic system of street railway accounting, and that it can be adopted and used by all railroads, large or small, under all varying local conditions. If further separation and classification is desired by any or all companies to meet varying local conditions, it can be done without disturbing in the least the present classification, by the use of other accounts carried as sub-divisions of the prescribed accounts, or if still further itemization is desired each account may be carried in detail on separate distribution of expense books.

The committee feels that, under the circumstances, it has done satisfactory work, and earnestly hopes that the classifications suggested may be adopted as a standard with such modifications as may be deemed desirable.

SCHEDULE OF OPERATING EXPENSE ACCOUNTS

"A" Maintenance of Way and Structures

1. Repairs and Renewals of Track and Roadway Construction. This account embraces the cost of labor, materials, supplies, tools and expenses of repairs and renewals of track and roadway construction, including renewals of ties, renewals of rails, repairs and renewals of joints, repairs and renewals of special work, such as crossings, crossovers, curves, guard rails, frogs, switches, etc.; ballasting, repairs and renewals of paving, repairs and renewals of bridges, culverts and subways; repairs and renewals of crosswalks; wages of roadmasters, track foremen, laborers, watchmen and others employed in above work; cost of punching, drilling and cutting rails, except for track wiring. When track is taken up, the labor expended therefor should be charged to this account whether another track is laid to replace it or not. The cost of tracks in car houses is included in this account.

2. Repairs and Renewals of Electrical Track Construction. This account embraces the cost of labor, materials, supplies, tools and expenses of repairs and renewals of electrical track construction, including cost of taking up, resetting and painting poles; repairs and renewals of trolley, feed, guard and supplementary wires and track bonding, underground feeders and conduits.

The expense of taking up and relaying paving when necessitated by repairs and renewals to electrical track construction is chargeable to this account and not to account No. 1.

3. Repairs and Renewals of Buildings and Improvements. This account embraces the cost of labor, materials, supplies, tools, and expenses of repairs and renewals of buildings and improvements, including power houses, repair shops, blacksmith shops, machine shops, paint shops, carpenter shops, car houses, stables, office buildings, depots, stations, switch tenders' houses, store houses, sheds, coal bins; and improvements in connection with same, including drainage, water, gas and sewer pipes and stationary fixtures belonging thereto, heating and lighting apparatus and fixtures, other stationary fixtures, sidewalks, street paving on streets in front of and adjacent to buildings, fences, sheds, outhouses, etc. Repairs of pits in car houses and shops, and repairs and renewals to docks and wharves are to be charged to this account. Repairs to track in car houses and yards must be charged to account No. 1, and repairs to electrical track construction in car houses and yards must be charged to account No. 2.

This account includes the cost of labor and material used in replacing buildings, sheds, etc., that have been destroyed or injured by fire or otherwise become unfit for use. The replacing of a better or more expensive building or parts thereof should be charged to this account to the extent of the ledger value of the buildings or parts thereof rendered unfit for use, and the balance should be charged to construction account.

This account should not include repairs and renewals of buildings and improvements not used in connection with the operation of the road.

"B." Maintenance of Equipment.

4. Repairs and Renewals of Steam Plant. This account embraces the cost of labor, materials, supplies, tools and expenses of repairs and renewals of steam plant, including engines and engine parts, appliances and fixtures, belts, belt tighteners and fixtures, receivers, lubricators and oiling devices, shafting, clutches, cranes, hoists and other engine room appliances; boilers, boiler fittings and appliances; furnaces, economizers, stacks, mechanical draft machinery, pumps, feedwater heaters, purifiers, tanks, condensers, coal and ash conveying machinery and other boiler room appliances; piping and steam fitting, including valves, separators, water and sewer connections and water meters.

5. Repairs and Renewals of Electrical Plant. This account embraces the cost of labor, materials, tools, supplies and expenses of repairs and renewals of electrical plant, including generators and generator parts, switchboards, cables and feeder terminals and wiring in connection with same, storage batteries, transformers, boosters, rheostats, circuit breakers, ammeters and other electrical equipment.

6. Repairs and Renewals of Cars. This account embraces the cost of labor, materials, supplies, tools and expenses of repairs and renewals of car bodies, including roofs and bonnets, window and deck lights, platforms, sashes, bumpers, draw barsgates, steps and grab handles, painting, varnishing and lettering, curtains and curtain fixtures, car seats and covering for seats, stoves and stove fixtures, electric heaters, electroliers, headlights, stationary fare registers, gongs, bells, bell cord fixtures, brass fixtures and trimmings, signs and sign fixtures, sand boxes, track brushes and snow scrapers; trucks, including wheels, bases and oil boxes, truck frames and parts, including pedestals, springs, etc., brake shoes, brakes and brake appliances, fenders, pilots and life guards. This account includes the cost of new cars and trucks purchased to keep good the original number, less the value of old material or insurance received.

7. Repairs and Renewals of Electrical Car Equipment. This account embraces the cost of labor, material, supplies, tools and expenses of repairs and renewals of motors, including armatures and parts, fields and parts, commutators and parts, gears, gear cases, gear case brasses and supports, pinions, brasses, bearings and brush holders, controllers, controller resistances and parts, rheostats, lightning arresters cut-out boxes, wiring and connections for power, light and heat circuits, trolley wheels, forks, poles, bases and bushings.

This account should include the cost of shifting summer and winter equipment. Electrical car equipments purchased to make good the original number are to be charged to this account less the value of old material or insurance received.

8. Renewals of Horse and Vehicle Equipment. This account embraces the cost of renewals of horses, depreciation of horses, renewal of harness equipment, renewal of vehicle equipment of every description not operated by mechanical power. The feed, stable expense and shoeing of horses and repairs of harness and vehicle equipment is charged to General Stable Expenses.

9. Repairs and Renewals of Miscellaneous Equipment. This account embraces the cost of repairs and renewals of freight, mail, express and supply cars, water and sprinkling cars, sand cars, salt cars, snow plows, sweepers, scrapers and miscellaneous snow equipment.

10. Repairs and Renewals of Shop Tools and Machinery. This account embraces the cost of repairs and renewals of shop tools, machinery and appliances, including engines, boilers, shafting, motors, etc., coal, coke, lubricants and waste, and miscellaneous supplies and expenses of general repair shops, including superintendence.

"C." Conducting Transportation

11. Power Plant Wages and Superintendance. This account includes wages of all employes of power plant, except when employed on repairs or renewals.

12. Fuel for Power. This account includes cost of coal or oil used as fuel or other fuel delivered at power plant.

13. Water for Power. This account includes cost of water used for power plant purposes only.

14. Lubricants and Waste for Power Plant. This account embraces the cost of lubrication of power plant.

15. Miscellaneous Supplies and Expenses of Power Plant. This account embraces the cost of carbon, brushes, tools and other supplies and expenses of the power plant not otherwise provided for.

16. Hired Power. This account embraces cost of power furnished by other companies. Income from sale of power is to be deducted from the expense of operation of power plant.

17. Superintendence of Transportation. This account includes the wages of division superintendents and their assistants, aids, inspectors, road officers and others employed in superintending transportation.

18. Wages of Conductors.

19. Wages of Motormen.

20. Wages of other Car Service Employes. This account includes wages of starters, transfer agents, switch tenders, trail car couplers and other car service labor.

21. Wages of Car House Employes. This account includes wages of foremen, watchmen, car placers, shifters, etc., motor inspectors and cleaners, lamp and headlight tenders, car oilers, wipers, car cleaners, car stove firemen and other car house employes not employed on repairs. This account should include the cost of shifting cars from one point to another for the purpose of transportation. If, however, the cars are shifted for purposes of repair the cost of so doing should be charged to account No. 6 and No. 7.

22. Car and Motor Supplies. This account includes cost of supplies for car oiling, incandescent lamps, illuminating oil and supplies, supplies for car cleaning, water for car cleaning, fuel and supplies for car heating, bell and register cord, trolley rope, carbon brushes for motors, lubricant and waste for motors, tools and other supplies except for "Repairs."

23. Miscellaneous Transportation Expenses. This account includes services and expenses of special inspectors, printing transfers and tickets, cost of conductors' books, spears, punches, portable registers, tools for motormen, employes' badges and uniforms when paid for by the company; cost of getting derailed cars on track and removing obstructions and wreckage, and miscellaneous car house expenses not otherwise provided for.

24. Cleaning, Watering and Sanding Track. This account embraces labor, materials, supplies, tools and expenses of cleaning, watering, sprinkling and sanding track, including wages of curve cleaners and greasers, track brooms, curve grease, etc., expense of removing dirt from track, wages of men employed in operating water and sprinkling cars, and cost of water for same; cost of sand, including wages and expenses of hauling, drying and distributing same and of sanding track. This account does not include cost of sprinkling rendered necessary by repairs or construction of track or paving.

25. Removal of Snow and Ice. This account embraces labor, material, supplies, tools and expenses of removing snow and ice, including cost of salt delivered in car house or bins and wages of men engaged in salting track and in operating snow plows, sweepers, scrapers, etc.; cost of shoveling and removing snow and ice whether done by company or otherwise. This account does not include rattan for sweepers or other repairs of snow plows, sweepers, scrapers, etc., included in account No. 9.

"D." General Expenses

26. Salaries of General Officers. This account includes salaries of president, vice-president, general counsellor or solicitor, secretary, treasurer, auditor, general manager, assistant general manager, chief engineer, general superintendent, purchasing agent, together with all officers whose jurisdiction extends over the entire system.

27. Salaries of Clerks. This account includes salaries of paymasters, cashiers, receivers and all clerks in general office and clerks for heads of departments. It should include the salaries of clerks employed in handling and counting receipts, transfers and tickets whether employed in the general office or in other places.

28. Printing and Stationery. This account includes all printing, stationery and stationery supplies, except printing of transfers and tickets, chargeable to account No. 23; printing of briefs, etc., charged to account No. 34; and signs, posters and other advertising matter charged to account No. 32.

29. Miscellaneous Office Expenses. This account includes cost of repairs and renewals of office furniture and fixtures, office supplies and expenses, including coin bags, money wrappers, money tags, postage, cost of telegrams, newspapers, periodicals, towel service, wages of janitors, porters and messengers, and all other miscellaneous expenses of general office.

30. General Stores Expenses. This account embraces all salaries and expenses in connection with maintaining stores departments, including cost of the distribution of all material and supplies and collection of scrap material.

31. General Stable Expenses. This account includes feed, horseshoeing, labor and miscellaneous stable expenses, ordinary repairs of harness and vehicle equipment. Renewals and depreciation of horses and renewals of harness and vehicle equipment are charged to account No. 8.

32. Advertising and Expense of Park Properties. This account includes the cost of advertising, together with all expenses incurred in maintenance of parks, park properties, resorts, etc., and expense of all music and cost of entertainment provided by the company.

33. Miscellaneous General Expenses. This account includes cost of public telephone service, cost of operating private telephone system, subscriptions and donations, traveling expenses of general officers and others connected with general office; contingent expenses connected with general management, not otherwise provided for.

34. Legal Expenses. This account includes the salaries and expenses of solicitors, attorneys, their clerks and attendants and all expenses of their offices (when in the full employ of the company), such as law books, printing briefs, legal forms, testimony, etc., also fees and retainers paid, services of attorneys who are not regularly employed by the company, also fees and other expenses of arbitrators for settlements of disputed questions, cost of suits, special fees, notarial fees, expenses connected with taking depositions, and all legal and court expenses of every kind not otherwise provided for under the head of "Injuries and Damages."

35. Injuries aud Damages. This account includes all charges on account of persons killed or injured, such as gratuities and compensation paid injured or disabled persons, their creditors, heirs, relatives and attorneys, salaries and expenses of surgeons, fees and expenses of doctors, coroners, undertakers, witnesses and others (except lawyers' fees and court expenses) nursing, hospital attendance, medical and surgical supplies, also wages and expenses of others occupied in connection with the adjustment of claims. It also includes injury to property damaged and all charges in connection with the adjustment of such claims.

36. Track Rentals. This account includes rents paid for lease of track and terminals.

37. Rent of Land and Buildings. This account includes rents paid for land and buildings used in the operation of the road.

38. Insurance. This account includes cost of insurance, including fire, casuality, employers' liability, fidelity, profits and other insurance.

Deductions from Income

Taxes. This account includes all taxes on real and personal property used in the operation of road, franchise taxes, taxes upon gross earnings and capital stock, car licenses, wagon and vehicle licenses. Taxes upon property not used in the operation of road should not be included in this item, but should be deducted from income from other sources, or charged direct to profit and loss.

Interest. This account includes interest on funded debt and interest on floating debt.

Rentals of Leased Lines.

Rentals of Leased Lines

SCHEDULE OF CONSTRUCTION AND EQUIPMENT ACCOUNTS

1. Organization. This includes all expenses incurred in effecting organization, including legal expenses.

2. Engineering and Superintendence. This includes wages and expenses of engineers and draughtsmen, superintendents, etc., on preliminary and construction work.

3. Right of Way. This includes all expenses incurred in connection with the securing of or paying for right of way.

4. Track and Roadway Construction. This includes cost of track and roadway construction, including material, supplies, tools, expenses and labor, excavating, grading, ballasting, bridges and culverts, paving, ties, rails, fastenings complete, welded joints, special work, tools and appliances, miscellaneous track material, supplies and expenses; labor laying track, hauling and distributing material. The cost of tracks in car houses to be included in this account.

5. Electrical Track Construction. This includes cost of electrical track construction, including material, supplies, tools, expenses and labor; poles and pole fixtures, material for setting poles, paint for poles, wire, overhead and underground devices, tools and appliances; miscellaneous material, supplies and expenses, labor setting poles, painting poles, wiring track, putting up overhead line construction, hauling and distributing material. The cost of electrical track construction in car houses to be included in this account. The cost of underground conduits and feeders where underground wire construction is used is also to be included in this account.

6. Real Estate Used in Operation of Road.

7. Investment Real Estate and Improvements. This includes cost of land and buildings not used in operation of road.

8. Buildings and Improvements Used in Operation of Road. This includes cost of all buildings and improvements in connection with same, including excavations, foundations, drainage, water, gas and sewer pipes, and stationary fixtures belonging thereto, heating and lighting apparatus and fixtures; other stationary fixtures, side walks, street paving on streets in front of or adjacent to buildings, fences, sheds, outhouses, etc. The cost of tracks and electrical track construction in car houses is not chargeable in this account.

9. Power Plant Equipment. This includes cost of steam and electrical plant complete, exclusive of buildings, including machinery, foundations and installation.

10. Shop Tools and Machinery. This includes cost of shop tools and machinery for general repair shops, car houses, etc., including foundations and installation.

11. Cars. This includes cost of car bodies, trucks and car fixtures.

12. Electrical Car Equipment. This includes cost of motors and electrical car equipment complete.

13. Miscellaneous Equipment. This includes cost of water, sprinkling, sand, salt and supply cars, freight, mail and express cars, all other cars exclusive of those charged in account 11; cost of snow plows, sweepers and scrapers; cost of horse and vehicle equipment, including tools necessary in the use of miscellaneous equipment.

14. Interest and Discount. All interest and discount paid and received in connection with funds for construction should be charged or credited under this heading.

15. Miscellaneous. This includes miscellaneous expenses, office expenses, wages of clerks and all other expenses that would not be included in any of the other accounts enumerated above.

Application of Electricity to Railroads now Operated by Steam Power

BY N. H. HEFT

The New York, New Haven & Hartford Railroad Company owns and controls about 2800 miles of main line railroad track in New York, Massachusetts, Rhode Island and Connecticut, of which about 16 miles are operated by electricity on the third rail system and 14 miles on the overhead trolley system. The company also owns the entire capital stock of the Stamford Street Railroad Company and the Meriden Electric Railroad Company, the former operating about 10½ miles of track and the latter about 17½ miles on the overhead electric system. It is through my official connection with the Meriden Company that I am permitted to be present at the meetings of the American Street Railway Association, a privilege which I thoroughly appreciate.

Electric railroading on a large scale is but the development of street railway experience, and if the future brings success in the efforts now being made to use electricity for heavy work, it will be due, largely, to the courage and enterprise of those who have "blazed the path of progress" and forced the fighting by entering into competition with an industry which believed itself, ten years ago, absolutely secure in its position.

There is little for me to tell you of novelty in the work done by the New Haven Company in Meriden and Stamford. These are ordinary street railway systems, fairly well equipped, and we try to operate them to serve the public properly. Believing, as we do, that a good track is the foundation of a good system, we have thoroughly

reconstructed the track in both cities with heavy rails. In doing so, we have paid the most careful attention to the matter of return circuit, bonding the rails so thoroughly as to make them the path of smallest resistance back to the station. We have thus avoided, to a very large extent, trouble with electrolysis. Nothing is more certain to my mind than that carelessness about making a track return circuit is a most serious mistake, and that carelessness about testing and maintaining joint connections is another. I would rather spend $1000 or more in providing ample carrying capacity of rail bonds than to put the same amount of money into the overhead circuit, if, by doing the latter, I should neglect the former.

About three years ago, the New Haven Company found that various electric railways in its territory were gradually extending their operations into the field of interurban work, and that the company's passenger earnings were suffering accordingly. It was at once seen that by no ordinary methods of changing schedules or increasing speeds could this lost traffic be won back again, and, with characteristic knowledge and courage, President Clark and the New Haven directors determined to "steal the thunder" of its new competitors, and commenced a series of elaborate experiments in heavy electric railroading. It must be confessed that this decision was reached only after some misgivings. To the average railroad man, street railways have, until recently, seemed a pretty sort of toy, fit for apprentices in the art of transportation. Latterly, however, he has waked up to the fact that "the tail will wag the dog" unless some radical action is taken, particularly in suburban and short distance work, and, in the Eastern sections of the country anyway, railroad men have become modest enough to be willing to look with respect upon the great work which has been accomplished in street railroading.

The first line to be equipped by the New Haven Company was a purely summer road, operated for about four months in the year only, through a narrow peninsula running out from the main land on the Massachusetts Coast from Nantasket Junction to Pemberton, a distance of about 7 miles of double track. This line was chosen partly because the main line operation would not be interfered with in case of trouble with the electric trains and partly because of the existing heavy summer traffic which would put the new apparatus and the feasibility of the entire system to a severe test. An overhead trolley line was built, with center pole construction, and everything made very strong and more substantial than was at that time found in any street railway work to our knowledge. At the time of construction ofthis overhead line, there were no suitable movable switches in the market, and we had to remodel and have built especially for our purpose those which we finally adopted. One feature, perhaps worthy of note, is the connection of the overhead switch with the track switch in such a way that both are controlled by a single lever at the switch stand.

The line was operated for the first summer with excellent success, and, all fear of trouble having disappeared, an extension of 3.6 miles was made on the main line of the company's Plymouth division, from Nantasket Junction to East Weymouth, this section be ing operated by the third rail system.

In December, 1896, we commenced work on a new line running from Berlin, Conn., through New Britain to Hartford, a distance of 12.3 miles, 3 miles of which, from Berlin to New Britain, is a double track, and the remainder, from New Britain to Hartford, a single track. A power station was built at Berlin at one end of this line partly because of a desire to test transmission of power to a considerable distance, and partly because Berlin is the center of several radiating lines which may eventually be put into operation by electricity.

The physical characteristics of both these lines have been so carefully and accurately described in technical papers that I shall only refer to them more or less incidentally in the following, confining my remarks chiefly to the results which we have found, and the conclusions which we have reached in our own minds as to the best methods of applying electricity in heavy railroad work.

TRAIN SERVICE AND TRAFFIC

We have learned very thoroughly, in our street railway experience, the lesson of the importance to any transportation agency, working in a thickly populated territory, of uniform fares and a frequent and regular train service—of a train service which requires no printed schedule to enable people to know when cars may be found in waiting. The time has come when every progressive railroad manager must recognize that new conditions and the new character of competition require a complete change of operating methods.

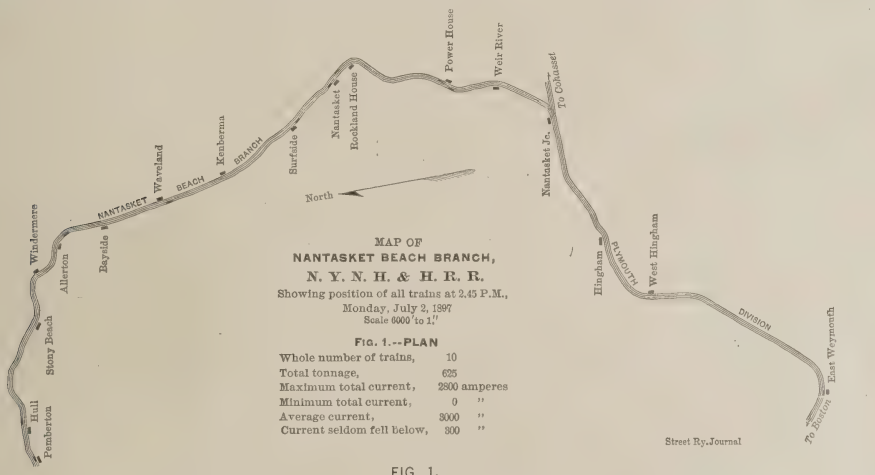


FIG. 1.

On its Nantasket Beach line, the New Haven Company gave, during the last summer, a regular half hour service from 6:30 in the morning until 11:30 at night. When unusually heavy boat loads arrived at Pemberton from Boston, trains were run in as many sections as were found necessary to take care of the people, but still the half hour schedule was not departed from on ordinary days. On Sundays and holidays, when boats arrived at Pemberton every fifteen minutes during the greater part of the day, express trains between Pemberton and Nantasket were sandwiched in between accommodation trains in such a way as give a fifteen minute schedule of alternate express and accommodation trains. The time table this summer required thirty-three regular trains daily, each way, between East Weymouth and Pemberton. During July and August, the traffic increased to such an extent as to require six motor cars in constant week day service, and on Sundays and holidays, eleven motor cars have frequently been called for.

The fares charged on the Nantasket Beach line before the advent of electricity were ten cents from Pemberton to Nantasket and eighteen cents from Nantasket to East Weymouth, a total of twenty-

eight cents from Pemberton to East Weymouth. With electric traction they have been placed at a uniform rate of five cents from Pemberton to Nantasket and five cents from Nantasket to East Weymouth. Under these new conditions, the traffic has increased enormously on this line, the summer of 1895, the first of electrical operation, showing an increase of 92.6 per cent over the previous summer in the number of passengers carried, the summer of 1896 showing 45.1 per cent increase over 1895, while, in the summer just passed, we have carried nearly three times as many passengers as in the last year of steam operation.

The operation of the line from New Britain to Hartford was commenced in May last, with a regular half hour train schedule from 6:00 in the morning to 11:30 at night, and with a uniform fare of ten cents each way, instead of twenty-three cents, the former charge. The electric line carries through passengers only between Hartford and New Britain, the passengers for the five way stations being carried by the regular steam trains running on a parallel track. For ordinary every-day service, a single open motor car was used during the past summer, while for extra loads, light double truck trail cars, seating seventy people, were attached. On rainy days, a standard closed passenger coach was hauled by the open motor car. On holidays and Sundays, the cars pulled two trailers, the entire train seating nearly 250 passengers. About the middle of August, steam service on the Berlin-New Britain branch was discontinued, and traffic has since been handled entirely by electricity. Sixteen trains each way per day are run, connecting with steam trains.

Under the conditions named on the Hartford-New Britain line we have carried, during the three summer months, 400 per cent more passengers than we carried through the corresponding months of last year.

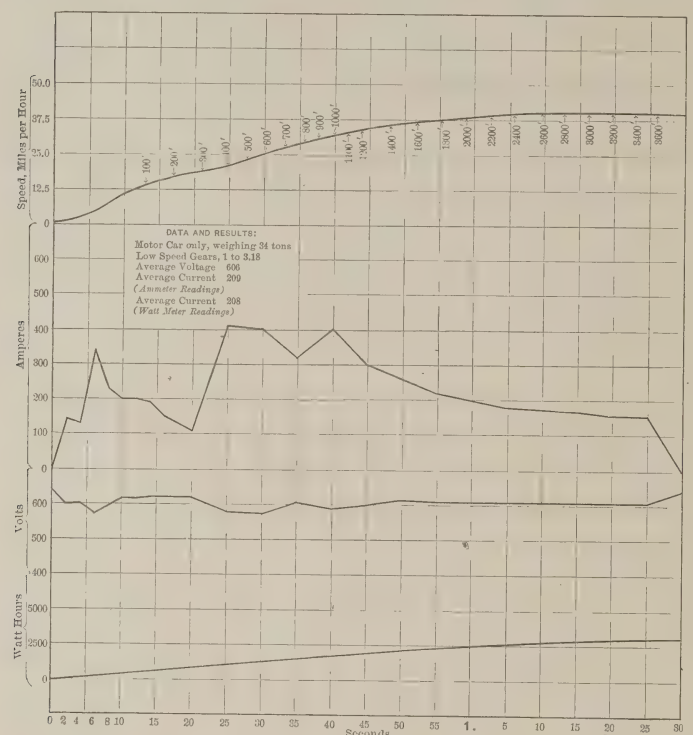


FIG. 2.

SPEED, ACCELERATION AND SCHEDULES

I do not suppose that any but a trained railroad man can understand the impossibility of operating trains and maintaining schedules by steam locomotives in the way that has been done by electricity at Nantasket Beach this summer. There are several grades and a great many curves on the line, as will be seen by the accompanying plan (see Fig. 1, on page 777). There are no excessively sharp curvatures or steep grades, and it is not here that the trouble has come. The difficulty is found in the fact that there are no less than seventeen stations on a line only 10.6 miles in length, or an average distance between stations of but about six-tenths of a mile. To make a run of 10 miles with sixteen stops in twenty-six minutes; to be *obliged* to do this in order to connect with boats arriving at regular half hour intervals, and to keep out of the way of frequent regular steam trains on the main line of the Plymouth division; to allow but four minutes at each end for unloading, switching (including running around trail car), and loading; and to do this day in and day out, in regular service, through an entire summer; these are things which cannot possibly be accomplished by steam locomotives.

Now the reason why electricity can do this and steam cannot, is found in the tremendous accelerating power of properly designed electric motors with rotary motion, as compared with reciprocal motion of steam locomotives. By examination of the curve of acceleration plotted from actual tests of a 60 ton train (see Fig. 2), and of the practical results shown in the curve of speed between stations in a service run on the Nantasket Beach line (see Fig. 3), as well as the accompanying time chart made up from the company's printed time cards, it will be seen how enormous is this accelerative power.

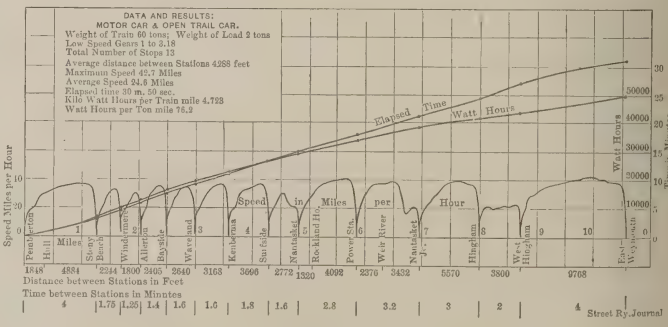


FIG. 3.

It will be seen, for example, that a 60 ton train, in running

from Windermere to Allerton, a distance of only 1800 ft., reaches a maximum speed of 31 miles per hour, while in the longer run from power station to Nantasket Junction, a distance still of but 5808 ft., a maximum speed of 39 miles is reached. The entire distance is covered, in regular service, at an average speed of 24.6 miles per hour, including stops.

Between Hartford and New Britain, the 9.3 miles distance is covered regularly by motor cars with two trailers in from 18 to 20 minutes, an average speed of from 28 to 30 miles per hour, while, with a special high-geared motor, a maximum speed of over 60 miles has been made; the entire distance of 9.3 miles being covered in 10 minutes. On this line, between Hartford and New Britain, a 52 ton train often reaches a maximum speed of 50 miles per hour. The current is cut off at twenty-nine grade crossings when single car trains are run.

It is worthy of note, in this connection, that the line between New Britain and Hartford is in direct competition with a trolley line between the same points, but following a more circuitous route. The schedule time of trolley cars is 55 minutes, as against our time of less than 20 minutes, and the rate of fare is 15 cents (including a transfer given for use on the street railways of either city), as against ours of 10 cents for the straight run between the two cities only. The ownership of right of way has a very important influence upon speed and competitive conditions under circumstances like these.

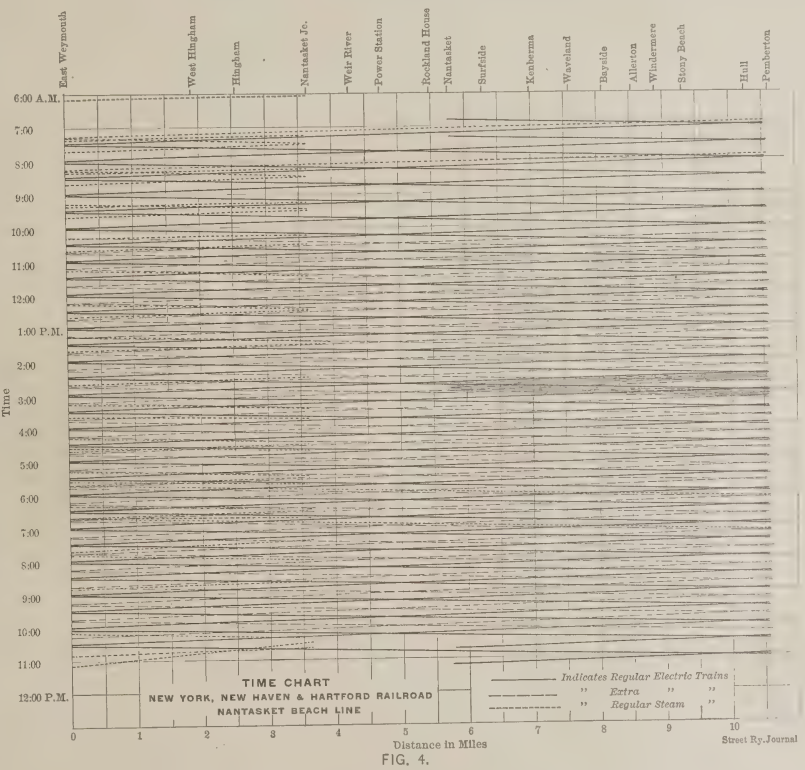


FIG. 4.

CARS AND EQUIPMENT

The type of car selected for any good transportation service has a direct bearing upon the development of traffic and maximum gross receipts. It has been difficult for steam railroads to depart far from the long established custom of closed passenger coaches of the present standard type, and to adopt open cars, on account of the disagreeable effect on passengers of the smoke and gases from engines. This has naturally thrown a great deal of traffic to competing street railway lines running open cars in summer, on account of the much greater pleasure in riding.

With electric operation, open cars in heavy railroad practice are possible, even at considerable speed, particularly if the front of the car is closed in with glass, and both at Nantasket Beach and on the Hartford-Berlin line, we have used heavy open cars with great success.

The motor car which we have so far used we do not consider, by any means, the final type, and even now, we have in mind plans of combination cars which we believe will be, on the whole, well adapted for railroad work. The present motor car is very heavily built, with floors of a height equal to that of our standard passenger coaches. It contains sixteen cross seats, capable of seating ninety-six passengers, and the entrance is from either side with three steps. Each car has two heavy railroad trucks, one of which is equipped with two 125 h. p. motors. The total weight of the motor car is 32 tons, and the trailer car of the same type weighs 25 tons. The motors which we have used up to date have been of a type common in heavy elevated railway work. These motors have often been in service for several consecutive days, making 324 miles each day, without apparent injury. We found the motors we are using already on the market when we commenced our experiments, and until recently no attempt has been made by us to specify changes. Under these circumstances, great credit is due the manufacturers for their efforts to meet the difficulties encountered. The experience gained with these motors has served as a basis for building larger and heavier types, better adapted for the severe work which they will be called upon to fulfill to meet our requirements. An important point which we shall specify in new motors is that they shall have the most perfect ventilation possible. The efforts of manufacturers have been hitherto directed towards completely encasing the motors, so as to make them waterproof, but in doing this, ventilation has been sacrificed. We have found it beneficial to blow out our motors several times during the day by means of a blast of air from a hose pipe connected to our air brake reservoir, but this is, at best, but a makeshift.

It is very difficult to dispose of all the necessary cables, wires, brake rods and chains, air brake cylinders and apparatus, switches and other car controlling mechanism in the limited space beneath the car floor, as may be readily imagined by those familiar with street railway work. As a consequence, there has always been more or less controversy between those responsible for the placing of the different portions of the equipment, as to who shall have the first right to a given space, perhaps hardly a half dozen square inches in section. There is also more or less trouble with abraded wires, short circuited shoe hangers, etc., and for our future work, we are making an effort to simplify this mass of equipment mechanism by putting some of it, particularly the wires and cables, in a space between the true floor of the car and a false floor, several inches below, specially provided for the purpose.

For operating heavy trains of this character, where currents of from 500 to 1000 amps. are sometimes used, the controlling apparatus must be massive and strong in every part, and the greatest care must be taken to prevent arcing. We have had no trouble with controlling apparatus on our regular equipments, and we consider this branch of the apparatus well perfected.

The danger to station and car apparatus from lightning discharges, which is so important a factor in street railroading where the overhead system is employed, is avoided in third rail work, since the third rail is so close to the ground that it is practically a lightning arrester itself throughout its whole length.

The problem of braking, which is so important a one in street railroading, is found more so with us, since the train weights and speed are enormously greater. The regular Westinghouse air brake system, with engineer's valve, is used on our electric trains, but instead of steam air compressors, we have an electric motor compressor controlled by an automatic regulator, which has given excellent satisfaction.

Our experience with trolleys on the overhead line at Nantasket Beach, originally put in two years ago, has not been satisfactory. We find it quite impossible to prevent the destruction of trolley wheels by almost continual arcing when attempting to take from the wire the heavy current required in starting and during acceleration, as well as the smaller currents taken at the maximum speed. There has been a good deal of trouble, moreover, in keeping the trolley on the wire in making speed and taking curves, and many trolley poles have been broken. The trolley difficulties have not interfered with the continuous operation of our line, but the cost of replacing wheels and poles has been rather large.

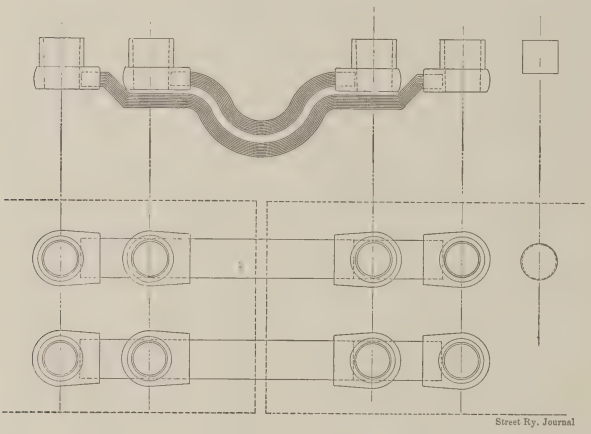


FIG. 5.—LEAF RAIL BOND.

These difficulties have had an important influence in causing us to reach a decision in favor of the third rail. The contact shoes which take the current from the rail to the motor circuit have given, on the whole, good satisfaction, although they are occasionally carried away by the approach blocks at grade crossings when these blocks happen to be slightly misplaced so that the shoes strike them at the wrong angle. The contact shoes are suspended by cast iron links, which are intended to be weak enough to allow the shoe to break away easily without doing damage to the framework of the car. The trail cars are also equipped with shoes and connected with the circuits on the motor car by means of flexible couplings, and it is possible, therefore, when the cars are run in train, to bridge the longest gaps found at grade crossings and switches, so that it is not necessary to turn the current off on approaching these. This arrangement makes our trail cars independent of the motor car for heating and lighting.

It will be noted perhaps that the Nantasket motor cars have two trolley poles, as well as contact shoes and the changing from trolley to third rail simply means the pulling down of the pole and the closing of the third rail switch.

THIRD RAIL AND RETURN CIRCUIT

Our third rail and return circuit experience will perhaps be of value to both street railway and railroad managers, as we have undoubtedly made a wide departure from established methods. We have solved a number of interesting problems.

First is the question of insulation. The third rail has a potential of 600 volts above the ground and rests upon creosoted wooden blocks doweled into the ties, its eaves being only 1⅝ ins. above the tie. Now it frequently happens that water accumulates 2 ins. or more in depth over the ties, and, if it were not for our experience to the contrary, we would naturally suppose that, under these circumstances, the line would be directly short circuited between the third and service rails through the water, the distance being about 2 ft. each way. Nevertheless, we have been able to operate our road without the slightest difficulty when this has happened, and nothing unusual has been noticed at the station, nor has the electrical output, as registered by the recording wattmeter been abnormal. At Berlin we have watched the ammeter closely when we knew the tracks to be submerged in two places, 10 miles apart, during a heavy rain storm, and we have found that the leakage was almost imperceptible when both cars on the line were at rest and their air pumps out of circuit. At the same time the wattmeter was standing still. Of course, if a long length of track was submerged, the leakage might become serious, but we have yet to learn how much is necessary to accomplish this result.

We aim to so connect our third rail lines and the service rail return as to have a practically complete metallic circuit of extremely low resistance, as far as possible disconnected with the ground. We do not believe in grounding our track, and, though ground plates are placed at the station, connected to our generator, by far the largest proportion of the return current comes through the cables connected directly with the track, the percentage coming from the ground plates being extremely small.

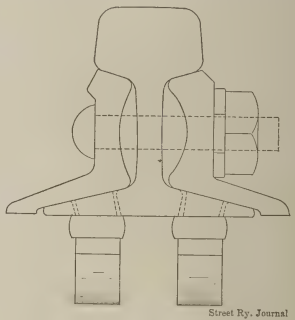


FIG. 6.—RAIL BOND IN POSITION.

The joints of the third rail are bonded by long copper plates, firmly bolted to both sides of the joint, sixteen bolts being used in all. These copper plates are tinned before being put into position. Owing to the large area of contact surface, the presence of rust on this surface does not materially interfere with the conductivity of the joint, as shown by accurate tests.

The service rails are bonded with the greatest care, four copper leaf bonds, having a cross section of copper equal in conductivity to that of the rail, being used. These bonds are inserted in the base of the rail instead of the web, so as to prevent breakage through play at the joints. The copper leaves are cast into end piece blocks in such a way as to weld them thoroughly together in the blocks. The latter are formed into a hollow cylinder, 1 in. in diameter, which passes through a hole in the flange, and by which a large area of contact is secured. Tapered pins are driven into the inside of this cylinder from the top of the flange, and the connection made is very perfect. The form of this service rail bond is shown in Fig. 5. Careful tests have shown that the joints of both third and service rails have now a slightly greater conductivity than an equal length of the rails themselves. Some of the tests of our third rail and service rail bonding and of the experiments which have

led up to our present practice may be of interest, and are given below.

A few words about the danger of the third rail system would be, perhaps, in order. There have been many cases of people who have stepped from the ground to the third rail without feeling the current, and anyone can step upon it from a dry tie without the slightest effect. On all except wet days, our employes work about it without trouble, avoiding, of course, putting themselves in direct contact with both service and third rails, but not infrequently "monkeying" with the current in such a way as to get shocks of more or less severity in a sort of horse play. On wet days, they refer to the third rail as being "lively," and are inclined to let it alone. Many of our employes have, however, received the heaviest shock possible to obtain, time after time, and care little about it, though those who are more influenced by electric shocks than others are sometimes thrown off their feet, but recover fully in a few minutes. We do not say that the third rail has no dangers, but we do not consider the danger as being at all serious or one which should interfere with the extension of the system.

As a result of exceptional care which we have taken in bonding our third and service rails, we have found it unnecessary, in any third rail work so far done, to use copper feeders, in spite of the fact that we are obliged to transmit current from Berlin to Hartford, a distance, as before stated, of 12.3 miles, straight away from the power station. This work is made up as follows: from Berlin to New Britain, a distance of 3 miles, there is a complete double track electric road with two 100 lb. third rails and four 74 lb. service rails, all most carefully bonded as described above. From New Britain to Hartford, a distance of 9.3 miles, there is one complete electric track, with 100 lb. third rail and 70 lb. service rails, all carefully bonded, in addition to which we have connected to the service rails of the electric track the rails of the second track, paralleling this the entire distance, at various places, in order to get the benefit of whatever conducting power there might be in this track connected only by its fish plates at the joints. As a result of this work, we are able to run two trains of 52 tons each on the New Britain & Hartford line, with an average loss of but 26½ per cent. The current output of the station at such a time averages about 300 amps., with a maximum flow of about 700 amps., at a pressure of 600 volts. Of course, if the service were heavier, so that more cars would be required, it would undoubtedly be necessary to reinforce the third rail with feeders.

TESTS FOR BONDS FOR THIRD RAIL

Each joint was made up of an angle plate of ⅜ in. boiler iron, 12 ins. long and same width as rail, bent, and fastened to the A shaped rail on the under side by sixteen ⅝ in. bolts through the rail flanges.

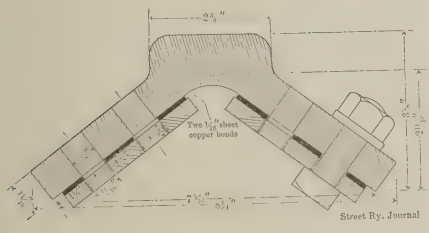


FIG. 7.—ARRANGEMENT OF RAIL BONDS.

The bonds consisted of two pieces of $\frac{1}{16}$ in. sheet copper, 12 ins. long and 4 ins. wide, tinned on the sides next the rail and plate, squeezed up between the rail and the plate under each rail flange.

Area of cross section of rail	9.3 sq. ins.
" " " " plate	3.6 "
" " " " copper	1.0 "
Weight of plate	12.0 lbs.
" copper	3.5 "

Bond A.—Rail; plate and copper filed and sandpapered bright.

Bond B.—Rail; plate and copper left as found; rail rusty and scaly; plate scaly and oily; copper dull.

TEST OF DROP IN VOLTAGE

Current, 200 amps.

	Drop in volts
1 ft. of 92.5 lb. third rail	0.001637 volt
Bond A, 12 ins. long	0.001632 "
Bond B, 12 ins. long	0.001907 "
Nantasket bond	0.00300 "
Bond A, 16 volts	0.001637 "
" 12 "	0.00200 "
" 8 "	0.00230 "

Bond A.—Rusted with salt and water for forty-eight hours. Current, 200 amps.

Joint	
Rusted	0.00199 volts
Hammered with sledge	0 00191 "
Bolts set up	0.00189 "
Hammered	0.00188 "
Set up	0.00187 "
Hammered	0.00187 "
Hammered on end	0.00187 "
Driven apart with wedge	0.00187 "

VOLTS DROP PER MILE OF 92 5 LB. STEEL RAIL

Current 1000 amps.

Rail	Drop in volts	% lost in bonds
1 mile steel, bonds neglected	42.0444 volts	
1 " rail bonded with A	42.0400 "	0.0
1 " " " " B	42.2820 "	0.56

NOTE—The figures showing drop per mile with current of 1,000 amps. are calculated from tests made with current of 200 amps.

COST OF POWER

In our Nantasket Beach station, we have installed two engine generator units of 800 h. p. and 550 k. w. capacity each. The steam is supplied by eight boilers of 200 h. p. rated capacity each. On heavy days, both these engines are required, but on ordinary days but one only, and this is not fully loaded; the average loads being perhaps one-half the maximum.

In the Berlin station we have installed two engine generators of 1200 h.p. and 850 k.w. each. The steam is supplied by ten horizontal tubular boilers, of 200 h. p. each. One unit only is required in the practical operation of all the cars on the Berlin and Hartford lines, and the average power output is hardly one-fourth of the maximum capacity.

In both stations, our aim has been not to follow out any engineering fads, but to provide apparatus proved by long experience to be of the most simple and durable character.

The details of piping and arrangement of steam apparatus have been so thoroughly described in the technical papers that it is unnecessary to refer to them here.

We are now running our Nantasket plant condensing and our Berlin plant non-condensing, the loads in the latter being too light to make condensing profitable.

In spite of the fact that these general conditions of operation do not point to a low cost of power, because of the fact that we are working neither station at anywhere near its full capacity, I suppose we are, as a matter of fact, producing power more cheaply than can be done in any power station in the country using coal as a fuel, the reason being that we are burning sparks. "Sparks," as we are accustomed to call them, are the half consumed coal dumped from the extension front of locomotives at the company's various round houses. Nevertheless, there is a great deal of steam generating value in these sparks, as we have found by experience, and they are being carried on the company's cars to our stations at Berlin, Nantasket and Stamford, and charged to the electrical operation at the cost of freighting (including the usual profit to the company for transportation), plus the cost of loading and unloading, a total charge of seventy cents per ton delivered.

In order to burn these sparks, we are obliged, of course, to make some changes in the furnace arrangements, chief among which is provision for the introduction of live steam under the grates, forming a blower or forced draft as well as providing the water which, in decomposition, furnishes the oxygen and hydrogen gases which increase greatly and facilitate the combustion of half burned coal and add enormously to the furnace heat. We originally supposed that some form of shaking or self-cleaning grate would be necessary in burning sparks, but have found in practice that, with ordinary grates together with the steam blower, there is no difficulty. In our experimental days, it was thought that it might

be necessary to use a proportion of ordinary soft coal with the sparks, and did so for a while, but it was not long before our firemen were educated to burn sparks only with entire ease, and no other kind of fuel is now used by us. Of course, we have to use a greater weight of this half consumed coal than would be the case with new coal, but still the economy is great, as a good quality of run-of-mine coal costs us, in Connecticut, about $3 per ton delivered at power station.

A few figures as to the cost of power at Stamford may be of interest. This station furnishes current for our street railway system at Stamford and for lighting our railroad stations with 350 incandescent lamps. We are operating one engine only, of 500 h. p. total capacity, direct connected to one 300 k. w. generator. In the boiler room are six 200 h. p. boilers. For the first six months of full operation with sparks only, the total cost of fuel for this station amounted to 3 mills per horse power hour or 4 mills per kilowatt hour. For so small a station and one where the average amount of power developed is hardly more than one-third the rated capacity of the engine, I believe this to be a low figure. We have recently made, for our own information, for use in larger plants, special tests of the cost of power developed in this way, using for this purpose a water rheostat, in order to load the engine up to more nearly its full capacity. As a result of these tests, we find the cost of fuel for power, with the use of coal, to be 3.2 mills per horse power hour or 4.2 mills per kilowatt hour. With the use of sparks, the cost is reduced to 1.9 mills per horse power hour or 2.5 mills per kilowatt hour.

At our Nantasket power station this season, the cost of fuel, with the use of coal, has averaged 4.2 mills per horse power hour or 5.6 mills per kilowatt hour, while, with the use of sparks, the cost has been 2.1 mills per horse power hour or 2.8 per kilowatt hour.

As before stated, our Berlin plant has not been run as economically thus far as itwill be when a greater load is put on the engines, and it will seem to be in the interest of economy to run compound condensing. At this station, the cost of fuel, with the use of coal, has been 9 mills per horse power hour or 12 mills per kilowatt hour. Using sparks as fuel has reduced this cost to 3 mills per horse power hour or 4 mills per kilowatt hour.

It is very difficult, of course, if not impossible, to make any direct comparisons between the cost of motive power for electric railroading and that for steam railroading, on account of the different way in which the trains are made up. The best criterion would be the cost of motive power per ton mile hauled, but even here the results would be of little value on account of the wide difference in conditions, and as a matter of fact, we have never attempted to make such comparisons.

I have tried to give you, as briefly as possible, some of the results of the pioneer work which the New Haven Company has been doing in heavy electric railroading. They are roughly stated, and we cannot pretend that they are in any way conclusive as affecting general railroad practice. For ourselves, however, we have formed some definite ideas as to what is possible for us to accomplish, and our plans for the future are being made with great care by President Clark and the board of directors, with the intention of dealing with the new transportation conditions which confront us in a broad-minded and progressive way. It is felt that a great transportation agency of this character owes it to the public from which it has obtained its franchises to furnish the best possible service and to make the most of the natural advantages which it possesses.

There will always be room, doubtless, for railroads of two characters, the one operating on a purchased right of way, where trespassers can be kept away and high speed obtained, and the other operating on streets and highways, where passengers can be taken up and let off at their own doors. It is possible that, in some thickly settled districts, such as are found in New England and the Middle States, where population groups almost touch each other, these two classes of service may occasionally be performed by the same agency, but there is no reason ordinarily, why there should not be the most amicable and friendly relations, and not infrequently of a business character, existing between steam railroad and street railway companies.

It is reported that the Erie Railroad Company is considering the plan of equipping its lines as far as the Oranges with the third rail system.

The Handling of Transfers; from the Printer to the Furnace

By John F. Calderwood

In the management of street car transfers, as in the many other affairs of practical life, the proof of the pudding is in the eating, so I shall confine myself to a plain statement of facts—in other words, to tell you, as succinctly and clearly as possible, how the Twin City Rapid Transit Company conducts its transfer business, or as the program has it: "The Handling of Transfers; from the Printer to the Furnace."

In order that the transfer system which we have evolved—for, by the very nature of the business, it must be a growth governed by local conditions, not a creation full fledged from the brain of any mortal Jove—I shall digress just enough to indicate the policy of our company toward its patrons. It is to avoid all semblance of arbitrary rules wherever possible, when coming in contact with the public, and particularly in giving transfers. We believe the street car business should be run as nearly like any other business as possible; we have transportation to sell, and the better the service we can give, the more politely or considerately we can treat our customers, the more patronage we will have. We believe the public have rights which, upon a purely business basis, it pays us to respect, and in the matter of transfers we believe we more than fulfill every requirement of what was regarded, at the time of its adoption by our City Council, as an exacting and sweeping transfer ordinance.

A theoretically perfect transfer system, so far as the service of the public is concerned, is one by which it is made possible for a person to start from any given point and reach his objective point by the shortest route and the quickest time.

A sincere effort is made in our system to reach this ideal. Not only do we try to give the quickest and best service for the passenger, but the conductors are expected to use judgment in carrying it out. In short, we do everything we can for the public--grant every reasonable request or concession—and do it cheerfully. And when we are compelled to refuse, we make it a point to show why the request is not reasonable. And I want to say right here that this policy pays. It pays in the harvest of nickels, for I believe that people will frequently walk or provide other means of transportation, when they would otherwise ride on our cars, because they have a real or fancied grievance against the company. But this is only a small part of the advantage of a liberal policy. I have noticed that in those cities where the first consideration—and the only one, apparently—is to snatch every nickel in sight, where arbitrary rules are imposed and the employes reflect the austere character of the management, the three cent fare epidemic has raged.

I think I can truly say that the people of Minneapolis and St. Paul, as a whole, are friendly to the Twin City Rapid Transit Company. We have repeated evidences of good will from the patrons of our lines, the press, the officials of our cities and public sentiment generally. We do not live over a volcano which has to be smothered with a blanket of subsidies, and I believe that one of the strongest bonds which bind the average citizen to us is a belief that Minneapolis and St. Paul have one of the best and most liberally managed street car systems in the country.

If you will refer to the maps of Minneapolis and St. Paul which I have distributed, noting the street car lines of both cities, you will see, at a glance, the problem of transferring which was presented to the Twin City Rapid Transit Company.

In the first place we have two cities, Minneapolis with a population of over 200,000, and St. Paul only a few thousand less, lying side by side—a rectangular, or perhaps, more accurately described as an elliptical city, with two foci, the circumference of which embraces 150 square miles. The two foci—the business centers—are about 9 miles apart, and are connected by a great Siamese artery, the interurban line running principally on University Avenue, as the street is called in both cities. About each of these foci we have a loop, and around the two loops, as the several car lines join the main stem, are the transfer points. Here nearly all the transferring is done, although this is slightly more general in Minneapolis than in St. Paul.

As you will see by the maps, the city of Minneapolis is gridironed by our tracks running almost parallel and brought together about the Minneapolis loop. In carrying the lines to one local point it has been found necessary to cross them occasionally before reaching the center, and at each of these crossings transfers are

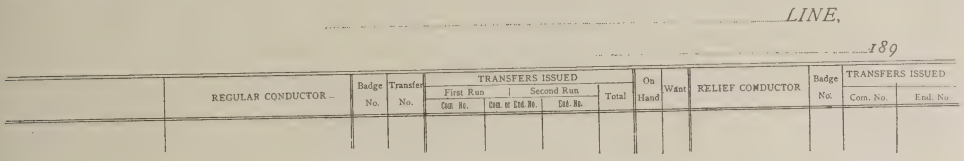
effected. What I have said about Minneapolis applies, in a general way, to St. Paul, so I will not particularize further.

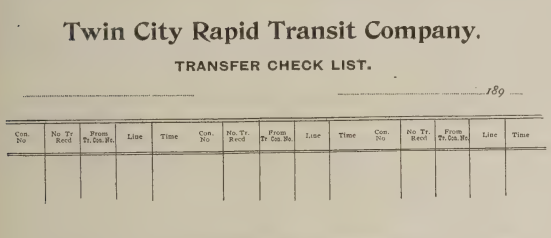
As I stated, our policy is to give the best and most satisfactory service possible. We have a uniform five cent fare in both cities and a man can ride from the falls of Minnehaha, in the southeastern corner of Minneapolis, to Shingle Creek, 12 miles; to Lake Harriet, our local Coney Island, 10 miles; or to Columbia Heights, 14 miles, for one fare. Or he can transfer to the interurban, the greatest and most popular of our lines, and ride half way to St. Paul, where, without change of cars, he pays another fare and can reach any point in St. Paul. By transferring to the West Seventh Street line he can go back to the Fort Snelling bridge, but a little more than a mile from where he started, having traveled a distance of about 20 miles from where he started.

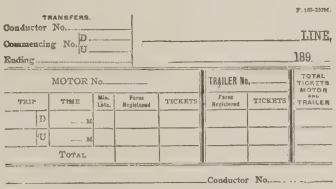
As most of you know, the Twin City Rapid Transit Company operates all the street car service of Minneapolis and St. Paul, all electric, except one line, the Fourth Street cable, running up St. Anthony Hill in St. Paul.

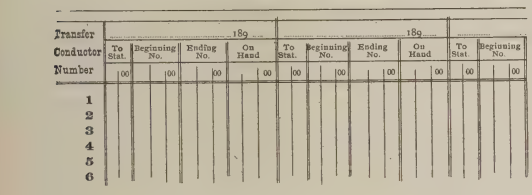
The ordinances of both cities require that transfers from one line to another be given "at the first intersection." No extra charge is made for the transfer ticket. A passenger, having paid his fare, is entitled to a transfer. But no second transfer is issued to the passenger who has presented a transfer, except on three or four extensions to the main lines. Transfers are registered the same as cash fares and are canceled by the conductor receiving them by punching the head of the transfer, thus indicating who received it.

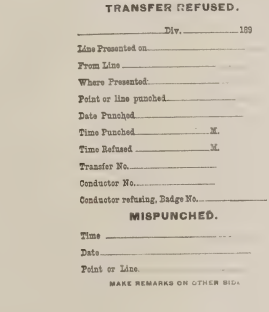
Transfers are issued by conductors at all points of intersection, entitling the passenger to a continuous ride in either direction upon

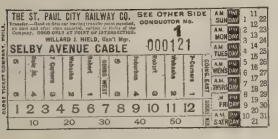


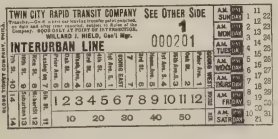












BLANKS AND FORMS USED BY THE TWIN CITY RAPID TRANSIT CO.

I fancy I hear some gentleman remark, "What do they expect? No wonder your patrons are satisfied and friendly." I acknowledge this point, we give long rides, because Minneapolis and St. Paul are pre-eminently cities of homes and a large proportion of our people live under their own vines and crab-apple trees. But notwithstanding the length of the average ride, we believe it pays to treat the public with liberality. If any man among you doubts the wisdom of a liberal policy, let him come to the Twin cities of Minnesota for an object lesson.

I have already said so much by way of introduction that I shall be forced to plunge right into the technique of the transfer business. I want to preface my remarks, first of all, by saying that I bring you no fine-spun theory or toy-working model. I have with me the entire paraphernalia of a system of transfers, including the reports upon which they are checked up and the records of the conductors verified, so that any average business man—he need not be an expert accountant--can readily understand the plan. I need only add that it has worked well under all circumstances and is more satisfactory than we had hoped at the time it was instituted.

the first car leaving the point of transfer, the hour and minute when the transfer becomes void being punched on the margin (a maximum limit of ten minutes being allowed after the time of issue).

Conductors are required to issue transfers to the several lines as they are reached. After passing the first intersection, or transfer point, transfers are issued to passengers desiring them immediately the fares are collected, thus avoiding the issuance of a transfer upon a transfer, the conductor punching the transfer (upon a ten minute or less limit) for the time the car is due at the point of transfer.

I realize that I am not regaling you with a chapter of light literature; I incline to the prosy, and the subject is necessarily technical, but I prefer to follow it out upon this line, because I believe if there is anyone here really interested in how we manage the transfer problem, with the aid of the blank forms which I have brought with me, he can study it out, after he has heard me through.

One essential about any transfer system is simplicity; it must be one that the men who put it into execution can fully and clearly understand, and that the public will readily apprehend. Another

MAP OF
Minneapolis,
St. Paul & Vicinity
Showing the Street Railway
System Controlled by the
Twin City Rapid
Transit Company.
Real Estate and Buildings.
A—Lyndale Car House.
B—9th Ave. Property.
C—Bloomington Car House.
D—Power House No. 2 and Shops, Store House and Car House.
E—Minnehaha Car House.
F—Minnehaha Power House.
G—19th Ave. Car House.
H—Power House No. 1 and General Offices
I—Power House Property.
J—Monroe St. Property.
K—University Property.
L—East Side Car House.
M—Franklin Ave. Prop'ty.
N—First St. Property.
O—Grant St. Property.
P—Forest Heights Prop'ty
Q—Mill St. Property.
R—Kent St. Property.
S—Rondo St. Property
T—Selby Ave Power House.
U—Snelling Ave. Property.
V—West 7th St. Property.
W—Ramsey St. Car House.
X—Hill St. Power House.
Y—Duluth Ave. Property
Z—Rice St. Car House.
1—Greenbrier Car House.
2—East 7th St. Car House.
3—East 7th St. Property.

important feature is that it should involve as little work as possible on the part of the conductor to issue them. He is frequently crowded and it will not do to have some elaborate or time consuming method of issuance.

Now having reviewed the conditions in a general way, my purpose is to give you next a complete story of the transfer "from the printer to the furnace" and then to take up, as briefly as I may, some of the principal reasons why we have adopted each feature.

The transfers which we use are our own design and are printed for us by the Globe Ticket Company, of Philadelphia. At present we are using eleven different colors of paper and ink, the idea being to have a different color for each line of tickets. The several colors of tickets enable the conductors, and also the transfer clerks in the office, to tell at a glance from which line they were issued.

The transfers have the conductor's transfer number printed in a conspicuous place. They are also consecutively numbered (in red), as you will notice upon examination. The conductor's number on the transfer indicates which conductor issues the transfer, but it has no reference to the number on his badge, as will be observed by an examination of form 379, where both are given. Samples of the transfers of the several lines are here among the other forms. They are practically self-explanatory.

The transfers are put up in pads of 100, and when received from the printing office they are done up in bundles of 500, enclosed in a paper wrapper for convenient handling. We carry a sixty days' supply of tickets for each line, a record of the amount of stock on hand being kept in a stock record book (of which I have several sample pages here), to show the exact number on hand for each conductor. The transfer stock is kept in a large case arranged for the purpose, at the principal office.

Transfers are sent out in quantity to the stations once a week. Each station keeps a daily transfer report book for each line of tickets. When a conductor reports for duty, before taking his car, he calls for his transfers (enough for the day) and his punch; one conductor's transfer number being used for each relief. When the conductor is relieved, he turns in the punch and the unused transfers. A record is kept in the report book at the station of the first consecutive number (the red figures) of the ticket of each conductor's transfer number. This is put down when he begins and is called the "Beginning Number" or "Commencing Number," and a corresponding "Ending Number" is entered in the report book to show the first number on the pad of current transfers when it is turned in, whether all or only part of the time card has been run, and the difference between the beginning and ending numbers gives exactly the number of transfers issued by the conductor. These report books are made out in duplicate, the original sheet being torn out and sent to the principal office daily and the carbon copy kept in the book for reference. The same report also shows the fact if an "extra" or "relief" conductor used the same transfer number.

For each car line there are special orders directing the issuance of transfers by conductors. As a general rule the conductor, after having collected the fares on a car going toward the loop, passes up the aisle and announces, "Transfers" which are issued just before the first intersection, or transfer point, is reached. After passing the first transfer point, transfers, if desired, are issued to passengers as they pay their fares, the conductor punching the transfer so as to allow ten minutes after the car is due at the point of transfer, the transfer ticket being good on the first car leaving the point indicated by the punch mark.

Conductors are required to keep a record on a trip envelope, form 150, of the number of transfers for each half-trip. This is done by the conductor putting down the first consecutive number (in red) which appears upon his pad when he starts away from the loop, also, when he reaches the other end, and again when he has completed the first trip. The difference between these three "consecutive" numbers shows how many transfers were issued on each of the two half-trips. The trip envelope also has a report of the leaving time at each end, or half-trip, the number of fares registered and how many of these fares were transfers from other lines. Within this trip envelope the conductor puts all the transfers he has received and accepted for fare, but no money. The difference between the fares registered and the transfers turned in shows how much cash is required to be paid in by him at the end of his day's work. It also shows the maximum number of transfers which a conductor may issue during the day—that is, if he should issue one transfer for every cash fare received.

If the conductor mispunches any transfers, or, if he takes up those already issued and issues new ones instead (as in case of a blockade, or when the passenger changes his mind and wants to take a different line than at first intended), these transfers are turned in in the current trip envelope, with form 414 attached, giving a full explanation. If the conductor has any transfers punched and not used when he is relieved, he turns them in in the last or relief trip envelope, attached to form 414. Transfers that are part due when presented by the passenger, or which for any other reason, are not good when presented for fare, and for which the passenger refuses to substitute cash fare, are also registered and turned in in the current trip envelope attached to form 414 with full explanation.

The trip envelopes are dropped in a box each trip as the car passes the starter's stand on the loop. This is one of the distinctive features of our system and I want to call it to your special attention. The reason is that we want to remove all temptation to manipulate the transfers, which might be possible if the conductor retained them to the end of the day; we do the book-keeping for the conductor, and by doing it in detail—trip by trip—we not only make it practically impossible for him to commit a great fraud, but we render it unsafe for him to attempt to do any crooked work at all. By our system of cross checks we know more about a transfer than the conductor himself.

As every street car man knows, the bane of the business is that too many people handle the receipts, and the gentlemen here know what the public does not know, perhaps, that the great objection to a liberal transfer system is that it opens the way for fraud and dishonesty, unless properly guarded.

While I am among those who believe that there is no effectual substitute for honesty, I think we can do much toward making men reliable and trustworthy by showing them that dishonesty is sure to be found out, and that it doesn't pay. Our company has comparatively little trouble from this source, and while our conductors and motormen are, as a class, above the average working man in executive ability and attention to their work, we regard it as the duty of the auditing department to see to it that nothing fraudulent is permitted. I think we have a system which effectually accomplishes this purpose.

I have covered half the journey of the transfer, from the printing office to where it has done its mission, been placed in the trip envelope by the conductor who took it up, and by him put in the box at the starter's stand. From there it is taken, with thousands of its kind, to the principal office to be checked up. The first verification is as to the number of transfers turned in. They must correspond with the number indicated on the trip envelope in which they were enclosed. If the number is not correct, note is made of it and the balance in cash is required. If the report is found correct, the transfers are turned over to the transfer clerks to be checked up for errors in transferring. First, we examine all the envelopes of each conductor to see if the transfers reported issued, as shown by the commencing and ending numbers, were in consecutive order; and next, to see whether the conductor issued more transfers than he had cash fares on that particular trip. After this the transfers are again examined as to date, point of transfer and time, the checkers knowing the exact running time between transfer points. In case transfers are found punched ahead, they are looked up and compared with the report for that particular time upon the envelope of the conductor who issued them. These errors and any others are reported to the instructor who takes them up personally with the conductors at the stations.

The principal abuse of any transfer system is in the peculation by conductors who try to cover up their theft by trading transfers. In fact, there are those who claim that it is impossible to stop stealing so long as transfers can be turned in for cash. Perhaps absolute prevention of theft is impossible; I will go further and say that, even where no transfers are given, men have been able to steal for a time.

One of the checkings is to test the probable trading of transfers. If one conductor is receiving four, five or more transfers at any one time, at any one point, from any other conductor, with anything approximating regularity, it may be regarded as a symptom to be inquired into. In a case of this kind an inspector is detailed to watch this transfer point and to ascertain whether the matter is as it should be. When any crookedness is in progress a checking system like this is certain to supply the clue, and it is seldom difficult to ferret it out with the pointer thus furnished.

Still another check is furnished when the transfer reports from the stations (form 379) are compared with the consecutive transfer numbers on the trip envelopes, to see if the conductor's report agrees with the beginning and ending numbers on the relief's or station reports. Each conductor has a regular punch. It is used by no one else and when he is off duty it is kept at the station. A transfer number may be used by more than one conductor, as in case of extras or when the full time card is not run by the same conductor, but the punch is never used by more than one man. A cut of the die of each punch, with the name of the conductor to whom it is charged, is kept at the office, and regular examinations of the punch marks are also made. I believe that, with this system of checking, it is practically impossible for conductors to trade transfers without our being aware of the manipulation.

When all the examinations have been completed, the transfers are carefully gathered and thrown under the boilers of our engine house and burned.

In conclusion, I will briefly take up the advantages and disadvantages of a transfer system, such as we have put into force. A liberal construction of our ordinance, giving transfers at the first intersection, results in a considerable percentage of passengers changing cars at outlying points, which enables them to get to their destination with the least loss of time. This avoids congestion and overcrowding at the downtown transfer points, which might result if we had only a few central transfer points. On the other hand, it makes it possible for passengers to double back with a single fare. For instance, a man can come downtown on the Fourth Avenue line, in Minneapolis, taking a transfer and getting off at the post office, which is at the transfer point. He can get his mail from his box and go back on the First Avenue line, these two lines being only from three to five blocks apart. To what extent this is done I cannot say, but it cannot be enough to make it worth while to consider it against the moral advantage of a satisfactory transfer system.

It is true that a transfer system like ours entails considerable expense, which might otherwise be avoided. I have made no close figures upon this item, but you can get some idea when I tell you that we use from 12,000,000 to 13,000,000 transfers a year, which is over 20,000 every day, and a corresponding increase when travel is heavy.

Owing to the transformation from horse cars to the electric system, and the fact that several extensions have been built, it is impossible to estimate to what extent our earnings have been affected as a result of our present transfer system.

The Care and Handling of Fares from Receipt to Bank.

By Charles L. Wight.

Under this title I will endeavor to explain the method at present used by the Toledo Traction Company. Please bear in mind that this plant issues several different kinds of tickets, and that plants receiving all fares in cash have much advantage in economy of time, blanks and accounting.

One of the objects of our association is to enable members to compare methods of accomplishing a certain result, and in so doing, detail of method together with an exhibit of forms used should be given to be of practical value.

Following is a list of blanks, with a brief description of their uses:

OFFICE OF
THE TOLEDO TRACTION COMPANY,

Toledo, O. ——— *1897.*

Mr ——— *Conductor.*

Your Report calls for - - $ ——— | ———
Amount Received, - - - ——— | ———
Due. - - - - - - - - ——— | ———
Check slip for ——— *not rec'd*

You will please enclose in accompanying envelope the balance due as above stated, and hand same on RETURN TRIP *to Station Clerk or Collector.*

If you have reason to believe the above charge is not correct, come to the office and examine your report.

THE TOLEDO TRACTION COMPANY,

SECRETARY.

REMARKS.

FORM 8.

Form 1. "Conductor's Report." In this is noted the number of cash fares and of each issue of tickets received as fares; the statement of register, number of transfers, etc. Accompanying this report is a punch slip used to verify the three cent and one cent fares received (Form 1A).

THE TOLEDO TRACTION CO.,

Foreman's Daily Report

OF TRANSFERS AND PUNCH SLIPS.

Date ——— *189*....

DELIVERED TO CONDUCTORS SERIAL NOS. as follows:

——— FOREMAN.

No. of Conductors Badge	Serial Number Transfer	Punch Slip 3c	Punch Slip 1c	No. of Conductors Badge	Serial Number Transfer	Punch Slip 3c	Punch Slip 1c

FORM 6.

This report with the

Form 2—3. "Conductors Cash Envelope" containing all cash, tickets and transfers received, is deposited with the station clerk, who gives his receipt therefor (Form 2A. Deposits are made at station at end of run for the day.

The Toledo Traction Co.
CONDUCTOR'S RECEIPT

Run No. ——— *Date* ——— *189*....

Received from Conductor No ———

ONE CASH ENVELOPE SAID TO CONTAIN

Cash, $ ———
No. Tickets, ———
No Trans. Checks, ———

Foreman.

FORM 2 A.

Form 4. "Division Superintendent's Report." This covers returns from station of all money packages, which is checked up at main office on delivery at 8 A. M. each day. These packages, together with conductor's report are kept in safe at station during the day and delivered to the auditor as above stated. This method gives the conductor and also the division superintendent a receipt for all returns.

SEE INSTRUCTIONS ON BACK.

TOLEDO ELECTRIC STREET RY. CO.

Date ——— *189*....

Run No. ——— *Route* ——— *From* ——— *M. to* ——— *M.*

Conductor ——— *Badge No.* ——— *Motorman* ——— *Badge No.* ———

5c REGISTER. CAR NO.	5c REGISTER. READING AT FINISH	5c REGISTER. READING AT START	5c REGISTER. DIFFERENCE	3c TICKET REGISTER. CAR NO.	3c TICKET REGISTER. READING AT FINISH	3c TICKET REGISTER. READING AT START	3c TICKET REGISTER. DIFFERENCE
Totals							

.....RINGS AT 5c EACH
LESS .....TICKETS AT 5c
CASH FROM 5c REGISTER .....
.....1c FARES .....
CASH ENCLOSED .....
Commencing No. of Transfer,

CAR NO.	TRIP IN OR OUT.	EXACT STARTING TIME. Hours	EXACT STARTING TIME. Minutes	ITEMS REGISTERED ON 5c REGISTER. 5c CASH FARES.	TICKETS. Regular	TICKETS. District Mess	TICKETS. Casino	TICKETS. Special	TICKETS. Emp. & Comp.	TOTAL 5c Reg. Each Trip	On 3c Register 3c TICKETS ONLY	ITEMS NOT REGISTERED. Slip Punch 1c CASH FARE	ITEMS NOT REGISTERED. Slip Punch 1/2 FARE CAMDEN TICKET	TRANSFERS RECEIVED	BadgeNo Employees and police in Uniform	CLOSING NUMBER TRANSFERS ISSUED EACH TRIP
	OUT															
	IN															

FORM 1.

Form 5. "Division Superintendent's Register Report." This gives a statement of register of each car at time of leaving on first trip and when arriving from last trip at night. The reports from conductors must agree with this statement, thus making a perfect check on rings as shown on conductors' reports.

Form 6. "Division Superintendent's Punch Slips and Transfers." These are issued by them to conductors, giving number of conductor, serial number of transfer and number of punch slip.

The foregoing is an outline of our method in the care of receipts from collection of fares

Form 1—W & R.-8-88-97-1000

TOLEDO ELECTRIC STREET RAILWAY COMPANY.

RECORD OF EARNINGS received from the ______ Line, on ______ 189

No. of Run	CONDUCTOR	Badge No	MOTORMAN	Badge No.	No. of Car	CASH FARES RECEIVED: 5 Cent Fares	1 Cent Fares	Chartered or Extra	TOTAL	TICKETS RECEIVED: Reg	3 Cent Tk'ts	D. M.	Casino	½ Fare Casino	Emp and Comp	Special	Total Tickets	Badge Pass.	Total Pass.	Transfers	MEM.

FORM 9.

TOLEDO ELECTRIC STREET RAILWAY CO.

RECORD OF CASH FARES AND TICKETS RECEIVED all Routes, for ______ 189

ROUTE	No. of Car	CASH FARES RECEIVED: 5 Cent Fares	1 Cent Fares	Chartered or Extra	Total Cash	TICKETS RECEIVED: Regular	3 Cent Tickets	D M	Casino	½ Fare Casino	Emp. and Comp.	Special	Total Tickets	Badge Pass.	Total Passengers	Transfers	MEMORANDA
Belt																	
Huron Street																	

FORM 10.

The Toledo Electric Street Railway Co.

CONDUCTOR PUNCH SLIP No ....FOR REGISTRATION OF 3c TICKETS. ....189.....

RUN No .... CAR No............ BADGE No............ CONDUCTOR....................................

LINE.. One space is to be punched at the time of Collection for EACH 3 CENT TICKET Collected. This Slip is to be returned with the Trip Sheet for the same RUN and THREE CENT TICKETS are to be enclosed with Cash Return to balance Amount punched. Punch in regular order of spaces.

99	98	97	96	95	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80	79	78	77	76	75	74	73	72	71	70	69	68	67
66	65	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34
33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1

FORM 1 A.

______ LINE.

No. ______ ______ *Conductor.*

No. ______ ______ *Motorman.*

Motor No. ______ *Date* ______ *189*

Register at Ending - ______

Trailer No. ______ *Register at Commencing* ______

Fares Registered - - ______

Relieved by Conductor No. ______ *Ticket Fares* - - - ______

Cash Fares - - - ______

Total Cash - - $ ______

Cash Received - $ ______

TRIPS	TIME M	North East: Fares	Free	South West: Fares	Free	TOTAL: Tickets	Fares Registered	TRIPS: FROM	TO
U									
D									
U									
D									
U									
D									
U									
D									
U									
TOTAL									

Notice: This report will not be accepted unless FULLY and CAREFULLY made out. NOTE CAREFULLY TRIPS MADE. WRITE REMARKS ON BACK.

FORM 3.

THE TOLEDO TRACTION CO.

STATEMENT OF EARNINGS.

Date ______ *189* __ *Weather* ______ *A. M.* ______ *P. M.*

ROUTE.	No. of Cars.	Cash Received.	Tickets Received.	Total Passengers.	ITEM.
Broadway and Lower Summit,					
Dorr Street and East Broadway,					
Monroe and Adams—Long Belt,					
Monroe and Adams—Short Belt,					
Erie Street and Nebraska Avenue,					
Western Avenue and Oak Street,					
Cherry Street and Walbridge Park,					
Lagrange Street and Union Depot,					
Forest Cemetery and Union Depot,					
Ironville,					
Glassboro,					
Belt Line,					
Huron Street Line,					
Indiana Avenue Line,					
Special Cars,					
Total Car Receipts,					
Ticket Sales, 22 for $1.00,					
do 24 for $1.00,					
do 3 cents each,					
do Casino, Round Trip.					
do Special.					
Total Ticket Sales,					
Casino and Ground Receipts,					
Aggregate Receipts,					

LINE. ______ **Conductor.** ______ **Motorman.** ______

MOTOR ______ **TRAILER** ______

No. ______ **No.** ______

Motor No. ______ *Trailer No.* ______ *Relieved by Conductor No.* ______

Date ______ *189*

Register at Ending - ______

Register at Commencing ______

Fares Registered - - ______

Ticket Fares - - ______

Cash Fares - - - ______

Total Cash - $ ______

Cash Received $ ______

MOTOR: TRIPS FROM	TO	NORTH-EAST: Fares	Free	SOUTH-WEST: Fares	Free	TOTAL: Tickets	Fares Registered	TRIP	TIME M	TRAILER: NORTH-EAST: Fares	Free	SOUTH-WEST: Fares	Free	TOTAL: Tickets	Fares Registered	TRIPS: FROM	TO
								U									
								D									
								U									
								D									
								U									
								D									
								U									
								D									
								U									
								D									
								U									
								D									
								U									
								D									
								U									
								D									
								U									
TOTAL																	

NOTICE: This Report will not be accepted Unless Fully and Carefully Made Out. NOTE CAREFULLY TRIPS MADE. **WRITE REMARKS ON BACK.**

FORM 2.

THE TOLEDO TRACTION COMPANY.

CONDUCTOR'S REGISTER REPORT.

Station ______ *Foreman* ______

Date ______ *189*

Car No. of ~~Register.~~		Statement.	Balances	Used by Conductor No.	On Route.	Condition of Register	REMARKS.
	In						
	Out						
	In						
	Out						

FORM 5.

to their delivery at main office. Observe that we do away with the counting of money, etc., at station and employment of receivers. The entire work is done in the auditor's office and under his personal supervision, at much less cost of labor and less liability to loss.

Form 7. "Counter's Cash Statement." This is used by counters to verify the total returns of routes for the day. Each envelope received from conductor is first examined and if in any way mutilated or unsealed, notation is made of such fact. We count the tickets and transfers first to be sure that no money is mixed with them, then the cash. No two open reports are allowed on the table at the same time.

If the returns enclosed do not correspond with the conductor's report, an actual inventory of contents is made on back of envelope and certified by at least two clerks. If more money is enclosed than called for by rings as shown on report, it is returned to the conductor. The cash is thrown into a pan provided with compartments for the several denominations, and on completion of the counting of routes, the money is placed in coin wrappers and counters, cash statement made out and given to clerk in charge. All shortages and overpayments are also noted on this slip.

Form 8. "Shortage Notices." The clerk in charge of counters sends to station clerks daily all notices of shortages or overpayments, and it is his duty to make collection from conductors and forward returns to main office.

"Bank." All metal money is placed in coin envelopes stamped with our company name and the number of the clerk enclosing it, as well as the date. In preparing the money for deposit the amount is checked in detail by two clerks. Deposit slip is made in carbon duplicate, and the signatures on all checks (giving amount) are placed thereon—we have special strong boxes for bank use, one key of which is kept by the bank teller. We make deposit at 10:30 daily.

Form 9. "Record of Earnings by Route." This statement is made by the clerk in charge of counters, and is designed to be a check on the counters and record of earnings of each line. It gives the number of runs, conductors' and motormen's names, number of badge, car number, etc., as well as the number of cash fares and tickets received, in detail. The total amount due from all conductors on the line must correspond with the counter's cash slip (Form 7).

Form 10. "Record of Earnings of all Routes." On this statement we consolidate the footings of route statements, thus giving total receipts for the day.

General. I have taken from my "General Earnings Record" a copy of headings which are herewith exhibited. This book is divided by extra heavy leaves into five sections. In the first division the record of earnings, together with record of receipt of tickets in detail, is kept by routes daily for each month. The second division is for totals of *all* routes daily for each month. The third is a summary of each route each month for one year. In the fourth division are the totals of all routes for one year. The fifth division is a record of all tickets sold, together with complimentaries, employes,' etc. I treat each issue of regular sales tickets as cash on the ledger, and, therefore, the amount sold must agree with ledger account, plus inventory.

I go somewhat outside of the subject assigned me, in order that a clearer idea may be obtained of the method taken to record fares from receipt to their "deposit in bank."

The company I represent controls and operates all street railways in Toledo, and by reason of conditions of franchises, separate accounts are made for each company. We also furnish current for all street lighting and incandescent lighting in Toledo.

Materials and Supplies Accounts From Purchase to Use

By W. G. Ross

The purchasing and storekeeping of materials and supplies are of great importance to street railway companies, requiring careful and constant watchfulness both on the part of the purchasing agent to secure the best materials at the lowest price, and of the storekeeper to see that they are properly handled and distributed.

In the purchasing of materials and supplies the company cannot be too careful in the selection of the man appointed as purchasing agent, his honesty must be beyond all question, and his capabilities or experience such as to warrant his appointment to this most important position.

In purchasing it is advisable, wherever possible, to call for tenders and quotations, and the lowest should invariably be accepted, and no favoritism shown. Price lists of standard goods should be kept carefully at hand, and catalogues systematically filled.

Materials purchased should be the best obtainable, and careful watching required to purchase the most modern and best goods, it being false economy to purchase anything but the best. Especially is this the case in the electrical equipment of the cars, it is here that the great expense of maintenance comes in, probably more than one-half of the supplies purchased for repairs are on this account, and experience has shown that it is only the best material that will stand the great strain that the electrical equipment is called upon to bear.

Great care should also be exercised in the purchasing of new electrical equipments, as changes, improvements and economies are rapidly taking place as the defects and weaknesses of the apparatus become apparent. By reason of these continual changes and improvements the purchasing agent should be in close touch with the manager and the heads of the shop departments, and consult with them, as also with the storekeeper, to see that the smallest possible stock of materials is kept on hand, and that no accumulation of out-of-date articles takes place.

All purchases made should be ordered on an official manifold form, plainly numbered and having stated thereon the places goods should be delivered at, and also that all invoices must state order number and accompany goods.

The storeroom should be conveniently situated near the principal shops of the company, and should be so arranged that supplies can be easily handled.

All material and supplies, whether for construction or operation should be in charge of a storekeeper. When material is required a requisition on the storekeeper should be made out on a regular printed form, signed by the foreman in charge and countersigned by the superintendent of the department. The requisition should state the article, quantity, and what required for, opposite which the storekeeper fills in the value, as it is from these requisitions that he classifies the actual material used during the month under the different headings for his monthly statement furnished the office.

The storekeeper should keep careful watch on his stock, keep it as low as possible, and see that there is no accumulation of out-of-date articles. When any supplies are required by him he should make out a requisition on the purchasing agent, giving the date for which it is required.

The storekeeper should keep a stores ledger, with accounts for the principal articles, in which ledger should be entered in the debit the invoices of goods as received, and the credit material used, the balance should agree with his stock in hand.

The storekeeper should have charge of all scrap material; he should have convenient places for safe storing, and the purchasing agent should dispose of same as frequently as possible, so as to prevent any accumulation.

Returns of scrap material turned in to storekeeper should be made direct to the office from the foreman of the shops, and no delivery of scrap material sold by the storekeeper should be made without an order from the office stating that payment has been received.

In the smaller companies it is desirable for the sake of economy to combine the position of purchasing agent and storekeeper; where this is done it is important that the purchasing should be done under the direct supervision of the manager.

In conclusion, the official in charge of the office should keep careful oversight of material and supplies from their purchase till consumption, watching the prices paid as also the returns of the storekeeper of the material used, as on him the management must depend to a great extent, to see that the company receives full benefit from these important departments.

Time-Keeping, Pay-Roll and Method of Paying

By Frank R. Henry

Time-keeping

The system herewith presented is one which the Missouri Railroad Company, of St. Louis, has followed for some time. Our manner of keeping time is by the hour for conductors, motormen

and track laborers; other employes by the day. The time is kept by the foremen or superintendent of each department in the following manner: the foreman of the car sheds is the time-keeper of conductors and motormen and all men that are strictly under his charge. The time table indicates the number of hours, and fractions thereof in tenths for each run made, and at the end of each day's run the foreman records opposite their names in his time book the number of hours made as indicated by the run upon which they were assigned. The total of the time for the day must agree with the total hours of the time table.

The foreman is required to group the time of the day men under the classification furnished by the office, i.e., the time of car cleaners, switch men, watch men, stable men, shed men, etc., must be recorded under their respective headings, and should an employe be taken from o e class of work to another, the time must be charged under each class separately.

The master mechanic of the repair shop keeps the time of the men under his charge, keeping the time of labor on car bodies, trucks, car painting and motor repairs separately.

In the machine and blacksmith shop the time is kept by the head mechanic, which with an itemized statement of time and amount of work turned out, is given to the master mechanic for his approval and returned to the office by him with his time book.

The time of track laborers making the ordinary track repairs is kept by the track foremen, keeping the time of all new construction separate from their regular work. We find it necessary to have a time keeper whenever a large force of men is employed on construction or re-construction work. Each time keeper is furnished with two time books, one printed for the first fifteen days of the month, the other for the last sixteen days. The necessity for this is that we pay twice a month. The time is totalized and calculations extended in time book by the time keeper and then returned to the office, from which we proceed to check off time and make up pay roll. The time book is then returned to the time keeper to be used for the same period of the next month.

PAY ROLL

The pay roll is ruled as follows : first column for number, second for name, the five succeeding columns in which to enumerate the class of work or classifications under which work has been rendered. The remaining columns are such as are usual to pay rolls, for total time, rate, amount paid, amount due and total amount.

After all the names and amounts have been copied from time-books and properly classified, the names are numbered and pay roll totalized, each classification being footed separately so as to show the amount of each and for the convenience of comparison.

METHOD OF PAYING

An envelope is prepared for each employe, placing thereon the pay roll number, name and amount of pay due, deducting any amount that may have been advanced thereon or other charges, such as accident insurance, uniform account, etc. Having prepared an envelope for each person on the roll in this manner, they are checked back to catch errors and to be assorted alphabetically. The money is placed on the envelope face up, change being put inside to facilitate handling, the money recounted by another person, then put inside the envelope and sealed.

The pay is delivered to each employe in person on pay day, upon calling at the office, except that the construction gangs are paid at place of work. Each employe receipts his envelope and drops it into a box provided for that purpose—this is done for future reference. They are then taken out of the box and assorted numerically. Should a number be missing, we turn to the pay roll and see to whom such numbered envelope was given, and the time-keeper is then requested to have him call at the office with his envelope. In case he has lost it or misplaced it another envelope is prepared for him to receipt.

WM. D. BARNES, president of the Greenbush & Nassau Railway & Power Company, of Greenbush, N. Y., is interested in an electric railway from Pittsfield to Albany. Construction work is now in progress on the road from Albany as far as Brainard, and Mr. Barnes states that steps will be taken to extend the road to Pittsfield as soon as arrangements can be completed on this side of the line.

THE City & Suburban Railroad Company, of Savannah, Ga., will petition for the right to extend its tracks on certain streets of the city.

Exhibits at the Convention

D. N. Long, of La Salle, N. Y., exhibited a headlight burning acetylene gas.

D. J. Sinclair, of Caledonia, N. Y., presented his automatic coupling for trolley cars and traction engines.

The American Improved Rail Joint Company, of Chicago, was represented by its president, A. S. Littlefield.

The American Pulley Company, of Philadelphia, Pa., had a couple of its "all wrought steel pulleys" on exhibition.

Naugle, Holcomb & Company, of Chicago, were present in the person of Mr. Naugle and George Weston, superintendent.

The Russell Manufacturing Company, of Chicago, distributed its catalogues and showed a number of its curve taking trolley hoops.

The Hope Electric Appliance Company, of Providence, R. I., exhibited samples of its instantaneous make and break safety switches.

The St. Louis Car Company, of St. Louis, Mo., was represented by J. J. Coleman, who showed photographs of the No. 8 and No. 13 trucks of his company.

The Electric Mutual Casualty Association, of Scranton, Pa., occupied a space at the convention and presented particulars of its method of insuring against casualties.

The Bibber-White Company, of Boston, Mass., distributed as a souvenir of the convention a letter opener and pocket comb. The company was represented by C. E. Bibber.

HEADQUARTERS OF THE STREET RAILWAY JOURNAL

The Jandus Electric Company, of Cleveland, O., and the Buckeye Electric Company, of the same city, were represented by B. Whipple and had some interesting exhibits.

The Weston Electrical Instrument Company, of Newark, N. J., did not make any regular exhibit, but its instruments were on many of the switchboards in the convention hall.

The Jewell Belting Company, of Hartford, Conn., distributed a very attractive souvenir in the form of a fine leather cigar case. The company was represented by C. L. Tolles and A. E. Silk.

The Safety Insulated Wire & Cable Company, of New York City, presented the delegates with copies of various strong testimonials which it has received from prominent railway companies.

The Central Union Brass Company, of St. Louis, Mo., was represented by T. C. White, and its souvenir of the convention—a commutator of a size suitable for a watch charm—was very popular.

Bradt & Zimmerman, of Troy, N. Y., showed the Bradt automatic car door handle latch for preventing the car door from sliding open on rounding curves or at switches. S. W. Bradt was in charge.

The Leschen-Macomber-Whyte Company, of Chicago, gave away a neat leather matchsafe and an edition of Eugene Field's "The Clink of the Ice," which some of the delegates truly appreciated.

The Rochester Car Wheel Works, of Rochester, N. Y., presented delegates with a neat leather purse as a souvenir of the convention. F. D. Russell and George E. Morse represented the company.

C. E. Greene, of Niagara Falls, N. Y., exhibited a number of samples of high insulation line material, including indestructible steel pins, glass and porcelain insulators for high voltage power transmission, etc.

The National Water Tube Boiler Company, of New Brunswick, N. J., was represented by Charles Y. Flanders, the company's New York manager, and presented to delegates a tasteful pocket book for carrying change.

The Pettingell-Andrews Company, of Boston, Mass., showed a device for lifting car bodies from trucks, useful in car house and repair shop work. The company also showed some of its various electric railway specialties.

EXHIBIT OF THE CENTRAL ELECTRIC CO. AND LOMBARD HYDRAULIC GOVERNOR CO.

The St.-Louis Register Company, of St. Louis, had its interests cared for by its Eastern agent, Giles S. Allison. The exhibit consisted of several registers, the fronts of some of which having been removed to show the internal workings.

The Russell Manufacturing Company, of Chicago, Ill., was represented by W. H. Russell, and had on exhibition a novel form of trolley harp for keeping the trolley on the wire when going around curves and on crossings.

The Pennsylvania Steel Company, of Steelton, Pa., showed samples of its adamantine construction of special work in the form of crossings, frogs and mates. The exhibit was outside of the hall at the right of the main entrance.

The Lombard Hydraulic Brake Company, of Boston, Mass., was represented by H. M. Daggett, Jr. The space was near that of the Lombard Water Wheel Governor Company, and the company had for distribution circulars of this brake.

The General Incandescent Arc Light Company, of New York, exhibited samples of its enclosed arc lamps and quick break switches. The arc lamps were operated in series on a railway circuit. E. A. Lavins was present at the convention.

EXHIBIT OF THE G. C. KUHLMAN CO.

The Mehling Manufacturing Company, of Cleveland, O., had an exhibit at the International Hotel devoted to its metal street car tickets and portable car safe and register. The company presented as a souvenir of the convention a handsome pocket knife.

The Standard Thermometer & Electric Company, of Peabody, Mass., had an exhibit of its enclosed arc lamps, which are operated five in series on a railway circuit. The lamps were noticeable for the steadiness of their light and the attractiveness of the cases.

The Buda Foundry & Manufacturing Company, of Harvey, Ill., showed two of its Paulus track drills for T and 11 in. girder rails. The drills were in service, drilling ⅞ in. holes through 1⅛ in. girder rails in two minutes. The exhibit was in charge of Charles Parsons.

The Atkinson Rail Bond Company, of Chicago, was very much in evidence through the head of the company, J. M. Atkinson, who presented a buttonhole thermometer as a souvenir. This was useful in determining what kind of a time the fellows had down at Buffalo.

The Obe Cullison Car Fender Company, of York, Pa., showed a model of the Cullison street car fender which doubles back under the platform, being shot out in emergency by the motorman's pressing upon a foot lever. The inventor, Obe Cullison, explained the model.

The Harrington Rail Bonding Company, of New York City, showed an enlarged drawing of a section of rail with bond in place. This bond was described in the last issue of the STREET RAILWAY JOURNAL. Mr. Harrington attended the convention in the interests of this device.

The Duff Manufacturing Company, of Allegheny, Pa., had its interests cared for by B. D. Tillinghast, who stated that its "Barrett jack" is being universally adopted by electric and cable railways. The jack can be worked at any angle; the street railway size weighs 60 lbs., and has a capacity of 10 tons.

The McMullen Woven Wire Fence Company, of Chicago, exhibited its fence, which has been in use for years on steam roads and is lately coming into use on suburban electric lines, which run over private right of way. Edmund G. Fisher was in charge and presented for a souvenir a handsome card case.

EXHIBIT OF THE COLUMBIA MACHINE WORKS

The Paper Vending Machine Company, of St. Louis, represented by Robt. A. Schlegel and Frederick A. Wind, exhibited a slot machine for vending papers in a car. The company proposes to put its machines in cars, giving a portion of the receipts in return for the privilege. The machines are not for sale.

Pomeroy & Fischer, of New York City, had a tastefully arranged exhibit of varnishes and paints, arranged on a tier of shelves in the form of a pyramid. This concern is sole agent in this country for Nobles & Hoare's London varnishes, which formed a feature of the exhibit. Mr. Pomeroy was present at the convention.

F. H. Newcomb, of Brooklyn, N. Y., manufacturer of uniform caps of every description, showed a case full of his caps which have been adopted as standard on the Metropolitan Street Railway of New York, the Kings County Elevated, Atlantic Avenue Railroad of Brooklyn, New York Central Railroad, and many others.

The Kleanit Company, of Akron, O., represented by W. F. Dressler, gave away cakes of "Kleanit" which cleans everything from your teeth to a street car track, but is especially recommended for cleaning and polishing windows, car bodies, fixtures, etc. The company presented a card showing a long list of railways using "Kleanit."

The Adams & Westlake Company, of Cincinnati exhibited a full line of oil and electrical headlights, also some very tasteful electroliers for three and five lamps each. Acme curtain fixtures and interior car fittings, brake handles and signal lamps were also shown. L. A. Gray, W. S. Bartholomew and H. E. Keeler represented the company.

The Pratt & Letchworth Company, of Buffalo, N. Y., through H. C. Edson and C. R. Brown, exhibited a fine line of open hearth

steel and malleable iron castings for car trucks and electrical apparatus. The company is doing a great deal of work for the larger electrical manufacturing companies and many street railways and supply houses.

The Milwaukee Rail Joint & Welding Company, of Milwaukee, showed a new cast joint differing from those now on the market, in that a steel jacket forms the mould and becomes a part of the finished joint after the molten iron is poured in. E. E. Warner, S. B. Durand and A. W. Lynn of the company, were present.

The Kauffman-Conkell Company, of Canton, O., through W. J. Kauffman and L. A. Loichot, showed its automatic cut-off and emergency device for rendering falling trolley wires harmless, by means of shifting the current to an auxiliary wire. This appliance allows the car to proceed at once, without waiting for the emergency wagon

EXHIBIT OF TAUNTON LOCOMOTIVE MANUFACTURING CO.

The H. B. Camp Company, of Aultman, O., represented by A. L. Daniels, exhibited its vitrified underground conduit which is used by the West End, of Boston, the Metropolitan, of New York, the Union Traction, of Philadelphia, the Chicago City, the Metropolitan, of Washington, the Consolidated, of Pittsburgh, and numerous other street railway companies.

The Wells & French Company, of Chicago, exhibited the Price momentum street car brake described in the STREET RAILWAY JOURNAL for October. Quoting from the descriptive catalogue, the brake is two years old and one hundred are in use on one road. W. G. Price and Frederick Saxelby showed the brake and were kept busy operating it for inquisitive railway men.

The Detroit Stove Works, of Detroit, Mich., through its Buffalo representative, H. L. Schutt, showed a line of car stoves, varying in price from $16 to $18 and a station stove at $9. The chief features of the car stoves are that they are of cast iron and have interchangeable parts. Mr. Schutt was especially well pleased with the convention, having made a number of good sales.

VIEW DOWN AISLE IN EXHIBITION HALL

The Partridge Carbon Company, of Sandusky, O., had space with the Central Electric Company, who is its agent. James Partridge, who was in charge, distributed an amusing card on which was printed in colors a grotesque picture of a man who had sand "on the seat of his pants" for scratching matches. This souvenir attracted much attention and there was a big demand for it.

The Billings & Spencer Company, of Hartford, Conn., had an exhibit of a panel showing a full line of drop forged copper commutator segments. Samples of the company's line material for electric railways were also shown. As a souvenir the company presented a handsomely bound pocket memoranda book with miniature copper representation of a commutator segment on the cover.

The Dayton Automatic Car Switch Company, of Dayton, O., had a model of the Rice automatic switch in charge of the inventor, Franklin Rice. This switch is automatic, being operated from the car by the motorman's foot. It is not an electric device, but purely mechanical. The motorman actuates the trip as the car passes over

EXHIBIT OF THE MEAKER MANUFACTURING CO.

it, and the motion is conveyed to the switch by an underground rod.

The Rochester Hose Bridge Company, of New York City, installed one of its bridges on the street car line to the convention hall, and delegates were able to appreciate its utility by being carried over it. Its features are: weight, 180 lbs.; carrying capacity, 30 tons; removable top for stringing hose without disturbing bridge; collapse to 6 ins. in width. R. P. Barbour took care of the company's interests.

EXHIBIT OF THE WELLS & FRENCH CO.

The Meaker Manufacturing Company, of North Chicago, so long a feature of street railway conventions, had a handsome booth tastefully decorated in blue and yellow bunting. This company has attended conventions since the time the exhibition had but a handful of exhibitors, and no convention would be complete without the head of this company with his genial humor and scores of reminiscences.

E. F. DeWitt & Company, of Lansingburgh, N. Y., was represented as usual. Mr. DeWitt had samples and models of his "Common Sense" sand box, and took pleasure in explaining to

delegates the merits of the device and the excellent record which it has made on different roads. The valve of this box is made of an anti-rusting metal which prevents any possibility of its corroding and sticking.

The Cravath Manufacturing Company, of Chicago, represented by its president, J. R. Cravath, found that many managers and electricians were on the watch for the exhibit of the Cravath excessive current recorder for keeping tab on the efficiency of motormen. This device has been put on the market since the last convention and marks one of the advances in street railway practice during the year.

The Watson & Stillman Company, of New York City, was represented by F. H. Stillman, and showed three of its large line of heavy machinery for electric railway service. The machines exhibited were a portable girder rail bender, a universal hydraulic punch and a Smith power rail bender. The machines were noticeable for their substantial and compact appearance and were carefully inspected by many of those in attendance.

The Taunton Locomotive Manufacturing Company, of Taunton, Mass., had a striking exhibit of snow plows on the railway tracks in front of the convention hall. Two types of plows were shown, the standard nose plow and the double track share plow, both of which were very favorably commented upon by the delegates. The company was represented by Jacob Wendell, Jr., R. L. MacDuffie, J. H. Wright and A. P. Emmons, of Boston.

The Hale & Kilburn Manufacturing Company, of Philadelphia, Pa., was well represented by H. T. Bigelow, who stated that all of the sample cars exhibited by the different manufacturers at the convention were equipped with Hale & Kilburn seats. The large number of Hale & Kilburn seats also in use on the electric lines of Niagara Falls and Buffalo, formed a most practical exhibit for the company and one which did not escape the attention of the visiting managers.

The Skeen Electric Switch & Signal Company, of St. Louis, occupied considerable space with its safety electric signal system for the protection of street railway crossings, either highway or steam railway. The signal is also for use in operating cars on single track with turnout. The company also exhibited an automatic magnetic regulator to keep car lamps and heaters in service at a constant potential. The superintendent of the company, Robt. Skeen, was in charge.

The Ham Sand Box was exhibited at the convention by the manufacturers, the Trojan Button Fastener Company, of Troy, N. Y. A. W. Ham and R. H. Ham were both present in the interests of the device. This sand box, it is claimed, will not leak, clog, or waste the sand, and as it is made of bronze there is no danger of any part of it rusting. The fact that there are no valves, no worm, and no gears in the construction of the box was noticed and commented upon by many of the visitors.

The Cleveland Frog & Crossing Company, of Cleveland, O.,

EXHIBIT OF THE GRAHAM-WOODWARD EQUIPMENT CO.

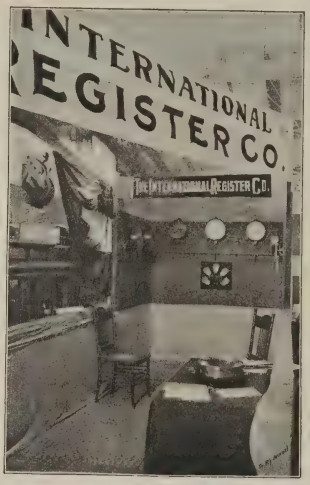


EXHIBIT OF THE INTERNATIONAL REGISTER CO.

EXHIBIT OF THE KEYSTONE ELECTRICAL INSTRUMENT CO.

The Garl Electric Company, of Akron, O., in connection with house and other telephones, exhibited its street car telephone. Only connection boxes are placed on the poles, the 'phone being carried on the car. In case the car is disabled too far away from the connection box for attaching the portable connection the telephone can be raised from the holder and carried to the nearest connection box and attached from that point. M. Garl was in charge.

The Van Wagoner & Williams Hardware Company, of Cleveland, O., had an exhibit consisting of a framed panel showing a full line of the drop forged segments for commutators manufactured by it. These segments have become very popular, and as the company supplies them in all forms for the earliest as well as for the latest types of motors, they have had a large sale. Mr. Van Wagoner attended the convention in the interests of his company.

The Fuel Economizer Company, of Matteawan, N. Y., exhibited a model of its well known Green economizer, and adjoining the model were several sections of tube employed in the economizer. The company also had several pamphlets giving drawings of actual installations in prominent power stations, the advantages of the economizer and a number of very strong testimonials from prominent managers in this country and abroad to the value of the economizer.

The Duquesne Forge Company, of Pittsburgh, Pa., made an exhibit of forged steel axle gears. The durability and wearing qualities of forged steel are too well known to need repetition, and long life with reduced weight are the merits claimed by the manufacturers of these gears. The amount of reduction secured in weight is said to be 30 per cent in the rough gear and 20 per cent in the finished gear. David S. Bissell, the originator of the gear, was in attendance.

exhibited specimens of its special work, switches and the Porter derailing switch. F. A. Lapham was in charge and took pleasure in explaining to the visiting delegates the special advantages claimed for the special work of this company, whose products have established for the company a leading position in the street railway fraternity. The Porter derailing switch especially attracted much attention, and many encomiums were pronounced upon it.

The W. T. Van Dorn Company, of Chicago, successor to the Fitzgerald-Van Dorn Company, so well known to convention goers, showed, in addition to its older style of couplers, a heavy ball joint, which it has just brought out, and pictures and drawings of its new attachment just installed on the new underground railway of London. The company, which was represented by W. T. Van Dorn, is manufacturing nine different styles of automatic couplers designed to meet every condition of street and elevated railway traffic.

The Hunter Illuminated Car Sign Company, of Cincinnati, is just placing on the market a new illuminated sign for both day and night service. It was exhibited by Lytle J. Hunter. The names of the various places reached by the car are printed on a sheet which passes over rolls controlled by the motorman who can at will cause any name to appear. Special illumination can be provided, or the sign may be arranged so that the light from the interior of the car illuminates it. The company guarantees the signs for two years.

The International Register Company, of Chicago, was represented by A. H. Woodward, treasurer and manager, Charles N. Wood, Boston agent and W. H. Brown. They exhibited a full line of the company's registers, including some beautifnl open models which attracted much attention for the reason that many people are unfamiliar with the internal workings of a register. The new

double register recently brought out also attracted much attention; many of the larger companies have already adopted it as standard.

The Hunter Automatic Fender Company, of Cincinnati, had no exhibit, but was represented by Lytle J. Hunter. The Hunter fender is making a great record and large numbers are being sold. Recent orders included one hundred for the Cincinnati Street Railway, thirty-six for the Wheeling (W. Va.) Street Railway, forty for the Lexington (Ky.) Belt Line Railway; forty for the St. Louis & Meramec River Railroad; thirty for the Citizens' Street Railway, Oshkosh, Wis., and one hundred for the Columbus (O.) Central Railway.

The Cleveland Construction Company, of Akron, O., exhibited the W. & W. oil journal box, which is being adopted by a number of street railway companies. The box can be made for any journal and is so thorough a lubricator that greater speed can be made with less power consumption than with any box now in use. It is further claimed that cars have been run over ten months on one filling of oil and the oil gives promise of lasting until the bearing is worn out. No waste or wicks are used, the oil being fed onto the journal by a revolving paddle.

E. P. Sharp, of Buffalo, N. Y., showed a full line of second hand apparatus, including an Edison No. 5 double reduction motor, S. R. G. motor and armature, and G. E. 800 armature, also a number of gear cases, rheostats, field spools, fare registers, reversing switches, ammeters and other odds and ends for old style apparatus. The exhibit attracted much attention from those managers who

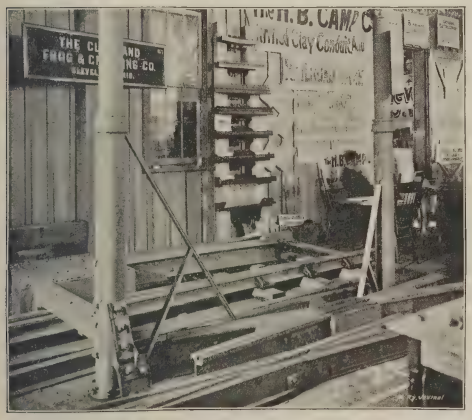


EXHIBIT OF THE CLEVELAND FROG & CROSSING CO.

have at present apparatus built several years ago and with whom Mr. Sharp had a large custom. In the rear of the exhibit was pasted a motto, "Any Old Thing."

Wendell & MacDuffie, of New York, were both present at the convention and had a number of exhibits. As the representatives of the Taunton Locomotive Manufacturing Company they were interested in the exhibit by the latter of the two snow plows in front of the convention hall referred to above. As selling agents of the Bowen face protector, to which reference is made later; as representatives of the Rochester Car Wheel Works and other important street railway manufacturing interests they had much to interest the attendants of the convention.

The John Stephenson Company, Limited, of New York City, did not make any exhibit, but was represented, as usual, by Messrs. Pugh and Tackaberry, who have attended a great many conventions, and are authorities on conventions as well as on the subject of cars. They presented as souvenirs a handsomely bound pocket blank book and also a convenient memoranda book, giving weights of different styles of cars, traction table, etc. The pamphlet also contained a list of some of the company's customers, and views of a number of standard types of Stephenson cars.

The Charles Scott Spring Company, of Philadelphia, Pa., had an interesting exhibit of the wide variety of springs manufactured by that established house. These included spiral, elliptical, torsional, brush holder, machinery and trolley springs. These different types were all very tastefully arranged, and the booth of this company was one of the most attractive in the convention hall. The company was represented by D. L. Roche, and H. C. Johnson, both from Philadelphia. As a souvenir the company presented a pocket note book handsomely bound in black leather.

The Parrish Signal Company, of Jackson, Mich., is a new name at the convention, but comes with a thoroughly successful invention for preventing accidents at crossings. The approaching car is automatically announced by the ringing of a bell and the flashing of a red light, continuing until cut out by the car as it passes the crossing. E. D. Warner, treasurer of the company, was not least among genial fellows and was a well known man before the first day was over. The signal is already in use on several suburban lines and gives promise of much popularity.

The Duplex Car Company, of Boston, Mass., had in regular

EXHIBIT OF THE CONSOLIDATED CAR HEATING CO.

service on the Niagara Falls & Suspension Bridge Railway and on the "Gorge Route," one of its combination open and closed cars which was fully described in the last issue of the STREET RAILWAY JOURNAL. The readiness with which this car can be changed from an open to a closed car, or vice versa, and its attractive appearance, made it the object of much interest. John A. Lowell, the president of the company, was present, and his invitations to ride on the car were eagerly accepted by those to whom they were tendered.

W. W. Whitcomb, was present in the interests of the Composite Brake Shoe Company, of Boston, and presented to delegates a fine list of testimonials from prominent railway companies on the value of the brake shoe. The pamphlet containing these testimonials also gave a list of the street railway companies in New England using the Composite shoe. This list is nearly, if not quite, a complete list of all the railways in New England. The pamphlet also contains extracts from reports and discussions at recent Master Car Builders' conventions on the merits of the "Compo" shoe.

The Jackson & Sharp Company, of Wilmington, Del., had on exhibition the duplex car recently built at its works and described in the last issue of the STREET RAILWAY JOURNAL. The exhibit was made in connection with that of John W. Lowell, the inventor of the car. The novel features of the car were described last month and are referred to elsewhere, but many encomiums were passed upon the high grade of workmanship which were displayed in the car, the attractiveness of its appearance and the durable

EXHIBIT OF THE CHAS. SCOTT SPRING CO.

character of every part. The company was represented by J. M. Jackson.

The Consolidated Car Heating Company, of Albany, N. Y., had, as usual, a very attractive exhibit in the convention hall as well as a large number of heaters in practical use on the cars in Niagara Falls, Buffalo and vicinity. In the convention hall the standard heaters, manufactured by the company for cross seat cars and closed cars with longitudinal seats, were exhibited. The company also

showed a heater with ornamental case adapted for parlor car service, its system of five and three point switches, etc. James F. McElroy. Henry R. Ransom and C. P. Cosper represented the company at the convention.

The Pearson Jack Company, of New York, exhibited models of its patent car replacing jacks, showing their superiority not only

EXHIBIT OF THE NEW YORK SWITCH & CROSSING CO.

in lifting, but in carrying or swinging at the same time. These jacks have been adopted by a long list of street railway companies who appreciate their value and they are fast superseding the old fashioned straight up and down screw jack. The foreign trade is also large and increasing; patents have been secured in Great Britain, France, Germany and Russia. These jacks are sent on thirty days' trial at the expense of the company. The exhibit was in charge of Geo. M. Brown.

H. W. Peabody & Company, of New York City, exhibited in the space of the Diamond Truck & Car Gear Company, two wooden models of the Pullens' joint box for roadbed construction. This box has been in use for three years on the tramway lines in Sydney, Australia, and has given such good satisfaction that 26 miles of track will be equipped with it during the coming year. Its construction was described in the last issue of the STREET RAILWAY JOURNAL, and the important merit is claimed for it that the joint bolts can be reached and tightened up without tearing up the pavement, by the simple removal of the box cover.

The Columbia Machine Works, of Brooklyn, N. Y., showed a full assortment of the many electric railway appliances for which this company has a high reputation. The fact that it is ready to

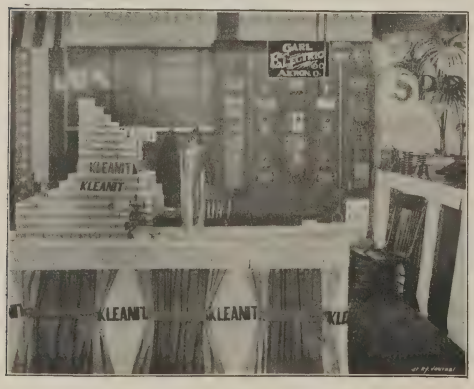


EXHIBIT OF KLEANIT AND THE GARL ELECTRIC CO.

supply all forms of car trimmings was made evident by a panel, upon which was mounted grab handles, window guards, strap rail brackets, etc. On a table in the exhibit were shown commutators of different types for Steel, General Electric and Westinghouse motors, sample bearings for the different systems, trolley harps, controller parts, trolley wheels, babbitt metal, etc. J. G. Buehler and W. R. Kerschner attended the convention.

The Lombard Water Wheel Governor Company, of Boston, Mass., was represented by A. V. Garratt, and showed some interesting speed curves of turbines governed by the Lombard governor. Visitors had also a chance to inspect the practical operation of this governor in the station of the Niagara Falls Hydraulic Power & Manufacturing Company. The company also showed speed recording strips produced from its steam engine governor which is claimed to be as marked an improvement in the art of regulating the speed of steam engines as the Lombard governor is in the art of governing water wheels. The exhibit attracted much interest.

Dillworth, Porter & Company, of Pittsburgh, had space in connection with the Continuous Rail-Joint Company, of America, Newark, N. J., and J. H. Sternberg & Son, Reading, Pa., all three of the companies being represented by Wm. F. Ellis. The first exhibited the "Goldie" perfect point spike, "Safety" tie plate, steel axles and a number of excellent photographs of the interior of the Boston subway, where the above mentioned track material is used. The Continuous Rail Joint Company showed its well known joint, which is also in use in the Boston Subway. The third company had a display of its Harvey grip rolled thread steel bolts.

The Cutter Electrical & Manufacturing Company, of Philadelphia, exhibited a full line of standard direct current, single pole and double pole circuit breakers, a 2000 volt, single pole circuit breaker and a 3000 amp., double pole circuit breaker. The latter is said to be the largest circuit breaker ever built, and is one of several recently built by the Cutter Electrical & Manufacturing Company for the United States Government Printing Office, at Washington, D. C. The circuit breaker attracted much favorable comment from the delegates present. The company was represented by W. M. Scott, electrical engineer, and H. B. Kirkland, New York agent.

The Partridge Carbon Company, of Sandusky, O., was represented by James Partridge, president of the company. This company had an exhibit in connection with the Central Electric Company, and showed a full line of the excellent self-lubricating motor

EXHIBIT OF THE CRANE CO.

and generator brushes, which it manufactures. The Partridge Carbon Company is one of the largest manufacturers of carbon brushes in the world, and its brushes are now in use on nearly all the prominent street railways in the country. The company has a great many fine testimonials from its customers as to the splendid wearing qualities and the good satisfaction in general that these brushes are giving.

Herrick & Burke, of New York City, electrical engineers, introduced at the convention their system of electrical inspection of railway motors as employed in Paterson, N. J., and elsewhere. The system consists of a small portable switchboard with trolley, the circuit of which is introduced in series with the motors to be tested by pulling down the car trolley and making contact to the trolley wire through the instrument. In this way the motors can be tested in the car house without disconnecting them in any way from the axle. The principle of the device, which depends upon the substitution method, was clearly explained by Mr. Herrick, who was present.

The Crane Company, of Chicago, had its interests taken care of by its well known salesman, G. A. Hurd. The exhibit showed the aluminum valve which Mr. Hurd locks up in a closet between conventions with some others; for example, a 24 in. valve 10 ft. high and weighing 6500 lbs. for a working pressure of 250 lbs. The exhibit also included high and low pressure wedge gates, extra heavy standard flange fittings, new valves tested to 5000 lbs. for hydraulic purposes, Crane's noiseless condensing back pressure valves, extra heavy swing and cup checks, steam traps and various types of flanges shrunk and screwed on to pipe. R. T. Crane, Jr., was in attendance part of the time.

The G. C. Kuhlman Company, of Cleveland, O., was represented by Mr. Kuhlman, and exhibited a very handsome vestibuled closed car on the track directly opposite the entrance to the con-

vention hall. The car measured 33 ft. over all and had a body length of 22 ft. 2 ins., and was fitted with Hale & Kilburn seats and backs upholstered in a rich pattern of old gold. The interior of the car was finished in cherry, and the ceiling was of birdseye maple. The car contained two four-lamp electroliers. The workmanship and finish of the car were much admired, and before the close of the convention the car was sold by Mr. Kuhlman to the Wakefield & Stoneham Street Railway Company.

The D. & W. Fuse Company, of Providence, R. I., had a display which aroused a great deal of interest. This consisted in demonstrating the absolutely non-arching properties of its fuse in comparison with a fuse of the ordinary exposed type, by short circuiting the 500 volt mains of the local street railway company. A 5 ampere exposed fuse was first short circuited producing a fierce arc until a special switch was opened. A D. & W. fuse under the same conditions produced no flash, the circuit being opened quietly and with complete success. The experiment was oft repeated, thoroughly establishing the claims for the new fuse. L. W. Downes and A. W. Hutchins represented the company.

The Monarch Stove & Manufacturing Company, of Mansfield, O., exhibited two of the Monarch track cleaners, one of which was beautifully gotten up with the blades, springs and nuts nickel-plated and other parts handsomely enameled; the other was of more substantial construction, designed for very heavy work. The exhibit was in charge of Emmet C. Baxter, general manager, W. T. Hurst, inventor, and F. A. Dew, superintendent. Orders were booked for several points in Canada and the States, and from the crowd about this exhibit it was manifest that the cleaner made a good impression. This was the only track cleaner on exhibition, and the special features of its construction were apparently well appreciated.

The New York Switch & Crossing Company, of Hoboken, N. J., made an exhibit in practical operation of its electric track switch for street railways. This was put in service on the Main Street line of the Niagara Falls & Suspension Bridge Railway Company, at a point within a short distance of the convention hall. This switch is operated from the car without any additional apparatus, the switch tongue being turned or not by the motorman, depending upon whether he passes over a short insulated section a few yards in front of the switch with the current on or with the current off. W. C. Wood, president of the company, attended the convention and exhibited the working of the switch to the visiting delegates.

A. O. Norton, of Boston, Mass., represented by H. A. Norton and E. T. Trefether, exhibited his specialty, street railway jacks for track and general purposes. The special feature of the exhibit was the No. 5 track jack for which the chief claims are a positive trip under all conditions and least number of wearing parts. The absolute safety and low price of this jack have caused it to be adopted as standard on a number of leading roads. They have also been recently ordered by a number of South American roads and are fast taking the place of hydraulics in general railway work. The exhibit also included a number of samples from the forty different patterns of jacks, ranging from 8 tons and 70 tons capacity, manufactured by this firm.

EXHIBIT OF THE NEW YORK CAR WHEEL WORKS.

The Corning Brake Shoe Company, of Buffalo, N. Y., exhibited near the center of the convention hall a full line of brake shoes for different makes of trucks, also models of the shoes in aluminum. As an object lesson of the value of these shoes, several partly worn shoes were also shown. One had made 55,000 miles on the Niagara Falls & Buffalo Railway and had yet some material left in it. Another had been taken from the Buffalo, Bellevue & Lancaster Railway and was only half worn after a service of 32,326 miles. The wearing surface of the Corning shoes, as is known, is composed of sections of soft coke cast iron, annealed and chilled charcoal iron. Those in charge of the exhibit were J. B. Terball, H. T. Mercur and Francis Granger.

L. A. Sayre & Company, of Newark, N. J., were represented by Mr. Sayre, and showed a set of ticket punches manufactured by him for perforating transfer and other tickets. Mr. Sayre also has a large punch for use at car houses and offices, for stamping a full pad of tickets before giving them to the conductor. This pad punch can be worked either by hand power or foot power. Mr. Sayre has devoted a great deal of attention to the subject of punches, and has introduced a number of improvements in their manufacture. His hand punch is of neat design, and not cumbersome, at the same time strong and capable of rapid operation. A special feature of his punches is that the die is always in full view, permitting accurate punching of figures.

EXHIBIT OF THE LEONHARDT WAGON MANUFACTURING CO.

The American Car Company, of St. Louis, Mo., sent to the convention for exhibition purposes a very handsome double truck vestibule car, which stood in front of the convention hall. The car was 36 ft. in length, including platforms, or 26 ft. body. The width of the car, between belt rails, was 8 ft. 6 ins. It was fitted up inside in cherry, with bronze trimmings and Scarritt cross reversible seats. The windows had pantasote curtains with Forsyth fixtures. The windows were double, making the car suitable for both summer and winter service. The car was mounted on American maximum traction double trucks, and was intended for Galesburg, Ill. William Sutton, president of the American Car Company, and E. J. Lawless, New York agent, attended the convention.

The Creaghead Engineering Company, of Cincinnati, had a very complete exhibit of its well known line of flexible brackets, both plain and ornamental. These are standard for high speed roads and are manufactured from the highest grade of material, the arms being of steel and all fittings made of malleable iron, making a bracket which it is practically impossible to damage in service. The exhibit also included a full line of overhead line material, malleable iron pole fittings, malleable iron cross arms, section insulators, insulated crossings, Bourbon strain insulators, etc. The display was nicely arranged, and in charge of G. R. Scrugham, their well-known superintendent. The company's souvenir was a very neat steel pocket rule in a leather case, and was in great demand.

The Sterling Supply & Manufacturing Company, of New York City, had a strong representation present in the persons of Wm. Tiffany, L. E. Robert, and F. A. Morrell. Much interest was manifested in the new register which this company is introducing on the market and in the new line of overhead equipment parts which were described in the last issue of the STREET RAILWAY JOURNAL. The brake, fenders, sandbox and other devices of this company were also favorably commented upon. The company's headquarters were in room 234 of the International Hotel, and its souvenir of the convention was eagerly sought after. It was a handsome gilded desk clock, the supply of which soon became exhausted on account of the extensive demand. It was certainly a "hit."

The Sargent Company, of Chicago, reported that the new brake shoe which it is placing upon the market attracted much attention, as the idea of surrounding a bundle of expanded metal sheets with cast iron is a departure in the manufacture of brake shoes. The company's booth was decorated in blue muslin; the exhibit showed the various steps in the manufacture of the new shoe, which was described in the Journal for October. The application of the expanded metal strips was shown in connection with a soft composition filling, it being impossible for this filling to fall out when incorporated with the expanded metal. Recent tests show a life of at least four times that of plain cast iron. F. W. Sargent, Geo. H. Sargent and A. T. Herr represented the company.

The Graham-Woodward Equipment Company, of New York City, was represented by Mr. Woodward, who exhibited his new bicycle hanger for street cars. This is an exceedingly ingenious de-

vice and by a practical railroad man, for Mr. Woodward is connected with the Market Street Railway Company, of San Francisco. The hanger consists of a fork device of Bessemer steel wire bent cold and made so that it can be either attached to the dash or to the side of a vestibule in the case of vestibuled cars. The handle of the bicycle is slipped over the fork and the seat then rests against the dash. While the support of the handle is firm it is not so rigid as to cause damage to the wheel in case of a slight jar or collision. Mr. Woodward's exhibit was close to the entrance where it received a great deal of attention.

The Taylor Electric Truck Company, of Troy, N. Y., had an elaborate exhibit of its trucks near the center of the recently com-

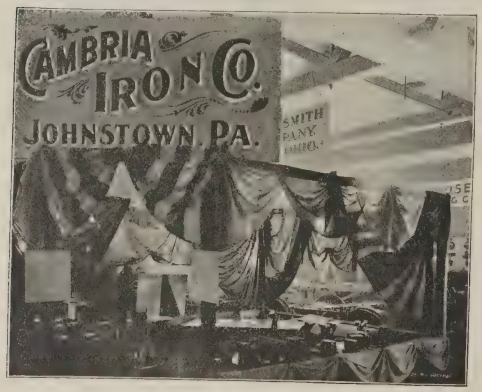
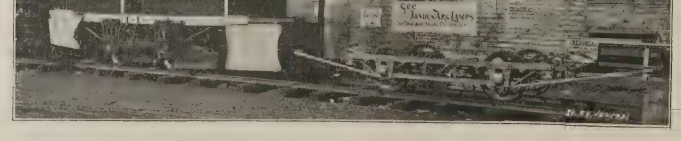


EXHIBIT OF THE CAMBRIA IRON WORKS

pleted addition. The exhibit included three trucks, a standard single truck, an Empire State double truck, and a standard single truck equipped with long extension truss for open cars. The latter truck was in front of the convention hall on account of lack of space within the building. The simple construction of the trucks, the absence of costly forgings and rivets, and the flexibility secured to the car body by the system of springs employed were made the subject of many favorable comments, and the exhibit was frequently visited and inspected by those at the convention. Mr. Taylor was present to explain the special merits of his construction, and with him were A. T. Reynolds and A. Tupper.

The Leonhardt Wagon Manufacturing Company, of Baltimore, Md., made an exhibit in front of the convention hall, which elicited many favorable comments. It consisted of two tower wagons; one was its well known emergency type for light work, and consisted of a ladder which can be folded up and laid back on the wagon. The other was its projecting platform tower wagon for overhead construction. The working platform on this wagon projects over the track in a position in which the use of the tower wagon does not interfere with the operation of cars on the track. The compactness of the wagon when the towers were not in use



BRILL SWEEPER AND TAYLOR TRUCK

and the fact that the towers were completely insulated were appreciated by those who examined the exhibit. The company was represented by Wm. M. Ives and W. K. Faust.

The Clonbrock Steam Boiler Company, of Brooklyn, N. Y., showed some models of its well known Morrin "Climax" boiler and also exhibited some very fine and large photographs of installations recently made by the company, including some of the 2500 h. p. boilers installed by the company at the Tennessee Centennial Exposition at Nashville, Tenn. The large amount of heating surface, which is fifty to one of grate, the fact that there are no dead points in the circulation, and the other valuable features of the boiler were appreciated by all who inspected the exhibit. Thos. F. Morrin, president of the company, was present, and was assisted in the exhibit by Chas. H. Sammens. As a souvenir the company presented the delegates with a bound set of photographic views of notable installations made of "Climax" boilers.

The Cambria Iron Company, of Philadelphia, Pa., occupied one of the most tastefully draped booths at the convention. The company's headquarters were located in the main hall on the aisle leading to the meeting room, and the attractive exhibit of the company was the occasion of much favorable comment. The company's exhibit consisted of sections of its standard girder, guard, renewal guard, tee, slot, Shanghai and other rails of varying weights and heights for every variety of work. The company also showed sectional diagrams of its different types of rail for electric railway service, and its headquarters were visited by large numbers of the most prominent railway men present. W. A. Washburne, of New York, who represented the company, told in a very interesting way the especial merits of the different sections exhibited.

McCardell, West & Company, of Trenton, N. J., showed one of the Trenton trolley wagons with extension platform and tower which have established a reputation for convenience and durability on electric railways. The exhibit was in front of the convention hall, and in charge of J. R. McCardell. The tower is constructed in the strongest manner and firmly braced, and the upper section is raised and lowered by a wrought iron chain passing over revolving sheaves fitted on sliding bearings and winding on a wrought iron cylinder secured under the sills of the body. The height of the tower when fully extended is 19 ft. 4 ins. The platform at the top revolves and can be secured in any position, and the wagon can be placed outside the tracks and all the work can be done from the platform without interfering with the running of the cars.

The Barney & Smith Car Company, of Dayton, O., was represented by its Eastern agent, F. E. Huntress, by H. E. Esterbrook and Harry Tesseyman, master mechanic. Its exhibit consisted of two trucks, one single truck, class "G" and one double truck, class "H." The class "G" truck has only recently been brought out; it is designed for simplicity, strength and durability, and having few parts does not easily get out of repair. The truck frame is of wrought steel, and all castings subject to strain are malleable. A special feature is the ease with which the wheels and axles can be removed. To do this it is only necessary to remove the lug in the pedestal jaw just beneath the oil box. It has a perfect brake, the braking power being equally divided on each wheel. The truck can be made for any kind of motor, any wheel base and track gage.

The Consolidated Car Fender Company, of Providence, had a very interesting exhibit in the convention hall, and one which attracted much attention. The company showed its system of car fenders, which has been widely adopted. Two fenders were shown mounted upon car dashers, the standard fender with bumper cushion and a special fender for parlor cars. On a table adjoining the fender were the different parts of the fender, from which the delegates obtained a good idea of how they are made up. The company also had a number of pamphlets and photographs of a horseless delivery wagon in Providence equipped with the fender. As a souvenir the company presented a neat

EXHIBIT OF M'CARDELL, WEST & CO.

leaflet of the shape and color of a pocketbook, and a small and exceedingly fine steel engraving of George Washington. The company's representatives were A. C. Woodworth, general manager; A. C. Woodworth, Jr.; G. H. Hale, general agent.

The Motorman's Protector Company, of Bridgeport, Conn., exhibited its patent protector. This is intended as a substitute for a vestibule and, as described in the last issue of the Street Railway Journal, consists of a sheet of glass about twice the width of a person's head, mounted on a flexible support which could be rolled up on a curtain roller fastened underneath the head. The height of a protector is regulated by a strap connecting the lower

part of the holder with the top of the dash. The whole device is light, durable, can be easily cleaned from snow and sleet by a brush of the hand, does not oscillate when the car is going at full speed, and is claimed to have many advantages over a vestibule while avoiding some of the disadvantages of the letter. It is the invention of an experienced motorman, John Bowen, who was present and explained the merits of the device. The selling agents for the device are Wendell & MacDuffie, who were also present.

The Miller-Knoblock Company, of South Bend, Ind., was represented by A. W. Morrell, and exhibited some fine assembled commutators for street railway motors. A careful inspection of these commutators convinced many that the company is fully justified in claiming it makes the highest class of commutators. The special process for their manufacture was invented by Mr. Morrell, and enables the company to offer a strictly high class product at a low price. The commutators were admired for their fine workmanship. The company also exhibited some large photographs of its wide throwing sprinkling cars used on electric street railways. This car will sprinkle thoroughly from curb to curb a street 100 ft. wide at one passage. As the injector is under control of the operator, by operating a single lever he can instantly regulate the quantity and width to suit the speed and condition of the track. The sprinkler elicited much favorable comment from street railway men.

The Joseph Dixon Crucible Company, of Jersey City, New Jersey, had a very attractive display of its unrivaled graphite goods. Chief among these is its new patent graphite wood gear grease, for gears in electric cars. This wood grease, it is claimed, bears the same relation to trolley cars as anæsthetics do to surgery, viz., deadening all noise and causing the gears to run as quietly as with raw hide pinions. The company also showed the Dixon silica graphite paint for trucks which will stay, so they say, for a full year on the trucks, and withstand the sand and mud abrasion for four seasons, also

EXHIBIT OF THE DIAMOND TRUCK & CAR GEAR CO.

the Dixon graphite commutator sticks for dressing commutators and arresting sparking; this is well spoken of by dynamo tenders. The Dixon resistance rods and belt dressing are too well known to even require mentioning. John H. Baird and A. L. Haasis were in charge of the show at space No. 39 on the sunny side of the hall and their mammoth Uncle Sam lead pencil wrote many an order.

The Diamond Truck & Car Gear Company, of Kingston, N. Y., has a reputation at conventions for making one of the most attractive exhibits on such occasions, and the company's record at Niagara Falls presented no exception to this rule. The company occupied a space along the western wall of the hall, and the potted palms made the exhibit a very tasteful one, while the reception space in the middle of the exhibit proved a popular place to rest. The company showed four trucks, two single and two double. The former were the Standard No. 3 and No. 5, which have been adopted by a number of prominent railway companies. Of the two double trucks one was shown in the company's own space, the other formed a part of the exhibit of the General Electric Company by whom it was fitted with motors. As a souvenir of the convention the company presented visiting delegates with a handsomely bound blank book. The company's representatives present were W. H. Wilkinson, W. H. Ten Broeck, F. T. Pullen and E. F. Hutton.

The Weber Railway Joint Manufacturing Company, of New York City, had a small, but interesting, exhibit of its rail joints. The character and principles underlying this joint are familiar to railway managers, and for this reason the company did not make an extended exhibit, but confined itself to a few sample joints which have been installed upon prominent railways, both steam and electric. One of these was a joint for a 9 in. girder rail, and was the same joint and section as that employed by the Consolidated Traction Company, of Jersey City, N. J., which is using Weber joints on both its old and new rails. Another application of the joint shown was to a 6 in. girder rail. The joint exhibited was similar to those employed by the Lynn & Boston Railway Company and other electric lines. In addition, the exhibit included a Weber joint for a 5 in., 75 lb. T rail, similar to those installed by the Weber Company on the track of the Boston & Maine Railroad. Percy Holbrook and Richard Devens represented the company at the convention.

The Murphy Manufacturing Company, of Pittsburgh, Pa., had one of the most elaborate exhibits at the convention. It was a set of its car wheel truing machines applied to a truck and in operation. The principle of this machine is well known to readers of the STREET RAILWAY JOURNAL, and the reason for the excellent results which have been secured by the machine on the Second Avenue Traction line of Pittsburgh, and elsewhere, were readily understood at the convention when the operation of the machine could be seen. The truck used for the purpose was one of the Baltimore type which had been in use for two years, and was equipped

EXHIBIT OF THE WEBER RAILWAY JOINT MANUFACTURING CO

with No. 38 Westinghouse motors. The truck was jacked up as in ordinary practice, the box lids let down, the centering pins run into the ends of the axle, the car motor was started, its speed being controlled by resistance, the emery wheel was revolved, and the practical operation of grinding demonstrated. Mr. Murphy, the inventor of the machine, was present and explained its operation. He was assisted by John Baly.

The Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., had, as usual, an exhibit which was excellent both in character of apparatus and in the manner of its representation. The company displayed a complete line of electric railway apparatus, from a booster outfit of a compound motor driving a 300 h. p. series wound generator to a motor fuse block. All of the different types of motors made by the company were shown, both as to outside construction as well as the inside of the armatures. There was a complete line of switchboard appliances, circuit breakers, light-

EXHIBIT OF THE ELECTRIC STORAGE BATTERY CO.

ning arresters and switches as well as diverters and controllers. The company had representatives at the convention from all its different agencies throughout the country, among them being W. F. Zimmerman, of New York City; R. S. Brown, of Boston; C. A. Bragg, of Philadelphia; J. R. Gordon, of Atlanta, Ga.; Maurice Coster, of Chicago, and E. L. Heinrichs of Pittsburgh. From the factory were present Messrs. Storer, Mallet, McLaren and Siegfried, while W. K. Dunlap had charge of the exhibit.

The Mica Insulator Company, of New York, Chicago and London, had its headquarters at the left of the main entrance, and the company's handsomely decorated booth presented a very attractive appearance. Commutator rings, segments, troughs, tubes, disks, plates and various forms of insulation were largely displayed, and were of special interest to all electric railway men. The company's new product known as M. I. C. compound was for the first time

EXHIBIT OF THE WESTINGHOUSE ELECTRIC & MANUFACTURING CO.

exhibited. Some ten different grades and styles of micanite and Empire cloths and papers were shown. This was probably one of the largest exhibitions of exclusively insulating material ever made and goes to show the progress of the company during the past four years in bringing to perfection this particular branch of the electrical industry. By the use of micanite in the construction and maintenance of the apparatus, electricity as a motive power has become a phenomenal success. Charles E. Coleman, of the Chicago house, was in attendance and had charge of the exhibit. Franklin Brooks, vice-president of the company, was also in attendance one or two days.

The American Rail Joint & Manufacturing Company, of Cleveland, O., had two large displays of its joints, one at the Exposition Hall and the other at the International Hotel. The company was represented by W. E. Ludlow, general manager of the company. The company had in all about thirty different styles of joints some of which are being used on steam roads where they have had hard and constant service for about two years and up to the present time have shown no signs of wearing or getting loose. The joints are used for girder rails with and without chairs from 3½ ins. to 9 ins., and for T rails from 35 lbs., to 100 lbs. The company has also a joint made expressly for what is known as the butterfly or three point rail which holds the rail very firmly. The American is said to be the only joint made that will hold this style of rail successfully. They have been in use for about two years and have given perfect satisfaction in every instance. The joints are made of malleable iron and are on the wedge principle; using no bolts or nuts. They cannot come loose. About 45,000 of them are in use. The company states that its orders for joints for the coming season are over $25,000.

The New Haven Car Register Company, exhibited its different styles of single, double and triple registers and a line of double registers as adopted by the New York New Haven & Hartford Railway; Calumet, of Chicago; Louisville; and Market Street, of San Francisco; also a new double register for use on cars operated by two roads not under the same management, arranged so that the conductor of each of the roads has full control of his side of the register which he locks when leaving the car, by a special lock to which he only has the key; no fares can be rung up on his side during his absence. The register is complete in all details and registers fully on the main train of figures and also on the totalizing train. Both sides are operated by the same rod; the two sides of the register are printed in separate colors. The company had its headquarters tastefully decorated with palms, and was represented both at the convention hall and at the International Hotel. It also showed a line of its well known high grade bronze and cord fixtures. Willis M. Anthony, president; F. C. Boyd, vice-president and general manager; J. S. Bradley, treasurer; A. W. Chappell and A. N. Loper, were in attendance.

Eugene Munsell & Company, of New York and Chicago, made

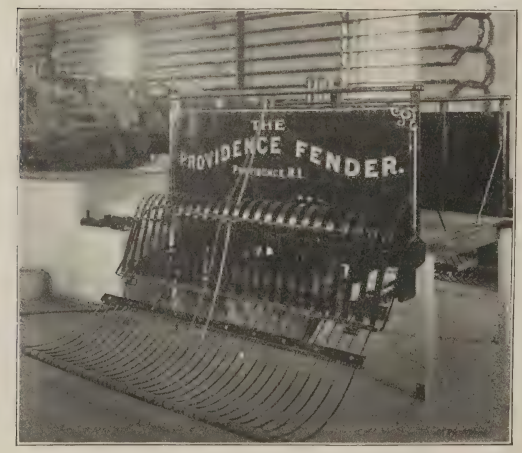


EXHIBIT OF THE CONSOLIDATED CAR FENDER CO.

EXHIBITS OF THE MICA INSULATOR CO. AND EUGENE MUNSELL & CO.

The Ohio Brass Company, of Mansfield, O., had one of the most prominent exhibits in the convention hall. Its space was directly opposite the only entrance to the building and could not escape immediate observation. The two sides of the space fronting on aisles were separated from the passage way by an ingenious chain made up of strain insulators supported at the ends by polished brass posts. On the other two sides were tiers of shelves covered with dark crimson plush on which the highly polished line appliances exhibited showed to excellent advantage. The exhibit proper consisted of a full line of track bond and overhead appliances, including a number of new devices for supporting the popular figure 8 trolley wire. There was also a varied assortment of car supplies, including headlights, track brush holders, gongs, commutators, etc. Among the appliances which attracted particular attention was the type O hangers and "Dirigo" insulation for hangers, strains, etc. Over the entrance to the exhibit were two of the Wood's flexible pole brackets. The company was represented by C. K. King and A. L. Wilkinson.

a very fine display of their "India and Amber mica" both in the sheet as it comes from the mines, and segments for railway motors. The exhibit was made in connection with that of the Mica Insulator Company. Several set of a variety of sized segments were attractively displayed beneath a large signboard on which were shown a full line of Van Wagoner & Williams Hardware Company's drop forged copper segments, for whom the company is general Western agent. At the entrance to the booth was shown "India mica" cut in sizes from $\frac{8}{16}$ in. $\times 4\frac{1}{8}$ ins. to 8 ins. $\times$ 10 ins. This large range of sizes shows that the firm is prepared to furnish "mica"

in almost any size, shape or pattern. A souvenir in the form of a "Mica Mine" puzzle was given and it was probably sought for as much as any one souvenir at the convention. Persons not in attendance can secure these souvenirs by writing the company at either New York or Chicago. While in this puzzle it is seemingly difficult to get all the miners into one mine, the feat is easily accomplished

EXHIBIT OF THE NEW HAVEN CAR REGISTER CO.

when you know how. The exhibit was in charge of Charles E. Coleman, of the Chicago house.

The Steel Motor Company, of Cleveland, O., made an exhibit of its electric railway motors and equipment which elicited many favorable comments from the delegates in attendance. The motors shown were of three different sizes, the 25 h. p. the 35 h. p, and the 50 h. p. The new features of these motors, which were described in the last issue of the STREET RAILWAY JOURNAL, were critically examined by those at the convention and many favorable remarks were made upon their substantial and compact appearance and evident simplicity. For the 50 h. p. size, the company showed an armature partly wound to give an idea of the method of construction. This armature has thirty-three slots and the same number of coils, or one coil only in each slot, reducing to a minimum the possibility of break-down. Adjoining the motors were two forms of Steel motor controllers, and special interest was manifested in the new tandem controller for 25 and 35 h. p. equipments in which the main and reversing handles are on the same shaft. As a result the controller is very compact and occupies but little space on the platform. The company had a strong representation present in the persons of Jos. N. Thomas, J. A. Rutherford and R. T. Lane.

EXHIBIT OF MONARCH TRACK CLEANERS

The United States Headlight Company, of Utica, N. Y., was represented at the convention by John Kirby, Jr., president, and J. W. Cross, secretary and treasurer. The following companies, who are selling agents of the United States Headlight Company, were also in evidence: Adams & Westlake Company, who had a very fine exhibition of various headlights manufactured by the United States Headlight Company; Dayton Manufacturing Company, represented by Joseph Leidenger and Peter Leidenger; Neal Electric Headlight Company, represented by George C. Ewing and F. E. Huntress. The United States Headlight Company also had on exhibition on a car running through Niagara Falls, the Wagenhals arc electric headlight, of which a description was published last month. This headlight will throw an intense light over half a mile, and has about 2000 c. p. The amount of current consumed is very small. It is easily adjusted and works, in all respects, perfectly. The United States Headlight Company claims to control all the valuable patents for electric headlights, and is pushing the trade vigorously. Its principal headlight is the Neal electric headlight, which is in use in its improved form, in nearly all of the principal cities in the United States, and for which there has also been a large foreign demand.

EXHIBIT OF THE CREAGHEAD ENGINEERING CO.

The E. T. Burrowes Company, of Portland, Me., had a very tasteful exhibit near the entrance from the annex to the main hall, and the merits of the company's curtain fixtures were well explained by the representatives present. The car curtains and shade fixtures, for which this company is famous, were well shown with their shades in frames, and included a sample of the No. 83 pinch handle fixture for which the company has recently been awarded a contract for the equipping of seventy-five cars now being built by the American Car Company for the Capital track of Washington, D. C. The same fixtures will be employed in eighty-five cars, sixty new and twenty-five to be rebuilt for the Brooklyn Heights Company. The company has recently perfected an open car curtain fixture,

EXHIBIT OF THE STEEL MOTOR CO.

No. 620 which met with great approbation at the convention. The representatives of the company stated that another company recently commenced to manufacture a fixture very similar to that supplied by the Burrowes Company under the title of their No. 83 pinch handle, roller top fixture. This, the Burrowes Company claims, was originated by them in 1890. The company reported a large number of orders for open cars this winter, and this factory is running full time. The company's representatives were H. H. Russell and W. S. Calhoun.

The New York Car Wheel Works, of Buffalo, N. Y., occu-

pied a prominent space in the annex and made a fine exhibit of car wheels and axles. One of the most interesting objects in the exhibition was a pair of 33 in. single plate wheels, weighing 460 lbs. each, made for interurban electric railway service in response to a demand from managers of interurban roads for a heavier wheel than can be supplied in a spoke wheel. Among the roads using this wheel are the New Palz & Walkill Valley Railway, the Bridgeport Traction Company and the Gloucester, Essex & Beverly Street Rail-

EXHIBIT OF THE E. T. BURROWES CO.

way Company. The company also showed some samples of 36 in. 400 lb. wheels, 33 in. 380 lb. wheels and 30 in. 300 lb. wheels. In the line of axles the company exhibited cold rolled axles for electric railway service. In this connection a box of samples, showing the difference between special cold rolled steel, hot rolled steel and iron, made an interesting feature. The character of chill in the New York car wheels was clearly shown by some sample test pieces. The delegates present had an opportunity of learning of the satisfaction given by the wheels of this company, from the fact that so many of them are in operation in Buffalo, Niagara Falls and vicinity. The company was represented by P. H. Griffin, J. A. Granger, Pemberton Smith, J. H. Yardley, and J. D. Rhodes.

The Electric Storage Battery Company, of Philadelphia, Pa., had a very interesting exhibit showing the use of storage batteries as a station auxiliary, either at the station or at the end of a long feeder line. A 120 volt circuit was secured by means of resistance, and fifty-five chloride accumulators of the type E, containing eleven plates each, were thrown in series across the circuit, as would be the case in actual operation. The load on the outside line was then varied to illustrate the action in actual operation where cars are started and stopped. An ammeter was introduced between the

EXHIBITS OF THE MURPHY CAR WHEEL GRINDER AND CLARK STREET CAR BRAKE.

source of supply and the storage battery, and another one between the battery and the load. While the latter indicated the varying calls for power the former stood nearly stationary, indicating that in spite of the varying load on the line, the accumulators kept a very constant average load on the feeders. A two-way current indicator in series with the accumulators showed the various changes in the direction of the current through them and from them. The exhibit attracted particular interest from the fact that a paper on the value of the storage battery for just such class of work was read before the association. The representatives of the company present were Herbert Lloyd, general manager, J. B. Entz, Charles Blizard, F. H. Clark and J. Y. Bradbury.

The Central Electric Company, of Chicago, had a brilliantly illuminated space, displaying to great advantage all its products and specialties. A large and well arranged panel showed the Central overhead material. On one side hung a commutator bar, the largest ever drop forged and made by the Billings & Spencer Company for the Niagara power plant. Garton lightning arresters were mounted on an oak panel, and being in circuit were in almost constant operation, to the admiration of old purchasers and their friends. A board filled with Bound Brook graphite trolley bushings and motor bearings was the means of securing several nice orders. Mica in all forms and shapes occupied a prominent space. A full complement of gongs filled a cosy nook. Two elegant switchboard panels from the W. S. Electric Company, whom the Central Company represents, were a feature of the exhibit. The DeWitt Common Sense sand box was full of grit and the air was full of praise for it. Trolley poles, wheels and harps galore added to the decorations. The company's space was large and commodious and accommodated large companies of callers. It was known as the brightest spot in the hall, due to the "Helios" 150 hour street railway arc lamp. The company was fortunate enough to dispose of most of the materials on exhibition and expressed itself as highly gratified with the results of the Niagara convention.

The Johnson Company, of Johnstown, Pa., and Lorain, O., made an elaborate exhibition of standard rails and special work. The largest piece of special work in the exhibit was a standard Pennsylvania Railroad steam and street railway crossing. The com-

EXHIBIT OF THE OHIO BRASS CO.

pany also made an extended exhibit of its guarantee special work in crossings, frogs, mates, etc. The crossing shown was composed of 100 lb., 9 in. rail, and one of the noticeable features of it was the large area of Harveyized plate insertion. The distinct advantage gained by a large area of durable material is, of course, greater wearing qualities with, as well, greater stability for the wearing plate; in fact, the points in the frog are guaranteed by the company to wear as long as the abutting curve rails. Adjoining the special work were templates of a large number of girder rails, including some novel sections recently rolled by the company for electric railways in Cork, Ireland, and for a new electric railway in Scotland. These rails had deep heads and light flanges. In its truck department the company showed two types of Dupont trucks, single and double. The single truck was equipped with Steel motors, and was in the space of the Steel Motor Company. The double truck was adjoining the single truck, and was in the space of the Johnson Company. The company had a large number of representatives present, including Daniel Coolidge, of Lorain; H. C. Evans, of New York; E. B. Entwisle, of Johnstown; W. E. Boughton, of Philadelphia; O. C. Evans, of Cincinnati; W. W. Kingston, of Atlanta, and A. S. Littlefield, of Chicago.

The McGuire Manufacturing Company, of Chicago, had one of the largest exhibits on the ground, in charge of G. F. Collins, and consisted of a standard single motor suspension truck, high speed elevator trucks in operation at the exhibits of the General Electric and Walker Companies, positive lock ratchet brake handles, Columbia heaters and the New Columbia heaters. W. A. McGuire, W. J. Cook and M. G. Hubbard, Jr., of this company were also in attendance at the convention. The McGuire Company has been extremely busy of late, having had many orders in all of its departments. Its new truck for the Alley L in Chicago, and its new Columbia heater have both been described in recent issues of the Journal. The company had also an exhibit at the Cataract Hotel in charge of Elmer P. Morris as mentioned elsewhere. The different exhibits in the hall and elsewhere about Niagara Falls re-

ceived a great deal of attention from the visiting delegates, all of whom spoke of the impression conveyed by them of strength, durability of trucks, efficiency and power of the sweepers, and neatness and attractiveness of the Columbia heaters. The company had a strong representation present and made a deep impression. Mr. McGuire and the other officials of the company present had many friends and customers present among the visiting delegates, and received many compliments upon the important contracts which they have secured in the street railway field during the past year, and upon the leading position which they occupy in the manufacture of street railway apparatus,

The Pantasote Company, of New York City, made an exhibit which attracted a great deal of attention from the visiting delegates. This material has already been widely adopted for car curtains and shades, and its merits are so pronounced that it promises to receive more general adoption. The material does not mildew like duck, and is waterproof, sunproof and impervious to climatic conditions. A good indication of its intrinsic merit is shown by the fact, as stated at the convention, that within the last four months over 10,000 car curtains have been sold to the Wagner Palace Car Company, by whom it has been adopted as standard for future cars. The booth at the convention was artistically arranged and draped, One side was devoted to exhibit pantasote curtains for open cars. These have been shown at former conventions where their merits

M'GUIRE SWEEPER AND AMERICAN CAR CO.'S EXHIBIT.

have been appreciated by attendant members of the association. In addition this year the company showed a very large line of closed car shades in artistic patterns. The character of the material is such that silk fabrics of the most delicate shades and texture can be laid upon it, affording opportunity for interior drapery equal to the most artistic house furnishings. Pantasote for car head linings in a large variety of patterns were shown and it was stated that these could be very readily attached to the car, ceilings making a durable and desirable method of interior decoration. In the rear of the booth was a car seat upholstered in pantasote leather, an application of the material which promises to be very extensive. The company was represented by John M. High, of New York, and H. M. Grier, of Chicago.

The Gold Street Car Heating Company, of New York City, exhibited this year its new type of electric heater which attracted much interest from those in attendance at the convention. The resistance coil of the heater is a fine spiral of German silver wire which is slipped over a large spiral core of thick wrought iron wire heavily enameled to make it a good insulator. The advantages of this form of construction are apparent, since the resistance coil is supported for its entire length. Danger of short circuiting is avoided by the location of the conductor wires on this spiral core, since if, by any chance, the resistance wire should break, the coils will be held in position on the core without the possibility of their short circuiting. As the core is also in spiral form and open, the air circulates easily through it, giving a good distribution of the heat—an important point to which Mr. Gold has paid special attention. In addition to sample coils and cores, the company showed sample cross seat heaters similar to those used on the Long Island Electric Railway Company, house, riser and panel heaters. In the rear of the space occupied by the company was an upholstered bench representing the side seat of a closed car upon which were attached heaters made by the company for cars of this type. One switch only is required for producing different degrees of heat. The first notch of the heater allows 3 amps. to pass through the coils, the second notch 6 amps. and the third notch, 9 amps. The company's souvenir, a cane, was eagerly sought after. Edward E. Gold, president; W. E. Banks, treasurer; John E. Ward, manager, and Frederick Weston, represented the company.

The H. W. Johns Manufacturing Company, of New York had, as usual, a very attractive exhibit. The space occupied by the company was surrounded by a table upon which was exposed in tasteful arrangement the apparatus manufactured by it. One side of the space was devoted to line material, and among the appliances which attracted special interest was the new toggle clamp pole insulator recently brought out by the company. These mechanically support the feed wire in any size from No. 0000 to 1,000,000 c. m. The details of these insulators were shown with pleasure, and sections of feed wire were placed in them to give a conception of the ease with which the feed wire is clamped firmly in place or released as occasion may require. The company also showed for the first time its fixtures adapted for holding the figure 8 trolley wire in both straight line, strain and splices; the latter holds the wire automatically and the greater the tension the firmer the wire is held. These clips are named from the inventor, Luscomb clips. On another table the company showed its different forms and heaters for electric cars. The heaters for cars with longitudinal seats were shown

PANEL HEATER SHOWN BY H. W. JOHNS CO.

on the side panel of the table and those for cross seats on top of the table. The heaters were in use and attracted much interest on account of their neat appearance and great radiating surface. They were in use and were controlled by a Johns regulating switch, giving three different degrees of temperature and avoiding any possibility of short circuit and poor contact. The merits of the apparatus of the company were explained by J. Emory Meek, of New York, and H. C. Luscomb, of Hartford.

JOHNS CROSS SEAT HEATER

Forsyth Brothers & Company, of Chicago, had one of the most prominent exhibits at the convention, and were kept busy showing their curtains and fixtures to the visiting delegates. A cross section of one of the cars which are being built for the North Chicago Street Railroad, showed their curtains and roller tip fixtures to good advantage. The cross section was full sized and was finished in every respect as a street car. In addition to this they had a fine mahogany frame holding six curtains and fixtures; these also were of full size. This concern claims to be the originators of the anti-friction roller tip fixture and to hold the patent of a rocking or tilting head having friction surfaces of divers holding power whereby the shade is made self-righting. The tips are provided with anti-friction rollers on their ends. The different kinds of curtain mate-

EXHIBIT OF THE JOHNSON CO.

rials shown included all styles of woolen terry goods both of the extra and standard qualities. The silk curtains were of tasteful design and intended for use in special cars where a fine effect is desired. Some twenty different patterns and designs were exhibited. Elmer P. Morris, the Eastern representative of the company, had another exhibit in the parlors of the Cataract Hotel. The company's new fall catalogue was dainty and attractive and fully explained the company's different styles of fixtures and curtains. The firm has recently established agencies in Montreal and New York, and with the company's European representative in London, is now well able to look after new business. Elmer P. Morris,

George H. Forsyth and W. H. Forsyth represented the firm at the convention. The Forsyth goods were also shown in the car exhibited by the American Car Company of St. Louis.

The Falk Manufacturing Company, of Milwaukee, Wis., made an elaborate exhibit at Niagara Falls to illustrate its system of cast welded joints. Many of the delegates in attendance were users of this joint, and all spoke in highest terms of its value as a mechanical and electrical connection between the rail ends. Among

EXHIBIT OF FORSYTH BROS. & CO.

the exhibits made by the company were sections of joints, in which the complete fusion between the surface of the rail and the iron cast around the joint could be plainly seen, other joints in which an attempt had been made to break the cast iron away from the rail, but in which particles of the iron clung to the surface of the rail, showing that they composed an integral part of it, joints which had been subjected to strains in an effort to pull the joint apart, but in which the rail itself had first broken some distance from the joint, moulds for joints, etc. The representatives of the company present also explained the present method of cleaning the rail ends before the joint is cast around the rail. This cleaning is done by a sand blast which removes all oxidation from the surface of the rail, leaving it perfectly clean. Since this method has been introduced any necessity for bonding the rail for electrical contact, it would seem, has disappeared. The merits of the bond were extolled by the managers of many railway companies present, and one stated that since the adoption of the Falk joint on his line several years ago he had not expended fifty cents for track repairs, where formerly a gang of

EXHIBIT OF THE PANTASOTE CO.

sixty men was constantly employed looking after the joints. The company had a strong representation present in the persons of Herman W. Falk, president, E. A. Wurster, secretary and treasurer, and Henry L. Prather, general sales agent.

Harold P. Brown, of New York, was present at the convention and his exhibit of bonds was a valuable one. In a case was shown a specimen angle plate covered with rust which had recently been removed from the rails of the Camden & Suburban Railway Company, after two years' use. The track during that period had been bonded with Mr. Brown's plastic bond, and the material was still in the angle plate, soft and plastic, showing that time and weather conditions for that period had no apparent effect on the character of the material. The bond was of the cork type and Mr. Brown had a letter from the general manager of the Camden & Suburban Railway to the effect that the bond was in perfect condition when removed. Mr. Brown also had an exhibition of detailed blue prints showing the method of bonding with his bond adopted by the Central London Underground Railway, the Dublin United Tramways Company, of Dublin, Ireland, and the Government Tramways of Sydney, N. S. W. In each of these installations Mr. Brown's bond, was selected after much investigation, and the special conditions existing in each case made necessary slight modifications from the standard American practice. Adjoining the bonds was a patent hand cleaner for cleaning the rail surface before applying the bond and a power cleaner driven by a gasolene engine for extensive installations. Much interest was also shown in Mr. Brown's exhibit of the E. C. A. bond. This is a flexible copper bond with plugs amalgamated with Mr. Brown's compound to secure perfect contact, and is intended for rebonding girder rails on paved streets, where a company desires to do this, without disturbing the pavement. For light work Mr. Brown furnishes a bond of small carrying capacity, consisting of a few leaves or strips of copper welded together at the ends, but for ordinary city service recommends his other forms. He also showed an ingenious method devised by him for measuring bond resistances. He was assisted in explaining the merits of his exhibit by F. N. Sheble and Frederick Reeve.

The Christensen Engineering Company, of Milwaukee, occupied one of the most conspicuous positions in the main hall, its exhibit being on an elevated platform directly opposite the entrance to the meeting room. The company made a very attractive exhibi-

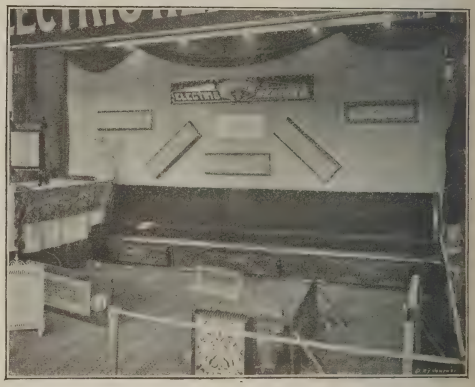


EXHIBIT OF THE GOLD STREET CAR HEATING CO.

tion which was in charge of N. A. Christensen, of Milwaukee, Garson Myers, of Chicago, and F. C. Randall, of Hartford, Eastern representative. The exhibit consisted of a test rack with twelve cylinders representing a train of twelve cars. The air for these cylinders was furnished by a Christensen No. 4 motor air compressor, which has a capacity of 40 cu. ft. of free air per minute. The current operating this motor was automatically controlled by a variation of pressure in the main reservoir, the motor being cut in and out of circuit as the pressure fell and rose between predetermined limits. A pressure of 70 lbs. per square inch was used in the train pipe and 90 lbs. per square inch in the reservoir. The action of the brakes was controlled by an improved form engineer's valve. The company also showed its No. 2 motor compressor which has a capacity of 14 cu. ft. of free air per minute, brake cylinders and piping for one heavy double truck motor car and two heavy double truck trail cars. The air brake systems already described are for straight air and the automatic controllers are alike for every type of compressor. Another portion of the exhibit consisted of a No. 1 motor compressor having capacity of 9 cu. ft. of free air per minute with automatic current controller, piping and brake cylinder connections for a heavy double truck, high speed motor car and trail car. The fourth section of the exhibit included an axle driven air compressor mounted and in operation on a truck equipped with Steel motors of the Steel Motor Company. The axle was 4 ins. in diameter, and the compressor occupied a space on the axle only 7½ ins. in width. All of the apparatus already described was in operation. The company also showed a No. 2 motor compressor unassembled, various details of engineers valves both for automatic and straight air and brake cylinders, regulators and other details of apparatus. The exhibit was very critically examined by the railway men present.

Elmer P. Morris and J. C. Dolph & Company, made a joint exhibit in two of the rooms on the ground floor of the Cataract

House. The headquarters of these gentlemen were well advertised and soon became popular, and in the evening the visitors were entertained with music. The exhibits, which were very extensive, lined the sides of both rooms. The apparatus shown by Mr. Morris was of those companies for which he is agent, and included the headlights of the Wheeler Reflector Company, glass insulators of the Hemingway Glass Company, switches and cut-outs of the Hope Electric Appliance Company, curtains and fixtures of Forsyth Brothers, illuminated signs of W. E. Harrington, Point Marion cross arms, poles and fixtures, overhead line parts of the Electric Railway Equipment Company, gears and pinions of the Simonds Manufacturing Company, trucks, stoves and plows of the McGuire Manufacturing Company, insulating paints and compounds of the Bradford Belting Company, telephones and electrical instruments of the Keystone Electrical Instrument Company, lamps of the General Incandescent Arc Light Company, and other appliances. Mr. Dolph's exhibit was also very extensive and included samples of roll drop and drop forged commutator bars and protected rail bonds of the Forest City Electric Company, insulating varnish of the Sterling Varnish Company, iron and steel gears and pinions of the Catskill Foundry & Machine Works, mica of the American Mica Company, railway cut-outs, fuses, etc., of the D. & W. Fuse Company, brushes, headlights, trolley wheels, etc. A particularly interesting feature of Mr. Dolph's exhibit was that of commutators and commutator segments. Mr. Dolph is prepared to supply assembled commutators for every type of railway motor from the earliest Edison and Thomson-Houston forms to the latest and most improved types. The segments can be roll drop or drop forged as the purchaser desires, and the insulation either India or Amber mica. In several of the older types of motors, such as the W. P. 30 and W. P. 50 the commutator has been increased in depth, giving a longer life without interfering with the use of the standard brush

EXHIBIT OF THE FALK MANUFACTURING CO.

holder. Mr. Dolph also showed the Beverly vertical brake wheel for vestibule cars. This, as its name implies, is a method of operating the brake shaft by a vertical wheel instead of by a grab handle operating in a horizontal plane, the principal advantage being the small amount of platform room occupied. The handle is fitted with a ratchet clutch made of cast steel. The headquarters were crowded each evening of the convention.

The Clark Brake Company, of Pittsburgh, Pa., had one of the most interesting and popular exhibits at the convention. It was a new hydraulic brake recently developed by Mr. Clark, and was applied to a Dupont truck equipped with Steel motors in the space of the Steel Motor Company and Johnson Company. The brake consists essentially of a hand operated, double action pump bolted to the front platform of the car, two being used on cars running in both directions. The piston of the pump is moved by a lever, requiring about one and a half strokes to apply the brake in ordinary cases where 50 lbs. pressure is required. Attached to the handle of the lever and within easy reach of the thumb of the motorman's hand, is the handle of the release valve which opens communication between the receiving and pressure sides of the pump. The brake cylinder, the piston of which actuates the brake levers, has three diameters of bore, fitted with three pistons. The smallest cylinder is of sufficient area to move the brake gear, take up the slack both of the shoes and journal boxes and set the shoes against the wheel with considerable force when a pressure of 50 lbs. per square inch is exerted by the pump. While this is being done the cylinder back of the large piston is filled with liquid from the reservoir through a check valve. When the shoes are set firmly against the wheels the valve of the large cylinder is opened and the liquid under pressure opens it, applying the brake with maximum force. The actual quantity of liquid to be pumped for the ordinary application of the brake is about 20 cu. ins. An arrangement is provided by which, as the shoes wear, the maximum pressure is pumped upon them at the proper time for securing the best braking efficiency. The liquid used is water and glycerine; 15 per cent of the latter and 85 per cent of the former, in summer; and 50 per cent of each in winter. By a modification in the construction of the cylinders and controller valve, trailers can be equipped requiring only one line of pipe. Two and a half strokes of the pump only are required to apply the brake on the two cars. The system seems to have been very carefully worked out and fuller particulars of it will be published later. It was very carefully examined by a considerable number of street

EXHIBIT OF THE CHRISTENSEN ENGINEERING CO.

railway managers, and many spoke of it enthusiastically and as desirous of seeing it in operation on their lines. Francis L. Clark, the inventor of the brake has had a very extended experience in braking problems, as engineer of the Westinghouse Air Brake Company, and was present at the convention. He was assisted in exhibiting the brake by J. M. Tate, Jr., and H. S. Clark, both of Pittsburgh.

The R. D. Nuttall Company, of Allegheny, Pa., had one of the most tasteful exhibits at the convention. It was on the main aisle leading from the entrance, and was a center of interest to the delegates present. An excellent display was made of the company's famous pinions and steel and steelite gears which were arranged along each side of the space and showed up handsomely upon a black baseboard. Steelite is a special composition which is handled exclusively by the Nuttall Company, and has shown excellent qualities. It is almost impossible to strip the teeth of a gear made of this material, and in a recent accident, in which the teeth on a set of

EXHIBIT IN HEADQUARTERS OF J. C. DOLPH AND E. P. MORRIS

gears were so bent as to render the gear useless, the teeth were straightened out by a blacksmith, and after a little filing the gear was in use again. This gear has since made 60,000 miles, and is on exhibition at the company's office at Allegheny. The durability of the material is shown by the high average which the gears have made in service for different roads throughout the country. The life of these gears averages about 100,000 miles, and many higher records than this are reported by users. The gears are made of different patterns to fit every different type of electric motors on the

market. In the center of the space occupied by the Nuttall Company were exhibited several trolley bases of different patterns; one of these was the Union Standard (U. S.) trolley, which, as its name implies, is a combination of the best features of all the previous standards. The duplex feature of the springs enables the trolley to be used under circumstances which would cripple the service if one single spring type of trolley were used. Adjoining the U. S. trolley were two other forms of trolley bases; one was the U. S. S. trolley, which is constructed for especially low work. This trolley has a minimum height of 5½ ins. The company also showed one of its D 2 trolleys; this is an early form of trolley which is very

EXHIBIT OF THE R. D. NUTTALL CO.

popular on some roads, and is in effect the well known T.-H. trolley. It is somewhat lighter than the U. S. trolley, and some prefer it on this account. On a table to the left at the entrance to the space occupied by the Nuttall Company was exhibited a full line of motor bearings. The Nuttall Company has made a specialty of manufacturing these bearings, which can be supplied for any type of motor, including the earliest forms, such as an Edison No. 6, T.-H. F 20, etc., as well as of the other latest forms. These bearings are lined with xylite, a bearing metal which has given very successful results during years of experiments, and has become very popular as a lining for motor bearings. The company was represented by F. A. Estep, Scott R. Hayes, Chas. M. Wood, Arthur S. Partridge, Chas. B. Arthurs, Garson Myers, George W. Provost.

William Wharton, Jr. & Company, of Philadelphia, Pa., had an exhibit of rails aad special work illustrating their best construction for electric railway service. The exhibit was at the right of the main entrance and was in charge of V. Angerer, R. K. Polk and J. C. Robinson, of Harrington, Robinson & Company, New England agents of the company. The exhibit was among the most interesting and important at the convention and gave an excellent idea of the tendency toward heavier and more substantial track construction toward which the leading rail manufacturers have done so much during the past few years. The feature of the exhibit was the use for wearing points of manganese steel which has been found so durable. One tendency of modern track construction, as explained by the representatives of the company present, was toward the disuse of compromise joints. The manner of effecting this was clearly shown by a sample frog exhibited in which all four rail pieces forming the front, were of different styles, viz., one T rail, one 6 in. grooved rail, one 9 in. Wharton girder rail, and one 9 in. Johnson girder rail. The center of this frog with the points were, of course, of manganese steel. A plain end, compromise joint, in which two rail sections of different joints were joined by a cast weld was also shown. In the middle of the space occupied by the company four tongue switches were exhibited. One of these was the Wharton standard switch in which the whole bed is of manganese steel; this prevents the tongue from being pounded down into the bed. Adjoining this were three slightly different switches also made by the company. One was the Carver patent switch which has a side bearing, one on each side of the base of the tongue. The advantage of this constructron is that it admits of the use of the tongue on a curve of as long a radius as 200 ft. Adjoining this was the standard of the West End Street Railway Company, of Boston, which has a patent fastening in the tongue of the switch, the invention of one of the engineers of that company. The fourth switch shown was that which is the standard of the Union Traction Company, of Philadelphia. This is a slight modification of the other types and employs the Carver heel, but has added a special feature to the Carver tongue by carrying the point very fine and strengthening it by a flange. This switch tongue is adapted for a spiral curve, the radius at the end being 300 ft. and at the heel 90 ft. The fact that this character of construction has been adopted by the two companies mentioned, the two largest street railways companies in this country, was commented upon by many. Adjoining the switches already described, was a sample of the Wharton unbroken main line switch which is well known, but which was exhibited for the first time attached to a half grooved rail. This switch eliminates the jolts on the main track incident to ordinary switches to car houses and commends itself for this reason. In the rear of this exhibit was a 9 in. manganese steel standard crossing, and adjoining the other exhibits was a table upon which were samples of cast iron shoes.

The Standard Air-Brake Company had a striking exhibit which greatly eclipsed those of former years. Not only was it an object lesson, but it showed the great progress which that energetic company had made. As is generally known, the Standard Air-Brake Company was the first concern in the world to build street railway air brakes, and its exhibit practically illustrated the different types of apparatus manufactured, from the beginning of its business to date. The exhibit occupied a prominent space between the Wm. Warton, Jr., & Co. and Brill Company, and was inspected by the majority of the delegates. The apparatus was in charge of the company's managing director, E. J. Wessels, who was assisted by the chief engineer, E. H. Dewson, Jr. The company was also well represented by the following: C. B. Fairchild, special agent, H. B. Taylor, assistant engineer, and E. E. Robinson, foreman. On entering the exhibit, on either side was to be found a Brill No. 27 truck, the one on the left equipped with the well known duplex compressor, direct axle driven. There are many of this type in service here and abroad. Thirty are completing their third year of active service on the Buffalo Railway Company's road. On the right was shown the well known geared compressor, which is the standard on several roads in the United States and Canada. This type has proved admirably suited for heavy traction and high speeds. Back of the duplex was shown the Standard Company's hollow spindle brake cylinder with fulcrum on back head for equalizing double truck brake rigging. A handy attachment enabled delegates to see how quickly and easily pressure can be applied. The attachment embraced a graduated spring, with a pressure indicator which showed the range from minimum to maximum, the latter being equal to an emergency stop. There was also shown the well known Standard interlocking handle, by means of which the controlling valve was worked; also the chime whistle. This was blown from time to time and announced to delegates that the Standard Company was, as usual, actively in the field. Adjoining this stood the automatic current controller which excited favorable comment from the numerous delegates who watched the precision and accuracy of its movements, and were surprised at the narrow limits within which it operated. This device makes it unnecessary for

EXHIBIT OF WM. WHARTON, JR., & CO.

the motorman to have any connection with cutting current in or out. Next to the current controller, was shown the company's water and dustproof electric compressor. Its freedom from vibration and noise, was very remarkable. The ease with which it compressed air quickly, and the remarkably small space it occupied excited much interest. The motor compressor was piped to a 14 ins. × 48 ins. special reservoir. The company's reservoirs are guaranteed to resist a far higher pressure than is required when operating the Standard system. Next was shown a No. 1 type brake cylinder with attachments showing the manner in which trail cars are braked. In addition, there was a profusion of special hose, couplers, gages,

regulators and mufflers, the whole giving a comprehensive idea of the entire Standard air brake system, and showing its remarkable simplicity, as well as the substantial character of the apparatus. The company's display was augmented by views of cars and trains in different parts of the globe on which Standard air brakes are used. The company's World's Columbian Exposition diploma and medal were also displayed, and a striking sign proclaimed that the "Standard" was first in the field and the only concern which had received a diploma and medal. The Standard Air-Brake Company's Australian agents, Noyes Brothers, were represented by Edward Noyes, the senior partner, of Sydney, New South Wales, who was an interested spectator and gave those who inquired a graphic report of the satisfaction which Standard air brakes had given in the distant colony in which he resides. Great credit is due to Mr. Wessels for his untiring energy, which has led to the building up of a large and constantly increasing business.

EXHIBIT OF THE STANDARD AIR-BRAKE CO.

The General Electric Company at the Convention

The General Electric Company made the most extensive exhibit at convention hall, confining it, however, to motors, controllers, meters and subsidiary apparatus. It occupied the southwest corner of the main hall and, brilliantly illuminated, formed a center of attraction for the entire fraternity. The motor exhibit comprised examples of the latest types G. E. 51, 52, 53, 55 and 57 motors. The G. E. 55 of 175 h. p. capacity attracted much attention. This was not mounted. The others were all shown in motion mounted upon trucks. One McGuire pivotal truck was equipped with a G. E. 51, 80 h. p. motor on one axle, and an electric brake on the other, both controlled by a B 7 controller. Another truck of similar make and type carried on one axle a G. E. 53, 50 h. p. motor of special build for narrow gage work, and an electric brake. A Brill No. 27 truck was equipped with two G. E. 57, 50 h. p. motors, with an electric brake on each axle. This is the equipment used in the high speed work on the Cleveland & Lorain road. To accommodate both motor and brake on the same axle the wheels are dished. The equipment was controlled by a B 8 controller. A Diamond truck also carried two G. E. 57 motors, without brake equipment. On a Peckham flexible cantilever truck, were mounted two G. E. 52, 57 h. p. motors with K 10 controller. All these equipments were arranged to show the operation of both motors and brakes. The equipments of the two McGuire trucks were controlled by one controller and were run either singly or both together. On each of the above equipments was set a Thomson recording car meter for use on the car itself, serving to show how a check may be placed on the performances of the motorman with the controller. In the exhibit of the Barney & Smith Car Company, two G. E. 1000 motors were mounted upon a pair of class H trucks. In the Peckham Truck & Wheel Company's exhibit two G. E. 52 motors were mounted on a cantilever street car truck. The Duplex Company's car, running on the city tracks, was also equipped throughout with General Electric apparatus, consisting of a double G. E. 1000 equipment, B 13 controllers and electric brakes.

Armature construction was exemplified by two completed G. E. 52 armatures, a full set of motor mica insulators, a series of armature coils ready for application to the core, and a number of field coils, also several complete sets of motor commutators bound and headed for shipment. The gear work was well represented, all gears and pinions shown coming from the gear plant of the General Electric Company.

Three boards were erected in the space. The first was devoted to circuit breakers of the K. L. Q. and M. types with magnetic blow-out, each of which could be shown in operation by means of a special switch, currents up to 200 amps. being ruptured. Upon the second was mounted an extensive line of instruments used in street railway and general work. These comprised the new electrostatic ground detector, Thomson inclined coil instruments of the portable and switchboard types, Thomson arc ammeter, astatic ammeter, G. 2 astatic recording wattmeter for station output measurements; portable indicating wattmeters and pocket ammeters and voltmeters. This board was surmounted by one of the new G. E. edgewise ammeters. The third board was equipped with M. D. magnetic blow-out lightning arresters, both open and closed. These were shown in operation, the equivalent of the lightning flash being followed by current from the 500 volt circuit. This exhibit attracted considerable attention from the railroad men, to whom its operation was fully explained. They were enabled to appreciate the method by means of which lightning discharges on lines are safely handled. To exemplify the action, when an accident should cause a high potential wire to fall across trolley wires with one end grounded, a voltmeter was used. The pressure being brought up to 2000 volts, the arrester came into action, showing that the current instead of passing through the apparatus would take its path through the arresters.

The exhibition space was illuminated by a number of enclosed arc, long burning, that is 100 hour, arc lamps for use on railway circuits. In front was an ornamental cornice carrying colored incandescent lamps. Above and behind it was a large sign with the company's name, and on the wall another giving succinctly the railway record of the General Electric Company, viz., 2173 generators aggregating 512,213 h. p., 46,191 motors aggregating 1,059,060 h. p. and 40,000 series parallel controllers.

The headquarters of the General Electric Company occupied the writing room of the International Hotel. Here it had erected a small booth in which an X-ray exhibition was given continuously. The new screen first used on this occasion is fixed 12 ins. square and platino-cyanide of barium is used instead of the ordinary fluorescing salt. The walls of the writing room were hung with neatly framed diplomas, and with these a large volume on the table made an excellent showing of the General Electric Company's prominence and pre-eminence at great expositions. For the first time a large number of the medals awarded to it were also shown.

EXHIBIT OF THE GENERAL ELECTRIC CO.

The social side was not neglected by the General Electric Com-

pany. On Tuesday it arranged an enjoyable tally-ho and carriage party over to Canada. This courtesy was taken advantage of by nearly every lady at the convention. Parlor D was the company's social annex, which after about 9 P. M. seemed a remarkable center of attraction for everyone.

The interests of the company were cared for by the following gentlemen: railway department, W. J. Clark, general manager; W. B. Potter, chief engineer; Ralph H. Beach, L. D. Tandy. Schenectady office, J. G. Barry, Lee H. Parker, F. E. Case, W. G. Carey, E. D. Priest, F. M. Boyles, H. Kernochan. Foreign department, Edgar Carolan. Supply department, J. R. Lovejoy, general manager; H. C. Wirt, chief engineer; J. H. Aitken. Meter department, C. D. Haskins. Convention committee, F. M. Kimball, secretary, Boston. T. Beran, New York, A. D. Page, manager Incandescent lamp department, Harrison. N. J. The sales offices were represented as follows: New York, W. G. Bushnell, A. B. Shepard; Chicago, T. P. Baily; Philadelphia, E. D. Mullen, W. J. Crowley; Boston, C. C. Pierce; Cincinnati, W. F. Hayes, F. B. Strieby; Atlanta, S. W. Trawick, A. C. Tenney; San Francisco, F. F. Barbour; St. Louis, Geo. D. Rosenthal, Buffalo, T. H. Fearey, D. F. Potter; Denver, Irving Hale.

The Exhibit of the Walker Company

A notable exhibit at the convention was that of the Walker Company of Cleveland, O., whose attractive booth, with its fine examples of electric railway machinery, kept scores of interested spectators before it. All of the items of the exhibit were handsomely finished and designed and made a most attractive spectacle even to the uninitiated.

EXHIBIT OF THE WALKER CO.

The feature of the exhibit was certainly a 400 h. p. elevated railway motor which furnished an example perhaps never before equaled in mechanical traction of concentration of great power in small space. It consists of a McGuire truck fitted with two No. 25 Walker elevated railway motors of 200 h. p. each. It was especially designed for the extremely heavy work to be met with in elevated railway traction and is capable of accelerating a three car train to a speed of 25 miles per hour in eighteen seconds. The motor is open to allow ample ventilation, while the bearings are self-oiling and so arranged that all waste oil is thrown back into the oil wells.

A double 4 A equipment, consisting of two 30 h. p. Walker motors was shown on a Peckham truck and with the electric brake controller formed an example of the Walker Company's standard equipment for street railway work. The controller (type J 2) has been designed to meet the demand for quickly applied braking without the disadvantage of clogging the truck of the car with special gearing. While it accomplishes this thoroughly, the controller is very simple. To apply the brake the reverse handle is turned to the appropriate notch; this opens the trolley circuit and converts the motors into generators, the current developed being absorbed in a rheostat and the pull of the fields on the armature produces the necessary braking. The contacts are arranged so that it can be used either as a gradually applied brake for ordinary stops or as one instantaneously applied in case of emergency. In addition to these two trucks a third was shown designed for interurban service. This truck—a Dorner & Dutton—was fitted with two 50 h. p. motors and comprised, with the controllers shown, the Walker 10 S double equipment. The motors in both this and the preceding equipment are spring suspended after the well known Walker method. Controllers for all the standard equipments were also shown, from the single motor controller to that for the double 50 h. p. equipment.

An excellent idea of the Walker motor construction was obtained from the handsome single motors and parts, noticeable among which was an example of a 2-N-20 h. p. motor, designed for narrow gage work. One hundred and twenty of these motors have been sold in a single order to the Oberschlesische Dampfstrassenbahn (The Upper Silesia Street Street Railway) in Prussia, a steam road "electrified" where the track gage is only 31 ins.

The 150 k. w. Walker street railway generator afforded a good example of modern generator construction. It is of 500 volts winding and has eight poles. Its protected back, ventilated armature and neatly wound field coils, protected with rope, were a few of its points of excellence. The brushes are held at a fixed angle with the commutator, yet the arrangement admits of the removal or replacing of a brush while the machine is in operation without risk to attendant or without loosening any screws or clamps. The 25 k. w. generator on the right of the booth showed the smallest dynamo manufactured by the Walker Company. It weighs 4200 lbs. and is capable of a continued output of 240 amps. at 125 volts; its speed is 300 r. p. m.

At the back of the booth was shown a large switchboard built for the Tamaqua (Pa.) & Lansford Railway. This is arranged for two 225 k. w. railway generators and has four feeder circuits. The board consists of four white marble panels mounted on an iron frame. Upon one panel are mounted the generator circuit breakers, ammeters, switches, lightning arresters and rheostats. On another are the main ammeter, a recording wattmeter and a recording voltmeter, all showing the total output of the station. On the other two are the circuit breakers, ammeters, switches and lightning arresters for the various circuits. Particular attention has been given to making all the connections on the back of the board in the simplest manner possible and all contacts and connections are designed to carry double the normal load without appreciable heating. A solenoid blow-out controller showed the latest type of street railway controller and is the embodiment of all the Walker patents. To cut out a motor in case one becomes disabled it is not necessary to open the controller and pry out a plug which may be rusted into place from disuse. There are six positions appropriately marked for the reverse lever instead of merely the usual "forward" and "reverse" viz.:

Both motors ahead, No. 1 motor ahead and No. 2 motor cut out, No. 2 motor ahead and No. 1 motor cut out, both motors back, No. 1 motor back and No. 2 motor cut out, No. 2 motor back and No. 1 motor cut out.

The operation of cutting out the motors is as simple as reversing a car. There are five running positions of the controller. These are arranged for uniform graduations of speed and the rheostat is so proportioned that the car can be run any length of time on any notch. The reverse cylinder is locked by a magnetic locking device which makes it impossible to move the reverse when current is flowing through the controller. The solenoid blow-outs are embodied in the partition between the controller fingers. This prevents them from injury by the arc. A marked advantage of this arrangement is that the absence of conducting core renders it impossible for a ground to develop in the solenoid circuit. The position of solenoid directing between the fingers placing them in a most favorable position for blowing out the arc, so that the effect is more direct and instantaneous than any other type of controller.

The company was well represented by the following gentlemen: S. H. Short, Cleveland, O.; F. W. Ferguson, Cleveland, O.; H. McL. Harding, New York; Chas. N. Black, New Haven, Conn.; W. A. Johnson, Toronto, Ont.; Daniel D. Craft, New York; J. Holt Gates, Chicago, Ill.; B. M. Barr, Cleveland, O.; Henry G. Issertel, New York; William Gibbs Bain, Philadelphia; J. S. Anthony, Cleveland, O.; Chas. E. Bibber, Boston, Mass.; Alex. T. Moore, Pittsburgh, Pa.

The company had also on exhibition a number of pamphlets descriptive of its apparatus. Among these were a handsomely illustrated catalogue entitled "Steam Dynamos for Railway and Power" and a smaller pamphlet "Cost of Electric Power from Coal .3631 cents per hour."

Exhibit of the J. G. Brill Company.

The J. G. Brill Company had an extensive exhibit at the convention. This was not confined to the space occupied by it in the convention hall, but the company had also some of its larger apparatus on the track in front of the hall, and different trucks were shown in connection with the different motor manufact-

urers in the spaces occupied by them. The company also occupied a parlor at the International Hotel, which was crowded with visitors in the evening. In the company's space at the exhibition hall quite a full line of single and double trucks were shown; among the former was exhibited the No. 21 E truck for electric motor cars with solid forged axle box frame, and one-half elliptic springs. The No. 21 E truck was of the same pattern as

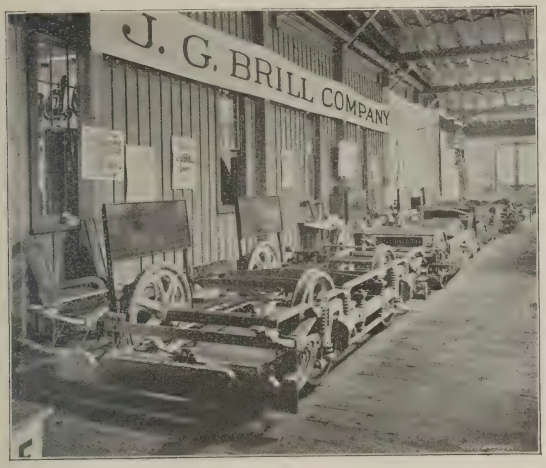


EXHIBIT OF THE J. G. BRILL CO

300 furnished by the Brill Company during the past year to the West End Street Railway Company of Boston. Adjoining this single truck was a No. 27 Perfect passenger truck, one of the type which has been making excellent records on a number of high speed electric lines, such as the Buffalo & Niagara Falls Electric Railway; the Akron, Bedford & Cleveland Railway; the Cleveland, Painesville & Eastern, and other interurban lines. This truck received much favorable comment. The company also showed its Universal double truck, the No. 27 D, which has been built especially for city service. The truck has a 4 ft. wheel base, allowing the wheels to swing between the car sills. Of course the exhibit included an example of the Brill Eureka maximum traction truck, which has established such a permanent reputation for merit. The Dunning patent drawbar also attracted much interest. These are manufactured by the J. G. Brill Company, and are fitted with housings permitting the drawbar to slide in flush with the car bumper when not in use. Some examples of Littell's patent track scraper, which the Brill Company manufactures, were also shown.

On the tracks in front of the convention hall was a handsome ten seat open car of standard design recently furnished by the Brill Company, for the Buffalo Traction Company. This car was fitted with patent rounded car seats and end panels which give greater room for the ingress and egress of passengers, also with the Brill patent angle bumper and entrance guards. It was mounted on a Brill No. 21 E truck. Adjoining this car was a standard Brill electric snow sweeper with vestibule ends.

In parlor A, at the International Hotel, the company had models of the Eureka maximum traction, No. 27 and No. 21 E trucks made in brass and appearing to good advantage. As a souvenir of the convention the company presented to visitors a handsomely bound and ingenious cardboard computer for determining the amount of power required to propel cars of different sizes or different types of trucks over different routes. The company's headquarters at the International Hotel were very popular. The company was represented by John A. Brill, W. H. Heulings, Jr., S. M. Curwen, G. M. Haskell, H. H. Archer.

Exhibit of the Peckham Truck Company

As usual, the Peckham Motor Truck & Wheel Company made an extensive exhibit and one which attracted widespread attention. The space occupied by the company proper was in the center of the hall first entered, but the company had also Peckham trucks on exhibition in the spaces occupied by the General Electric Company, Walker Company, and the Westinghouse Electric & Manufacturing Company, and had in front of the convention hall one of the Ruggles rotary track cleaners and a No. 17 truck. What made the exhibit most interesting was the fact that Mr. Peckham exhibited here for the first time his full line of double trucks for all classes of service from that for light city cars to the heaviest trunk line service. The double trucks exhibited were the No. 14, double cushioned extra strong; No. 14 A, triple cushioned with swing bolster; No. 14 B, triple cushioned swing bolster truck for short radius curves; No. 14 C, double cushioned, center bolster, maximum traction truck; No. 14 D, triple cushioned, swing bolster, maximum traction truck; No. 15, extra strong, triple cushioned, swing bolster, double truck, and the No. 17 truck already referred to. The series attracted widespread attention, and the general opinion of the delegates who inspected the trucks was that the details of each had been very carefully worked out for the conditions for which it was designed, and that the principle of a cantilever bridge side frame, which had proved so successful in Peckham single trucks, would be equally as desirable for double truck service. Especial interest was manifested in the rubber cushioned spring bolster and the statement was frequently made that this device would effectually reduce the noise of running and the transmission of the concussion of the wheels on the track to the car body. Much attention was also given to the No. 14 C and No. 14 D, the two maximum traction trucks of Mr. Peckham, these trucks, being on quite a different line from anything heretofore exhibited of the kind, produced much discussion. The powerful leverage secured for the brake rigging by the use of a double lever brake with a floater on a curved bar by which the truck is permitted to turn under the car body in a curve without altering the position of the brake shoes, also attracted much interest. The No. 17 heavy electric locomotive truck outside the hall came in for much favorable criticism and the arrangement of the side frame, permitting its removal and easy inspection of the motors, was generally appreciated.

In addition to the line of double trucks, exhibited, Mr. Peckham also showed examples of his single trucks, including an Excelsior, extra strong, with M. C. B. box, one of a large order just finished by him for the Cincinnati Street Railway Company. The

EXHIBIT OF THE PECKHAM MOTOR TRUCK & WHEEL CO

trucks shown in the General Electric, Walker and Westinghouse exhibits were all of the standard extra long pattern, and the truck under the Lowell duplex car in use on the Niagara Falls & Suspension Bridge Railway was also of the Peckham make.

In addition to his series of trucks Mr. Peckham had at the convention hall a very fine set of photographs mounted in a revolving frame, showing different types of cars equipped with his various trucks and illustrating very clearly the wide variety of trucks which

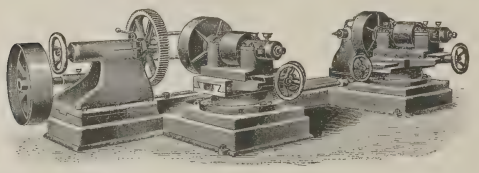
he is prepared to manufacture. His new catalogue, to which reference is made elsewhere, also attracted much attention. This contained a handsome series of large engravings, showing the different trucks manufactured by Mr. Peckham, as well as detail views of some of the important features in each. The Peckham Truck Company also occupied a parlor at the International Hotel, which in the evening was a favorite meeting ground for the different delegates. Along one side of the room was a beautiful series of groups, printed on celluloid, of the Peckham trucks, and on the tables were three or four fine models in aluminum of the trucks themselves. Every

PECKHAM NO. 17 TRUCK

detail, down to the bolts and screws of the original trucks, was duplicated in miniature in the aluminum models, and they made possible a study of the features which have made the Peckham trucks so famous. The company distributed at its hotel headquarters one of the most tasteful and attractive souvenirs of the entire convention in the shape of a photograph of the Falls on opaque glass and mounted on a leather back and stand. The company had a strong representation present in the persons of E. Peckham, president; J. A. Hanna, Chicago; W. H. Gray, Chicago; E. G. Long, New York; Chas. S. Ackley, New York; A. W. Field, Boston.

Exhibit of the Springfield Manufacturing Company

The Springfield Manufacturing Company, of Bridgeport, Conn., made an exceedingly interesting exhibit of its steam and electric car wheel grinder, which has already been illustrated and described in previous issues. This machine is designed to grind the wheels either on or off the axles and independent of the car, the company

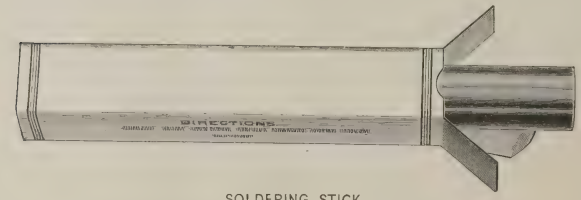


CAR WHEEL GRINDER

believing it better to grind the wheels off the car where there will be less danger of emery dust getting in the journal bearings. The emery wheels are held by a patent chuck which enables the grinder to run at a high speed with perfect safety. Mr. Jackman was present in the interests of the company and explained the merits of the device to visiting delegates.

Soldering Stick

The Western Electric Company is placing upon the market a soldering stick, the general appearance of which is shown in the accompanying illustration. It is about 6 ins. long and 7/8 in. in di-



SOLDERING STICK

ameter and is composed of carefully prepared and pure chemicals which are non-corrosive and at the same time make a very superior flux for soldering. The virtue of this stick is that it makes the solder stick to the wire—a most important point—for if there is a gap between the solder and the wire and the two metals do not amalgamate there is a local action caused by the current of electricity which eventually will eat away the wire at the joint. It is for this reason that the underwriters have been so particular to specify that joints shall be well cleansed and soldered, knowing that a joint that is not cleansed could not be well soldered and would be a hazard from the fire insurance standpoint.

Railway Crossing Signals

The problem of crossing protection is every day coming more and more to the front in the efficient operation of electric roads where speed and safety are required. The question of crossing accidents and the resulting endless claims for damages is a most important one to railroad managers. The Parrish electric railway crossing signal is a new device designed to provide such protection at grade crossings. It has but lately been put upon the market after tests covering a period of nearly two years.

CROSSING SIGNAL

In construction and operation the signal is very simple. It is a system in which both lights and bell are used, located at the crossing to be protected and controlled by a relay connected electrically with three switch boxes placed above the trolley wire, one each side of the crossing some distance away starting the signal, and one at the crossing stopping it. When desired, connection can also be made to the track. The construction of relay and switch boxes which, with bell and lights, constitute the signal, is so simple as to require scarcely any attention. It can also be relied upon to work in all kinds of weather, not being affected by rain, snow, sleet or intense cold. The signal is automatically operated by the car approaching the crossing, which causes the ringing of a bell and the flashing of a red light, continuing until cut out at the crossing. The same operation holds good for cars moving in either direction on single or double track. In the latter case the alarm is given until the last car is past the crossing. Its reliability, simplicity and durability, together with the absolute certainty to give the signals named, are strongly emphasized. The original cost is not great, while the annual expense for power and maintenance is practically nothing.

The uses for which the signal are adapted are many. It not only affords protection against crossing accidents, but also, while giving a danger signal to the public, shows crossing clearance to the motorman, enabling increased speed with greater safety and insuring higher earning capacity per car. It can be used upon either overhead or underground trol-

ley, or third rail system, and also as signals for motorman, for stations, for block signal work upon main line, turnouts, or grade crossings with other lines, and it is especially applicable for drawbridge protection. The signal given in the illustration is in use upon the Glen Haven & Irondequoit Electric Railaoad at Rochester, N. Y. It is also in operation upon electric and steam roads in different parts of the country. The signal is manufactured by the Parrish Signal Company, and has also been patented in Canada, Great Britain, France, Austria, Australia and the United States.

A Long Electric Train

The accompanying engraving shows what is probably the longest train of passenger cars ever pulled by an electric locomotive. The view was taken on the Akron, Bedford & Cleveland Railroad during a recent excursion made by a grocers' association from Alliance, O., to Silver Lake, a pleasure resort on the Akron, Bedford & Cleveland Railroad. The train consisted of ten ordinary passenger coaches and one baggage car, all crowded with passengers. The electric locomotive is one owned by the Akron, Bedford & Cleveland Railroad and is equipped with Westinghouse No. 38 B, 50 h. p. motors.

A LONG ELECTRIC TRAIN ON AKRON, BEDFORD & CLEVELAND ELECTRIC RAILWAY

Ticket Punches

The accompanying engravings show two new types of ticket punches manufactured by L. A. Sayre & Co., for which a number of advantages are claimed. Fig. 1 shows top and side view of the standard type of hand punch. An important feature of this is the fact that the numeral to be punched in the transfer ticket is always in sight, so that the punch can be made in the proper place and not by guesswork. This permits the accurate punching of the figures by the conductor, and obviates any misunderstanding due to possible mistakes on his part.

Fig. 2 shows a novel type of heavy punch, for use in depots, railway offices, and elsewhere, and suitable for punching pads of a hundred or more tickets at one time. This is made, as shown, as a hand punch, but it can be readily adapted for foot power. The use of a punch of this character will save much time where a large number of tickets have to be punched; and the machine, as will be seen, is compact and is noticeable for its durable and strong appearance.

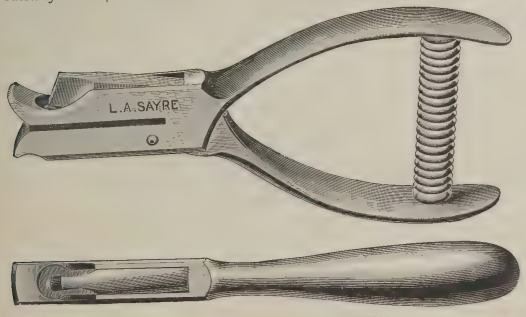


FIG. 1.—CONDUCTOR'S PUNCH

FIG. 2.—PAD PUNCH

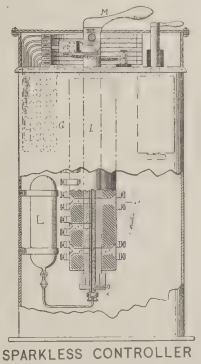
THE Milwaukee, Racine & Kenosha Electric Railway Company, Racine, Wis., has completed its line to Kenosha, and will begin work on the construction of a road through that city as soon as a franchise is granted.

Novel Form of Sparkless Controller

The accompanying illustration represents a new form of controller for electric cars, which has been designed by J. C. Henry, of Denver. The switching is done in an enclosed receptacle containing carbonic acid or some similar acting gas which is incapable of supporting combustion, thus preventing flashing or arcing. If desired, however, puffs of the gas under heavy pressure may be directed to the point when the circuit is broken, so that in addition to the cooling effect of the gas, any tendency to arc will be mechanically resisted by the jets. The armatures are switched from series to parallel, while the fields, which are connected in series, are constantly in shunt relation with both armatures. Both of these elements are connected to the same controller and are so timed that the speed of the car is controlled smoothly either in accelerating or retarding, by a single lever.

To further explain the operation: suppose a pair of ordinary motors connected in parallel, driving a street car at a speed of 15 m. p. h., each of the motors receiving 15 amps. from a 500 volt circuit, and the voltage 480; the field's magnetization would be very weak. Now, if the speed of the car remain the same, such as it might in descending a grade, and the resistance in the field circuit be decreased, so as to give four times the number of ampere turns, this would quadruple the motor's pressure. By decreasing the car speed, however, to, say, 8 m. p. h., as would soon happen when the motors work as dynamos, the available voltage is but 900. If the car speed decreases to 5 m. p. h., the motor voltage is 562; while at 4 m. p. h. it is but 450; so that at all speeds above 4½ m. p. h. the motors, when descending grades, or when coming to a stop, may be used to pump current back into the line.

The controller has but a single handle; the forward movement regulates the supply of current to the armatures, while the backward movement regulates the amount of current the armatures give back to the line. When the back pressure approaches the initial, as it would in the case stated when the car speed is lowered to 4½ miles, the armatures, which are then in series, are disconnected from the line and short circuited under the variable field; the car is consequently smoothly brought to a stand.



SPARKLESS CONTROLLER

In the drawing, *I* represents the controlling cylinder which deals with the armature circuits only; *M* the handle which is moved in both a horizontal and vertical direction; the former movement controls the armature circuit, while the latter varies the resistance, *G*, which is in the field circuit. *L* represents a flask containing the arc obliterating gas under pressure, which is allowed to escape through the ports, *s*, when the circuit is broken.

Heavy Electric Railroading in Iowa

The accompanying engraving shows a train of one motor car and five trail cars on the line of the Mason City & Clear Lake Railway Company, of Mason City, Ia. This line has recently been built and has in addition to its regular equipment of motor cars a ten ton electric locomotive equipped with two 75 h. p. Walker motors. The

PASSENGER TRAIN ON MASON CITY & CLEAR LAKE ELECTRIC RAILWAY

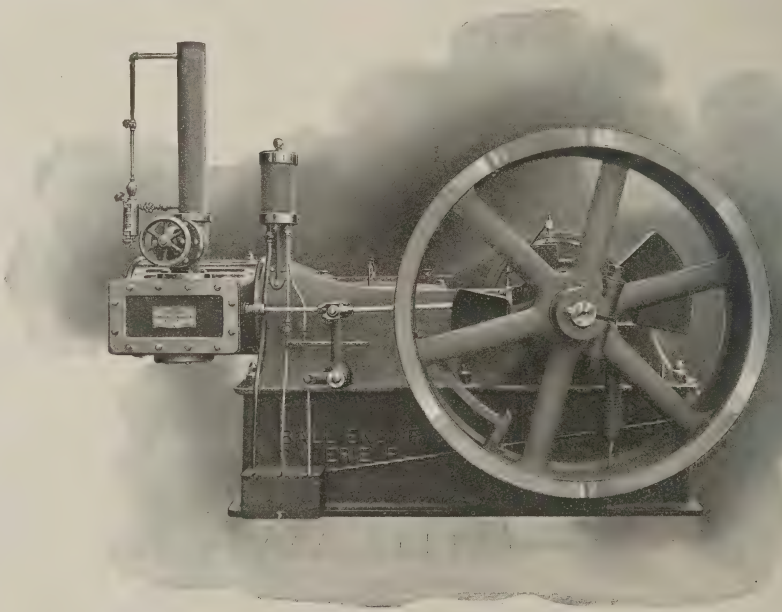
motor car shown in the engraving is 45 ft. in length over all and is equipped with four Walker 50 h. p. motors. Both motor and trail cars are mounted on Peckham No. 14 double trucks and are equipped with Standard air brakes. The electric compressor of the latter, which is of 1½ h. p., is mounted on the motor car and is governed by the company's automatic current controller. The trail cars have twenty double seats with center aisle and hold in seating capacity eighty passengers each.

The air brakes have, it is stated, proved fully equal to all demands made upon them. The entire train of eight cars can be perfectly braked with a low consumption of air. The trailers require only 1 lb. of air and the locomotive 2 lbs., for effective braking, per stop. The trains make a speed of from 30 miles to 32 miles per hour along the line. For about a mile there is a grade of 4 per cent. The illustration shows the train, in the vestibule of which the Standard motor compressor is located. An excellent opportunity for demonstrating the value of these air brakes recently arose. The superintendent was running a train of locomotive and trailer, and while approaching the city with speed reduced to 15 miles per hour, a runaway horse with buggy attempted to cross the track. This buggy contained a woman and three children. The superintendent made an emergency stop which brought the train to a standstill 4 ft. away from the buggy, which had been overturned on the track by the frightened horse. The officials have expressed themselves as well pleased with the installation.

THE Long Island Electric Railway Company, of Brooklyn, N. Y., proposes to erect a large railroad station at Jamaica.

New Ball Engine

A record of many years of success, and its use in many electric light and electric railway stations, make it unnecessary to introduce to the readers of the STREET RAILWAY JOURNAL the Ball engine, built by the Ball engine Company, of Erie, Pa. The company has however added some new features which well merit attention.



NEW SINGLE CYLINDER BALL ENGINE

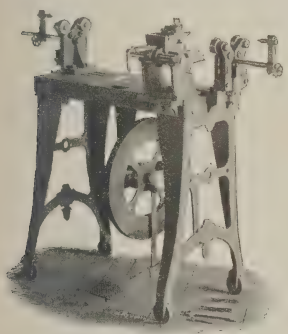
The single cylinder engine, as illustrated, is equipped with the new Rites governor and automatic lubricating system, and shows a very pleasing appearance. The governor, which was fully described on page 567 of the September issue, is a combination of inertia and centrifugal forces, and not only regulates to a high degree of perfection, but with rapid adjustment, and without instability or racing. It also has the advantage of simplicity, as the entire governor consists of a single moving piece suspended upon one pivotal point, thereby reducing friction to a minimum.

The lubrication of the engine, as illustrated, is accomplished by the use of the gravity system of supply to graduated sight-feeders located at the various oiling points upon the engine. This system becomes automatic through the use of a pump that is driven continuously from the valve motion, delivering oil into the tank. The pipes are so connected that direct pressure may be established on the supply pipes for the purpose of removing any obstruction that may occur. The gravity system of oiling seems to have many advantages over the splash or direct forcing systems, for in these systems, in the process of elevating the oil to a sufficient height to

feed over the engine, the oil becomes aerated, but in the gravity system by pumping into a tank there is opportunity for the air to leave the oil; consequently each of the feeds shows clear oil instead of an oil that is almost saponified by being filled with air. The oil after having been distributed over the running surfaces, gravitates down to the bottom of the inside of the frame, and from there is led out to the front end of the frame and through an inclined pipe down to a receiving tank setting near the floor level. Here the oil passes through one or two screens to remove any floating particles of foreign matter, and is then pumped to the supply tank above the engine.

Portable Lathe for Turning Motor Commutators

This machine, which is illustrated herewith, will be found useful by companies who have not a machine shop and whose magnitude hardly warrants such a shop, and who can by this means postpone the installation of one for some time at least; also by large companies who have terminal car houses at which a certain amount of work could be done to good advantage. The shaft or arbor of the armature of a railway motor is run on its bearings (not on its centers), and in this machine is carried on accurately ground ball bearing rollers. The lathe, therefore, turns the commutator true with the shaft regardless of the conditions of the centers in the shaft, and reduces the distance of points of suspension, which does away with all trembling and chattering, leaving the commutator perfectly smooth The ball bearing rollers also reduce the friction so that foot power can be used, as shown, or the machine can be run by a small motor if desired. The rollers are adjustable from 1¾ ins. to 3 ins., and the alignment is always preserved. It will swing armatures 16 ins. in diameter and is mounted on rollers so that it can easily be transferred to any part of the building, or run out of the way when not in use. The money saving features claimed by the manufacturers of this lathe are, that it is always at hand and available; hence commutators will be kept in proper order and their life prolonged. The lathe is built by A. J. Johnson & Co.



PORTABLE LATHE

Carnegie Open Hearth Girder Rails

Few events of recent occurrence in the manufacturing field mean as much to street railway managers as the just announced determination of the Carnegie Steel Company, Limited, of Pittsburgh, to engage in the manufacture of girder rails for street railway purposes, for home and foreign consumption. The Carnegie Company has never until recently given serious attention to this important branch of the business, being occupied with other lines of commercial iron and steel manufacture, but now, having developed a system, or "manufacturing cycle," which extends from the mine at one end to the finished commercial product at the other,—a system which is the wonder and admiration of the engineering world—it is now reaching out in every direction to utilize the economic advantages of the system to the greatest possible extent.

The Carnegie Company owns its mines; transports the ore obtained therefrom, at practically cost, on its own railroads; reduces the ore to pig in its own blast furnaces; converts the pig into blooms, and the blooms into rails, beams, and other forms of manufactured steel—all under its own roof.

For some time past the Carnegie Company has had under construction an immense addition to its Homestead plant, to be used exclusively for the production of girder rails for street railway lines. The new plant is about completed, and the company is now prepared to take orders for spring delivery, as the plant will be put in operation by Dec. 1.

With characteristic enterprise, the Carnegie Company will put on the market girder rails of an entirely different quality from the grade heretofore used. Instead of soft Bessemer steel, which has been used almost exclusively in the production of girder rails in the past, the company will manufacture its rails from basic open hearth steel, which it claims to be of much superior quality for this purpose. Ten 50 ton open hearth furnaces have been constructed for the Homestead girder rail mills, and the whole output at Homestead will be of open hearth steel. All of the machinery in the new rail mills will be driven by electricity.

One of the important advantages which are, or ought to be, derived by street railway companies in dealing with the Carnegie Company is the possibility of obtaining prompt deliveries even of very large orders, when the new mills are in full working operation. Hardly any limit can be placed upon the capacity of the mills for turning out work, as it is announced that the company can put its three large mills at Homestead on girder rail work if necessary.

A Political Attack on the Terre Haute Electric Railway Company

The remarkable success which Russell B. Harrison has made in handling the street railway system of Terre Haute during the past three or four years, especially in establishing most cordial and friendly relations with the public whose interests have been so efficiently served under his management, is well known to most street railway managers, and the surprise felt at the news coming from Terre Haute on Oct. 18, to the effect that the company had been placed in the hands of a receiver through failure to pay certain street paving taxes, was genuine and widespread. Investigation of the facts in the case appears to show, however, that this action was unjust, and inspired by motives on the part of those responsible for it will not bear close scrutiny.

It seems that the legislature last winter passed an act authorizing the city of Terre Haute to extend the street railway company's paving assessments or indebtedness into a long time, low rate interest bond. The council unanimously passed an ordinance in June granting the extension and authorizing the bond issue. The mayor of Terre Haute, however, announced that he would refuse to sign the bonds, and when asked the reason, stated that in his opinion the act was unconstitutional. Legal opinions from some of the best lawyers of the city and state were thereupon submitted to him by the company to the effect that the city was not responsible for the bonds nor for the constitutionality of the act, among these opinions being one from ex-United States Attorney General Miller. The mayor, however, would not accept these decisions as good, and on Monday morning last, before daylight and at an hour when funds could not be placed in the bank, or the assistance of friends obtained, the city treasurer, at the mayor's instance, levied upon the property. The mayor made an affidavit as to the indebtedness, and the road was placed in the hands of a receiver until all questions could be determined upon. It is stated that a part of the indebtedness for which the company was sued for a receiver is owned by the company itself, but part of it is not due, but had the mayor signed the bonds there would have been no taxes standing against the company as a basis for the court proceedings. It is stated also that the action of the mayor was not authorized by the city council and was unknown to them and it does not appear that the mayor has any authority in the matter of collection of taxes under the laws of the state, but nevertheless used the police force to prevent the operation of the cars. No notice or intimation of the intended levy was made to the company and there has never before been a case in the state where a receivership was applied for in a tax matter.

The sentiment of the city of Terre Haute was overwhelmingly with the company in the outrageous attack upon it, and there is much indignation shown at the action of the city officials. The City Council, believing that a serious blunder has been made and to show its good will to the company, unanimously adopted a resolution on Tuesday night complimenting the present management and requesting the receiver to retain it, and the receiver, who is a conservative and prominent citizen, will undoubtedly do this, and will handle the property in the interest of all concerned.

The International Hotel

A large factor in the success of the Niagara Falls convention was the effort made by the management of the International Hotel to make the stay of the delegates and convention attendants during the week a pleasant one. Although the weather was not most propitious for a visit to the Falls, the general verdict of those who stayed at the International Hotel was that the management was most assiduous in its efforts to make the time of its guests agreeable while they were within its doors. Much of this was due to the able manager, S. A. Greenwood, with whom many of his guests during convention week became acquainted. Mr. Greenwood was born in Chippawa, near the Falls, and has had a long hotel experience. He managed a hotel in 1882 at Niagara Falls, afterwards went to Quebec as chief clerk of the Russell House, and during the World's Fair managed the Keene Hotel. At the close of the Fair he returned to Niagara Falls as chief clerk of the International Hotel, then went to the Tifft House in Buffalo, returning to the International Hotel this spring as general manager. During this season a number of conventions have met at Niagara Falls, so that Mr. Greenwood has taken care of a number of large gatherings, all of which have been managed with as much skill and system as during the meeting of the American Street Railway Association.

S. A. GREENWOOD

AT THE CONVENTION

Representatives of Street Railway Member Companies

Akron, O.—C. A. Bien, Supt. Akron & Cuyahoga Falls Rapid Transit Co.

Akron, O.—W. D. Chapman, Gen. Man., P. J. Boucher, Elec. Supt., W. D. Chapman, Jr., Akron St. Ry. & Illuminating Co.

Allentown, Pa.—A. F. Walter, Sec. and Treas., Jilson J. Coleman, Direct. Allentown & Lehigh Valley Traction Co.

Alton, Ill.—H. H. Harrison, Pres., J. G. White, Engr. Alton Ry. & Illuminating Co.

Anderson, Ind.—Charles L. Henry, Man. Union Traction Co.

Atchison, Kan.—J. A. Bendure, Supt. Atchison Ry., Light & Power Co.

Atlanta., Ga.—E. Woodruff, V. Pres. and Man., H. N. Hurt, Supt. Atlanta Consolidated St. Ry. Co.

Atlanta, Ga.—E. Woodruff, Pres., F. M. Zimmerman, Supt. Atlanta Ry. Co.

Atlantic City, N. J.—W. K. McAlister, Atlantic City Elec. Ry.

Auburn, N. Y.—G. L. Shank, Auburn City Ry.

Augusta, Ga.—D. B. Dyer, Pres., C. B. Reavis, Sec. Augusta Ry. & Elec. Co.

Aurora, Ill.—D. A. Belden, Gen. Man. Aurora St. Ry. Co.

Baltimore, Md.—F. L. Hart, Gen. Man. Baltimore City Pass. Ry. Co.

Baltimore, Md.—Wm. A. House, Thomas C. Jenkins, Baltimore Traction Co.

Baltimore, Md.—Samuel B. Thompson, Mast. Mech., J. P. Baker, City & Suburban Ry. Co.

Battle Creek, Mich.—L. N. Downs, Pres, F. I. Griswold, Supt. Citizens' St. Ry. Co.

Bay City, Mich.—R. S. Ashe, Supt., W. R. Morrison, Asst. Gen. Man. Bay Cities Consolidated Ry. Co.

Binghamton. N. Y.—G. T. Rogers, Binghamton St. Ry. Co.

Birmingham, Ala.—J. B. McClary, Gen. Man., J. A. Stratton, Sec. and Treas. Birmingham Elec. Ry. Co.

Boston, Mass.—E. P. Shaw, Direct., J. H. Cunningham, Direct. Haverhill & Amesbury St. Ry. Co.

Boston, Mass.—Chas. S. Sergeant, Gen. Man., Walter S. Swan, Direct., Robert H. Derrah, Pres., Clerk, M. Rounds, West End St. Ry. Co.

Boston, Mass.—C. M. Wicker, Pres. North Shore Traction Co. (15 Wall St., New York).

Boston, Mass.—H. Fisher Eldridge, M. C. Frye, Directs. Mystic Valley Ry. Co.

Bradford, Pa.—W. E. Matthews, Supt. Bradford Elec. St. Ry. Co.

Bridgeport, Conn.—Andrew Radel, Bridgeport Traction Co.

Brockton, Mass.—Marcellus Eldridge, Jas. P. Shaw, Directs. Wakefield & Stoneham Ry. Co.

Brooklyn, N. Y.—C. L. Rossiter, Pres., Ira A. McCormack, Gen. Supt. Chas. D. Meneely, Audr., W. M. Barnaby, Acct., L. Van Cott, Purchasing Agent, David Moffatt, Master Mechanic, Brooklyn Heights R. R. Co.

Brooklyn, N. Y.—F. S. Drake, V. Pres. and Gen. Man., D. A. House, Nassau Elec. R. R. Co.

Brooklyn, N. Y.—W. F. Ham, Sec. Atlantic Ave. R. R. Co.

Buffalo, N. Y.—Godfrey Morgan, Buffalo, North Main St. & Tonawanda Elec. Ry. Co.

Buffalo, N. Y.—H. M. Watson, Pres., H. H. Littell, V. Pres. and Gen. Man., Jos. S. Baecher, Treas., P. C. Deming, Supt., Robt. Dunning, Mast. Mech., M. A. Doughty, Elecn., Wm. H. Bush, John S. O'Brian, Geo. Kuhn, M. W. Brigham, Geo. S. Patterson, Buffalo Ry. Co.

Buffalo, N. Y.—H. H. Littell, V. Pres., R. E. Danforth, Supt. Buffalo, Bellevue & Lancaster Ry. Co.

Buffalo, N. Y.—George Chambers, Supt. Buffalo Traction Co.

Buffalo, N. Y.—L. L. Grove, Supt. Buffalo & Williamsville Elec. Ry. Co.

Camden, N. J.—J. N. Naraman, John M. Isaac, Camden, Gloucester & Woodbury Ry. Co.

Camden, N. J.—Wm. A. Scull, Pres., W. E. Harrington, Gen. Mgr. Camden & Suburban Ry. Co.

Carbondale, Pa.—Jno. P. Aitken, Carbondale Traction Co.

Cedar Rapids, Ia.—Royal H. Holbrook, Ch. Engr. Cedar Rapids & Marion City Ry. Co.

Chicago, Ill.—Geo. O. Nagle, A. C. Heidelberg, C. E. Moore, W. H. Carker, Wm. Weatherwax, F. R. Greene, Sec., T. C. Pennington, Treas., W. G. Price, Chicago City Ry. Co.

Chicago, Ill.—John M. Roach, Supt., J. Millar, Mast. Mech. North Chicago St. Ry. Co.

Chicago, Ill.—Geo. A. Yuille, Asst. Gen. Man., Jas. R. Chapman, West Chicago St. R. R. Co.

Chester, Pa.—Dr. John MacFayden, Gen. Man., W. C. Wood, Supt. Chester Traction Co.

Chicago, Ill.—H. M. Sloan, Gen. Man. Calumet Elec. Ry. Co.

Cincinnati, O.—John Harris, Supt., B. L. Kilgour, Elecn., W. H. Davis, Cincinnati St. Ry. Co.

Cincinnati, O.—H. H. Littell, Pres., H. P. Bradford, Gen. Man. Cincinnati Inclined Plane Ry. Co.

Columbus, O.—M. W. Crabtree, Supt. Columbus Central Ry. Co.

Columbus, O.—P. V. Burlington, Sec. and Treas., W. F. Kelly, Gen. Supt., M. S. Hopkins, Elec. Engr. Columbus St. Ry. Co.

Cleveland, O.—Will. Christy, V. Pres., F. J. J. Sloat, Supt. Akron, Bedford & Cleveland R. R. Co.

Cleveland, O.—Henry J. Davies, Asst. Secy. and Treas., E. J. Cook, ElecnEngr., George A. Stanley, Geo. L. Radcliffe, J. L. Crumins, W. W. Herrick, W. G. McDole, Cleveland Elec. Ry. Co.

Council Bluffs, Ia.—W. S. Dimmock, Omaha & Council Bluffs Ry. & Bridge Co.

Covington, Ky.—Jas. C. Ernst, Pres., T. M. Jenkins, Supt., J. M. Hutton, Direct. South Covington & Cincinnati Ry. Co.

Colorado Springs, Col.—A. L. Lawton, Gen. Man. Colorado Springs Rapid Transit Co.

Connellsville, Pa.—D. S. Fornwalt, Supt. Connellsville, New Haven & Leisenring St. Ry. Co.

Dayton, O.—Geo. B. Kerper, V. Pres. & Gen. Man. People's Ry. Co

Dayton, O.—D. B. Corwin, Pres., Thos. E. Caswell, The City Ry Co.

Denver, Colo.—C. K. Durbin, Supt. Denver Tramway Co.

Derby, Conn.—B. W. Porter, Gen. Man. Wm. J. Clark, Derby St. Ry. Co.

Des Moines, Ia.—J. S. Goodrell, Supt. of Motive Power, W. G. Owens, Supt. Des Moines St. Ry. Co.

Detroit, Mich.—John H. Weston, Detroit St. Ry. Co.

Detroit, Mich.—John Grant, Supt., Tho. Farmer, Jr., M. E., C. Remelius, M. M. Detroit Citizens' St. Ry. Co.

Dubuque, Ia.—H. G. Torbert, Gen. Man. Dubuque Traction Co.

Elmira, N. Y.—Wm. W. Cole, Gen. Man. West Side R. R. Co.

Erie, Pa.—F. D. Ernsberger, Erie Elec. Motor Co.

Exeter, N. H.—W. D. Lovell, Exeter St. Ry. Co.

Fall River, Mass.—G. W. Palmer, Jr., Globe St. Ry. Co.

Findlay, O.—Geo. B. Kerper, Pres., Chas. Smith, Supt. Findlay St. Ry. Co.

Fitchburg, Mass.—W. W. Sargent, Supt., A. H. Moore, Ch. Eng. Fitchburg & Leominster St. Ry. Co.

Fredonia, N. Y.—M. M. Fenner, Sec. Treas. & Man., A. Kusniski, Ch. Engr., H. T. Litchfield, Dunkirk & Fredonia R. R. Co.

Girardville, Pa.—E. W. Ash, Gen. Man. Schuylkill Traction Co.

Hamilton, Ont.—J. B. Griffith, Man., V. H. Waggener, Elecn. and M. M., G. D. Fearman, F. B. Griffith, Inspector Hamilton St. Ry. Co.

Hamilton, Ont.—C. K. Green, Supt. F. H. Watson, Hamilton Radial Elec. Ry. Co.

Hannibal, Mo.—D. Thomson, Pres. and Gen. Man. Hannibal Ry. Co.

Harrisburg, Pa.—F. B. Musser, Supt. Harrisburg Traction Co.

Hartford, Conn.—E. S. Goodrich, Pres., Wm. Grauten, Elec. Engr. Hartford St. Ry. Co.

Hazelton, Pa.—A. Markle, Gen. Man., G. W. Thompson, Supt., C. A. B. Houck, Elec. Engr. Lehigh Traction Co.

Houston, Tex.—H. C. Chase, Sec. and Asst. Treas. Houston Elec. St. Ry. Co.

Hoosic Falls, N. Y.—C. B. Story, Supt. Hoosic Ry. Co.

Hull, Que.—J. E. Brown, Hull Elec. Co.

Johnstown, Pa.—H. C. Evans, Johnstown Pass. Ry. Co.

Kalamazoo, Mich.—L. N. Downs, Pres., Dee Allen, Sec. Citizens' St. Ry. Co.

Kansas City, Mo.—J. A. G. Becker, M. M., Chas. Grover, E. E., C. F. Holmes, Man. Metropolitan St. Ry. Co.

Kingston, Ont.—J. Halliday, Kingston Portsmouth & Cataraqui Elec. Ry. Co.

Kokomo, Ind.—Chas. L. Harry, Kokomo City St. Ry. Co.

Langhorne, Pa.—W. B. Parry, Supt. The Newtown, Langhorne & Bristol St. Ry. Co.

Lansing, Mich.—Laurence Barrett, Treas., L. N. Downs, Pres. Lansing City Elec. Ry. Co.

Lexington, Ky.—R. T. Gunn, Supt. Belt Elec. Line.

London, Ont.—C. E. A. Carr, Gen. Man., Sec. and Treas. S. Potter, Ch. Engr. and Supt. London St. Ry. Co.

Louisville, Ky.—J. O. Haddock, Gen. Supt., W. O. Mundy, Sta. Supt., F. H. Miller, Asst. Sta. Supt., T. J. Minary, Gen. Man. Louisville Ry. Co.

Lowell, Mass.—Philip Y. Bagley, Supt., Charles F. Bancroft, Elecn. Lowell & Suburban St. Ry. Co.

Lynn, Mass.—E. C. Foster, Gen. Man., A. F. Breed, Pres. Lynn & Boston R. R. Co.

Manchester, N. H.—Charles Williams, Pres., Charles H. Bartlett, Treas., W. H. Walker, Man., A. H. Williams, Pur. Agt. Manchester St. Ry. Co.

Memphis, Tenn.—F. G. Jones, V. Pres. and Gen. Man., C. H. Ruddock, Direct. Memphis St. Ry. Co.

Meriden, Conn.—N. H. Heft, Pres. Meriden Elec. R. R. Co.

Middletown, N. Y.—O. C. G. Urban, Supt. Middletown-Goshen Traction Co.

Milwaukee, Wis.—John I. Beggs, Gen. Man., T. E. Mitten, Gen. Supt. Ry. Dept. Milwaukee Elec. Ry. & Light Co.

Minneapolis, Minn.—Geo. R. Folds, J. F. Calderwood, Audr., Willard J. Hield, Gen. Man. Twin City Rapid Transit Co.

Nashville, Tenn.—E. G. Connette, Gen. Man., George Swint, M. M. Nashville St. Ry. Co.

Natick, Mass.—Geo. F. Keep, Supt. Natick & Cochituate St. R. R. Co.

Newark, N. J.—John Bowers, Starter Newark & So. Orange Ry. Co.

New Bedford, Mass.—A. C. Gardner, E. E. Potter, Gen. Supt. Union St. Ry. Co.

New Britain, Conn.—E. S. Breed, Supt. and Gen. Man. Central Ry. & Elec. Co.

Newburyport, Mass.—Charles Odell, Pres., Charles H. Wilson, Direct. Newburyport & Amesburyport St. R. R. Co.

New Haven, Conn.—G. A. W. Dodge, Gen. Man. New Haven St. Ry. Co.

New Haven, Conn.—A. E. Pond, Supt. Winchester Ave. Ry. Co.

New Orleans, La.—George H. Davis, Man., Geo. W. Bacon, Engr., J. K. Newman, Direct. Canal & Claiborne R. R. Co.

New York City.—A. C. Tully, Pur. Agt., Thos. Millen, Gen. Man. Metropolitan St. Ry. Co.

New York City.—T. A. Delaney, Supt. Second Ave. R. R. Co.

New Castle, Pa.—W. Cummins, New Castle Traction Co.

Niles, O.—D. Moynaham, Prop. Mineral Ridge & Niles St. Ry. Co.

Niagara Falls, N. Y.—Charles B. Hill, Sec. and Treas., Alexander O. Porter, Direct., J. E. Brewster, Supt. Niagara Falls & Susp. Bridge Ry. Co.

Niagara Falls, Ont.—W. Phillips, Gen. Man. Niagara Falls, Park & River Ry.

Norfolk, Va.—Wm. Rosborough, Gen. Man. Norfolk St. R. R. Co.

North Tonawanda, N. Y.—W. Carl Ely, Pres., Bert Van Horn, Gen. Man., C. K. Marshall, Supt. Buffalo & Niagara Falls, Elec. Ry. Co.

Norwalk, Conn.—Wm. F. Acton, Gen. Man., A. B. Hill, Engr. Norwalk St. Ry. Co.

Norwich, Conn.—E. P. Shaw, Jr., Gen. Man., W. L. Adams, Supt., L. Bentley, Norwich St. Ry. Co.

Oil City, Pa.—J. H. Forbush, Supt., W. M. Jones, Elecn., B. F. Smithman, Oil City St. Ry. Co.

Olean, N. Y.—Joseph MacCarroll, Olean St. Ry.

Omaha, Neb.—W. A. Smith, Gen. Man. Omaha St. Ry. Co.

Ottawa, Ill.—Wm. F. Ellis, Pres. Ottawa St. Ry. Co.

Palatka, Fla.—Wm. P. Craig (East Orange, N. J.) Pres. Palatka & Heights St. Ry. Co.

Paris, France.—Auguste Boissonnas, Metropolitan Elecn. Ry. Paris.

Patterson, N. J.—W. R. McAdoo, Man. Patterson, Ry. Co.

Philadelphia, Pa.—Chas. Hewitt, Elec. Union Traction Co.

Philadelphia, Pa.—D. A. Hegerty, Gen. Supt. Heston, Mantua & Fairmount Pass. Ry. Co.

Philadelphia, Pa.—F. C. Lugar, Man., F. W. Janney, Supt., Jno. A. Brill, Direct. Roxborough, Chestnut Hill & Norristown R. R. Co.

Pittsburgh, Pa.—S. J. MacFarren, V. Pres. and Gen. Man. Schenley Park & Highlands Ry. Co.

Pittsburgh, Pa.—Robt. P. Cunningham, Treas., J. F. Saitz, Supt. Suburban Rapid Transit St. Ry. Co.

Pittsburgh, Pa.—J. M. Tate, Jr., Gen. Man., John Murphy, Gen. Supt. Second Ave. Traction Co.

Port Huron, Mich.—H. A. Dixon, Supt., William Canham, Pres. City Electric Ry. Co.

Portland, Me.—W. R. Rood, Pres., A. U. Jaastad, Engr., E. A. Newman, Gen. Man., A. Whitney, Charles F. Libbey, Directs. Portland R. R. Co.

Providence, R. I.—A. T. Potter, Gen. Man., W. D. Wright, Elecn. Union R. R. Co.

Quincy, Ill.—E. K. Stone, Jr., Sec., H. S. Partridge, Asst. Sec. Quincy Horse Ry. Co.

Quincy, Mass.—Benj. J. Weeks, Supt., A. D. Gore, Supt. Construction, Brainard T. Dyer, Quincy & Boston St. Ry. Co.

Reading, Pa.—Jno. A. Rigg, Pres., S. W. Muelings, Jr., V. Pres., A. V. Arrowsmith, F. C. Randall, C. A. Bragg, Directs. United Traction Co.

Richmond, Va.—R. Lancaster Williams, Treas., Wm. B. Williams, Asst. Audr., A. Langstaff Johnston, Con. Engr. Richmond Traction Co,

Rochester, N. Y.—Alfred Green, M. M., J. W. Hicks, Supt., H. A. Nicholl, L. M. P., F. M. Nicholl, J. H. Stedman, Man. Transfers Rochester Ry. Co.

Rockland, Me.—Thomas Hawken, Supt. Rockland, Thomaston & Camden St. Ry. Co.

Rome, Ga.—J. B. Marvin, Treas. and Gec. Man. The City Elec. Ry. Co.

Saginaw, Mich.—Homer Loring, Recr. Union St. Ry. Co.

San Antonio, Tex.—R. S. Wakefield, Supt. San Antonio Edison Co.

Salt Lake City, Utah.—W. S. Patterson, M. M. Salt Lake City R. R. Co.

Scranton, Pa.—Frank Silliman, Jr., G. M., E. F. Seixas, Elec. Engr. Scranton Ry. Co.

Sheboygan, Wis.—F. I. Saemann, Treas. Sheboygan Light, Power & Ry. Co.

Sioux City, Ia.—Chester P. Wilson, Sec. Treas. and Gen Man. City Traction Co.

Springfield, Ill.—T. J. Minary, Direct., F. H. Miller Springfield Con. Ry. Co.

Springfield, O.—L. O. Williams, Supt. Springfield Ry. Co.

St. Joseph, Mich.—W. Worth Bean, Pres. and Gen. Man., W. H. Hull, Direct. St. Joseph & Benton Harbor Elec. Ry. & Lt. Co.

St. Louis, Mo.—Robt. McCulloch, V. Pres. and Gen. Man., W. M. Adams, Sec. Cass Ave. & Fair Grounds Ry. Co.

St. Louis, Mo.—Robt. McCulloch, V. Pres. and Gen. Man., C. N. Duffy, Sec. and Treas. Citizens' Ry. Co.

St. Louis, Mo.—Sam'l. Barnes, Elec. Engr., Otto Schmidt, M. M. Lindell Ry. Co.

St. Louis, Mo.—Frank R. Henry, Sec. and Treas. Missouri R. R. Co.

St. Louis, Mo.—Charles Green, Recr. People's Ry. Co.

St. Louis, Mo.—Robt. McCulloch, Gen. Man., Richard McCulloch, Elec. Engr. St. Louis R. R. Co,

St. Louis, Mo.—H. A. Rockwell, Elec. Engr. St. Louis & Suburban Ry. Co.

St. Louis, Mo.—Thomas W. Murphy, Supt., James H. Roach, Sec. and Treas., E. H. Peirson, Union Depot R. R. Co.

Sydney, Australia.—Gustave Fischer, Ch. Asst. Engr. for Tramways at Sydney.

Syracuse, N. Y.—Matthew Murphy, Audr., Paul T. Brady, Direct. Syracuse Rapid Transit Co.

Taunton, Mass.—Geo. C. Morse, Supt. Taunton St. Ry. Co.

Toledo, O.—Albion E. Lang, Pres., Geo. A. Cooke, Asst. Gen. Man., F. B. Perkins, Supt. Toledo Traction Co.

Toledo, O.—C. A. Denman, Gen. Man. Toledo & Maumee Valley Ry. Co.

Tonawanda, N. Y.—Geo. L. Wells, F. S. Mott, Geo. P. Smith. Tonawanda Elec. R. R. Co.

Toronto, Ont.—John W. Moyes, Gen. Man. Metropolitan St. Ry. Co.

Trenton, N. J.—Henry C. Moore, Pres., R. S. Woodruff, Counsel, Chas. Y. Flanders, Trenton Pass. Ry. Co.

Troy, N. Y.—C. H. Smith, Supt. Troy City Ry. Co.

Warren, O.—C. S. Bidwell, Supt. Trumbull Elec. R. R. Co.

Washington, Pa.—J. Kent, Supt. Washington Elec. St. Ry. Co.

Washington D. C.—R. F. Baker, Pres., Theodore J. King, Sec. Treas. and Supt. Columbia Ry. Co.

Washington, D. C.—L. Winters, Capital Traction Co.

Webb City, Mo.—F. H. Fitch, Supt. Southwest Missouri Elec. Ry. Co.

Wheeling, W. Va.—F. H. Strieby, representing W. A. Shirley, Sec. Wheeling Ry. Co.

Wichita Kan.—Herbert B. Church, Pres. Wichita Ry. Light & Power Co.

Wilkesbarre, Pa.—John Graham, Gen. Man., Jas. Fagin, Elec. Engr., L. O. Hoover, Pur. Agt. Wilkesbarre & Wyoming Valley Traction Co.

Williamsport, Pa.—Ernest H. Davis, Gen. Man., Chas. T. Herrick, Asst. Supt. Williamsport Pass. Ry. Co.

Wilmington Del.—Thomas S. Belles, Wilmington City Ry. Co.

Worcester, Mass.—Chas. B. Pratt, Pres., A. H. Stone, Treas., Jno. N. Akarman, Supt., C. J. Field. Con. Engr. Worcester Consolidated St. R. Co.

York, Pa.—Charles H. Mayer, Treas. York St. Ry. Co.

Youngstown, O.—A. A. Anderson, Gen. Man. and Treas., Harry Dixon, Official Mahoning Valley Ry. Co.

Others in Attendance

Ackerman, P. C., American Electrical Works, New York.
Ackley, C. S., Peckham Truck Co., New York.
Adams, W., E. P. Morris, New York.
Adams, H. E., Central Electric Co., Chicago.
Adsit, J. O., Buffalo Engineering Co., Buffalo.
Ahearn, T., Ahearn & Soper, Ottawa, Ont.
Aitken, J. H., General Electric Co., New York.
Allen, Norman Gould, American District Steam Co., Lockport, N. Y.
Allen, J. B., The E. P. Allis Co., Chicago.
Allison, Giles S., St. Louis Register Co. and Hildreth Varnish Co., New York.
Angel, W. A., Pratt & Letchworth, Buffalo.
Angerer, Victor, Wm. Wharton, Jr., & Co., Inc., Philadelphia.
Anthony, W. M., Pres. New Haven Car Register Co., New Haven.
Anthony, J. S., Walker Co., Cleveland.
Archer, H. H., J. G. Brill Co., Philadelphia.
Armstrong, F. C., Canadian General Electric Co.
Arthur, C. B., Hayes & Arthur, Cleveland.
Atkinson, J. M., J. M. Atkinson & Co., Chicago.
Austin, M. B., Safety Ins. W. & Cable Co., Chicago.

Babcock, J. H., American Dist. Steam Co.
Bailey, Geo. C., John A Roebling's Sons Co., Chicago.
Bailey, Theo. P., General Electric Co., Chicago.
Bain, W. G., Walker Co., Philadelphia.
Baird, Jno. H., Jos. Dixon Crucible Co., Jersey City.
Baker, Frank B., American Electrical Works, New York.
Baker, Frank M., Railroad Commission, Albany, N. Y.
Balch, John, Electrical Engineer.
Baldwin. R. A., New York Switch & Crossing Co., Hoboken, N. J.
Baly, John, Murphy Manufacturing Co., Pittsburg.
Banks, Wm. E., Gold Street Car Heating Co., New York.
Barber, A. G., Valentine & Co., New York.
Barbour, R. P., Rochester Hose Bridge Co., Rochester.
Barbour, F. F., General Electric Co., San Francisco.
Barr, B. M., Walker Co., Cleveland.
Barr, H. P., Engineer, New York.
Barrett, J., Duff Mfg. Co., Allegheny.
Barry, J. G., General Electric Co., New York.
Barry, Chas. D., Henry W. Peabody & Co., New York.
Bartholomew, Wm. S., The Adams & Westlake Co., Chicago.
Baxter, E. C., The Monarch Stove & Manufacturing Co., Detroit.
Baxter, Fred. C., The Monarch Stove & Manufacturing Co., Detroit.
Beach, R. H., General Electric Co., New York.
Beach, H. E., Gold Street Car Heating Co., New York.
Beadle, Edward, Railway Register Manufacturing Co., New York.
Beran, T., New York.
Bibber, W. E., Walker Co., Boston.
Bibber, Chas. E., Bibber White Co., Boston.
Bigelow, H. T., Hale & Kilburn Manufacturing Co., Chicago.
Binning, Robt. E., New Process Raw Hide Co., Syracuse.
Bissell, David S., Duquesne Forge Co., Pittsburgh.
Black, Chas. H., Cleveland.
Blewett, Scott H., Missouri Car & Foundry Co., St. Louis.
Blizard, Chas., Electric Storage Battery Co., New York.
Blood, John Balch, Blood & Hale, Consulting Engineers, Boston.
Boughton. W. E., The Johnson Co., Philadelphia.
Bowen, John, John Bowen & Co., Newark, N. J.
Bowman, W. P., John A. Roebling's Sons Co . Cleveland.
Boyd, F. C., New Haven Car Register Co., New Haven, Ore.
Boyles, T. D., General Electric Co., New York.
Bradley, S. W., Electrical Engineer.
Bradley, Jno. S., New Haven Car Register Co., New Haven.
Bradt, S. W., Bradt & Zimmerman, Troy, N. Y.
Bradbury, J. Y., Electric Storage Battery Co., Philadelphia.
Brady, Paul T., Westinghouse Elec. & Mfg. Co., Syracuse, N. Y.
Bragg, C. A., Westinghouse Ecle & Man'f'g Co., Pittsburgh.
Brandon, Geo. F., Brandon Accident Brake, Utica.
Briggs, F. R., Mehling Manufacturing Co., Cleveland.
Brill, Edward, J. G. Brill Co., Philadelphia.
Brill, Jno. A., J. G. Brill Co., Philadelphia.
Broome, E. H., Philadelphia, Pa.
Brown, Harold P., Plastic Rail Bond, New York.
Brown, E. M., General Electric Co., New York.
Brown, R. S., Westinghouse Elec. & Mfg. Co., Boston.
Brown, C. R., Pratt & Letchworth Co., Buffalo, N. Y.
Brown, W. H., The International Register Co., Chicago.
Brown, Geo. M., Pearson Jack Co., New York.
Browne, C. H., Van Wagoner & Williams Co., Cleveland.
Brownell, F. B., Brownell Car Co., St. Louis.
Buehler, J. G., Columbia Machine Works, Brooklyn.
Bulkley, J. N., General Electric Co., New York.
Burleson, W. E., F. W. Oliver Co., Niagara Falls.
Burns, Chas. T., Chas. T. Burns & Co., Rochester, N. Y.
Bushnell, E. M., Bushnell Manufacturing Co., Easton, Pa.
Bushnell, W. G., General Electric Co., New Haven, Conn.
Byrns, Robt. A., Walker Co., Cleveland.

Cabot, J. A., Creaghead Engineering Co., Cincinnati.
Calhoun, W. S., The E. T. Burrowes Co., Portland, Me.
Caldwell, R. L., Walker Co., Cleveland.
Calley, B. F., Jr., H. L. Bowden & Co., Boston.
Campbell, L. A., Canadian General Electric Co., Toronto.
Candee, W. L., The Okonite Co., Ltd., New York.
Carey, W. G., General Electric Co., New York.
Carpenter, Reid, Card Electric Co., Mansfield, O.
Case, F. E., General Electric Co., New York.
Case, Frederick R., Hoopes & Townsend, Philadelphia.
Casper, Wm. P., Consolidated Car Heating Co., Albany.
Castle, Charles C., Hildreth Varnish Co., New York.
Challen, P. J., Fuel Economizer Co., Matteawan, N. Y.
Chappell, A. W., New Haven Car Register Co., New Haven.
Chase, J. D., Chase Construction Co., Detroit.
Chase, Samuel A., Western Electric Co., New York.
Christensen, N. A., Christensen Engineering Co., Milwaukee.
Chur, Walter, American Railway Institute Co., New York.
Church, Townsend V., Julian L. Tate & Co., Chicago.
Clark, Horace F., Clark Brake Co., Pittsburgh.
Clark, Frank H., Electric Storage Battery Co., Philadelphia.
Clark, Francis L., Clark Brake Co., Pittsburgh.
Clitz, R., The Johnson Co., Boston.
Coburn, L. J., Smith & Wallace, Boston.
Cockey, M. R., John A. Roebling's Sons Co., New York.
Coleman, Chas. E., Eugene Munsell & Co., Chicago.
Coleman, Jilson J., St. Louis Car Co., Allentown, Pa.
Collins, G. F., McGuire Manufacturing Co., Chicago.
Condit, Scars B., Jr., L. A. Chase & Co., Boston.
Connors, N. M., N. Y. Switch & Crossing Co.
Conway, M. W., New York Switch & Crossing Co., New York.
Cooke, W. J., McGuire Manufacturing Co., Chicago.
Coster, Maurice, Westinghouse Electric & Mfg. Co., Chicago.
Crafts, Samuel D., Walker Co., New York.
Crane, J. O., Gen. Agt. Holmes, Booth & Haydens, New York.
Crane, R. T., Jr., Crane Company, Chicago.
Cravath, J. R., Cravath Manufacturing Co., Chicago.
Crider, J. S., The Washington Carbon Co., Pittsburgh.
Cross, J. W., U. S. Headlight Co., Utica, N. Y.
Crowley, H. J., General Electric Co., Philadelphia.
Curwen, Samuel M., J. G. Brill Company, Philadelphia.

Daggett, H. M., Jr., Lombard Hydraulic Brake Co., Boston.
Daly, John, Murphy Varnish Co., Pittsburgh.
Daniels, A. L., The H. B. Camp Co., Aultman, O.
Darlington, Frederick W., Con. Engr., New York and Phila.
Dayton, Jas. B., Trenton Malleable Iron Co., Trenton.
Dean, D. B., Terre Haute Car Mfg. Co., Terre Haute.
Dee, A. V., The Schillister Co.
Delany, W. H., New York.
Demary, R. C., Akron Electrical Mfg. Co., Akron, O.
Deming, Frederick C., Carnegie Steel Co., Pittsburgh.
Dew, F. A., Monarch Stove & Manufacturing Co., Mansfield, O.
De Witt, E. F., E. F. De Witt Co., Lansingburgh, N. Y.
Dewson, E. H., Jr., Standard Air Brake Co., New York.
Devens, Richard, The Weber Railway Joint Mfg. Co., New York.
Dodd, S. T., Walker Co., Cleveland.
Dolph, John C., John C. Dolph & Co., New York.
Donohoe, F. E., American Electrical Works, Chicago.
Donovan, F., Rochester, N. Y.
Donaldson, J. A., Mertes Mfg. Co., Allegheny.
Douglass, R. M., Norristown, Pa.
Dowdell, Augustus, Valentine & Co., New York.
Downes, L. W., D. & W. Fuse Co., Providence.
Doyle, W. L., John A. Roebling's Sons Co., Trenton.
Doyle, J. F., Pullman Co., Pullman, Ill.
Drake, John I., Hope Electric Appliance Co., Providence.
Dressler, W. F., "Kleanit" Co., Akron, O.
Dunlap, W. H., Westinghouse Elec. & Mfg. Co., Pittsburgh.
Durand, S. B., Milwaukee Rail Joint & Welding Co., Milwaukee.
Durel, P. S., Christensen Engineering Co., Milwaukee.
Dutton, W. A., Dorner & Dutton Co., Cleveland.

Edson, H. C., Pratt & Letchworth Co., Buffalo.
Ellis, William F., Dilworth, Porter & Co., Pittsburgh.
Elliot, W. H., Elliot Frog & Switch Co., East St. Louis, Ill.
Emmons, A. P., Wendell & MacDuffie, Boston.
Entwisle, E. B., The Johnson Co., Lorain, Pa.
Entz, J. B., Electric Storage Battery Co.
Estabrook, H. M., Barney & Smith Car Co., Dayton, O.
Estep, Frank A., R. D. Nuttall Co., Allegheny.
Evans, O. C., The Johnson Co., Cincinnati.
Evans, H. C., The Johnson Co., New York.
Evans, E. O., Contractor, New York.
Ewing, Geo. C., Bryan Marsh Co., Boston.

Fairchild, C. B., Standard Air-Brake Co., New York.
Falk, H. W., Falk Manufacturing Co., Milwaukee.
Faust, Wm. R., Leonhardt Wagon Manufacturing Co., Baltimore.
Farrell, John, Inspector, Buffalo.
Fearey, Thomas H., Manager General Electric Co., Buffalo.
Ferguson, W. L., Central Union Brass Co., St. Louis.
Ferguson, F. W., Walker Co., Cleveland.
Ferguson, W. S., The Pittsburgh Reduction Co., Pittsburgh.
Ferry, C. E., Peckham Truck Co.
Field, Arthur W., Eastern Agent Peckham Truck Co., Boston.
Field, H. G., Field & Hinchman, Detroit.
Fish, C. A., Geo. Kissam & Co., New York.
Fisher, E. G. McMullen Woven Wire Fence Co.
Fischer, G., Engineer N. S. W. Tramways, Sydney.
Fisher, G. E., Chace Construction Co., Detroit.

Flanders, Chas. Y., Morris, Tasker & Co.; Nat'l Water Tube Boiler Co., New York.
Fletcher, E. C., E. P. Sharp, Buffalo.
Forsyth, W. H., Forsyth Bros. & Co., Chicago.
Forsyth, G. H., Forsyth Bros. & Co., Chicago.
Foster, H. A., Buffalo.
Fuller, F. G., W. R. Brixey Manufacturing Co.
Frenyear, T. C., Westinghouse Electric & Mfg. Co., Buffalo.

Gagnon, C. E., Jr., Gagnon Spragge & Co., Montreal.
Gardam, J. N., Peckham Truck Co., New York.
Gardner, A. C.
Garl, M., Garl Electric Co., Akron, O.
Garratt, Allan V., Lombard Water Wheel Governor Co., Boston.
Garrison, A. C., Columbia Incandescent Lamp Co., St. Louis.
Garton, W. R., Central Electric Co., Chicago.
Gates, J. Holt, Walker Co., Chicago.
Gay, H. B., Walker Co., Baltimore.
Gayley, O. C., Safety Car Heating & Lighting Co., New York.
Gent, Wm., F. W. Oliver Co., Niagara Falls, N. Y.
Gerry, Rowland, Jones & Laughlin, Ltd., Pittsburgh.
Ghegan, Jno J., J. H. Bunnell & Co., New York.
Giblin, John, Springfield Emery Wheel Co., Bridgeport, Conn.
Gilman, Chas. S., National Lead Co., Cleveland.
Glover, Sam'l W., The Post-Glover Electric Co., Cincinnati.
Gold, Edward E., Pres. Gold Street Car Heating Co., New York.
Gordon, J. R., Westinghouse Elec. & Manufacturing Co., Altanta.
Granger, John A., New York Car Wheel Works, Buffalo.
Granger, Francis, Corning Brake Shoe, Buffalo.
Grauten, Wm., Electrical Engineer, Hartford.
Gray, W. H., Peckham Truck Co., Chicago.
Gray. L. A., The Adams & Westlake Co., Chicago.
Gray, E. W. F., Westinghouse Elec. & Mfg. Co., Pittsburgh.
Green, W. C., Sales Agent Henry R. Worthington, Cincinnati.
Greene, C. E., Niagara, Falls, N. Y.
Grier, H. M., Pantasote Leather Co., New York.
Griffin, J. C., Crosby Line Steamers, Milwaukee.

Haasis, A. L., Jos. Dixon Crucible Co., Jersey City.
Hale, Irving, General Electric Co., Denver.
Hale, G. H., Consolidated Car Fender Co., Providence.
Hall, T. A., Walker Co., Cleveland.
Ham, R. H., The Trojan Button Fast. Co., Troy, N. Y.
Ham, A. W., Ham Sand Box, Troy, N. Y.
Ham, H. B., Heine Safety Boiler Co., Boston.
Hallett, R. C., Hildreth Varnish Co., New York.
Hanna, J. A., Peckham Truck Co., Chicago.
Hanon, George, General Electric Co., New York.
Harding, H. McL., Walker Co., New York.
Harrington, F.W., India Rubber & Gutta Percha Ins. Co., New York.
Harrington, S. H., Harington Rail Bonding Co., New York.
Harris, E. P., Mechanical Engineer, Dunkirk, N. Y.
Harris, C. C., Illinois Steel Co., Cleveland.
Hartwell, Arthur, Westinghouse Elec. & Mfg. Co.
Haskell, G. M., J. G. Brill Co., Hartford, Conn.
Haskins, Caryl D., General Electric Co., Boston.
Hathaway, Alfred G., Cleveland.
Hatley, Geo. H., Pratt & Lambert Co., Cincinnati.
Haycox, W. E., Fulton Truck & Foundry Co., Mansfield, O.
Hayes, Scott R., Hayes & Arthur, Cleveland.
Heathcote, W., Canadian General Electric Co.
Heinrichs, E. H., Westinghouse Elec. & Mfg. Co., Pittsburgh.
Hemingway, D. C., Hemingway Glass Co., Covington, Ky.
Henry, O. D., The Steel Motor Co., Johnstown, Pa.
Hernandez, J., Adam Cook's Sons, New York.
Herr, Arthur T., The Sargent Co., Chicago.
Heth, John D., Taunton Locomotive Works, Taunton, Mass.
Heulings, W. H. Jr., J. G. Brill Co., Philadelphia.
Hicks, J. B., Pratt & Lambert Co., New York.
High. Jno. M., The Pantasote Co., New York.
Hinchman, T. H., Jr., Field & Hinchman, Detroit.
Hinds. F. C., 53 State Street, Boston.
Hirsch, Herman, C. Buschner's Roller Bearing, New York.
Hodgkins, Edward E., The Q. & C. Co., Chicago.
Holbrook, Percy, Weber Ry. Joint Mfg. Co., New York.
Homer, F. E., F. E. Homer & Co.
Hood, Chas. O., R. Bliss Manufacturing Co., Pawtucket, R. I.
Hubbard, O. M., The Bradford Belting Co., Cincinnati.
Hubbard, M. G., Jr., McGuire Manufacturing Co., Chicago.
Huntress, F. E., Barney & Smith Car Co., Boston.
Hunter, Lytle J., Hunter Illuminated Sign Co., Cincinnati.
Hurd, G. A., Crane Co., Chicago.
Hurst, W. T., The Monarch Stove & Mfg. Co., Mansfield, O.
Hutchins, A. W., D. & W. Fuse Co., Providence, R. I.
Hutton, E. F., Diamond Truck & Car Gear Co., Kingston, N. Y.

Issertel, Henry G., Walker Co., New York.
Ives, Wm. M., Leonhardt Wagon Mfg. Co., Baltimore, Md.

Jaastad, A. W., Sheaff & Jaastad, Boston.
Jackman, Geo. W., Springfield Manufacturing Co., Bridgeport, Conn.
Jackson, J. Monteith, Jackson & Sharp Co., Wilmington, Del.
Jackson, Newton, Electric Mutual Casualty Association, Scranton.
Jackson, John, Simonds Manufacturing Co., Pittsburg.
Jacob, W. H., Card Electric Co., Mansfield, O.
Jens, W., The Johnson Co., St. Louis, Mo.
Johnson, J. M., La Crosse, Wis.
Johnson, W. L., Walker Co., Toronto.
Johnston, Henry C., Chas. Scott Spring Co., Philadelphia.
Johnston, A. Langstaff, Constructing Engineer, Richmond, Va.
Jones, J. M., Jr., J. M. Jones' Sons, West Troy, N. Y.
Jones, B. J., Sargent & Lundy, Chicago.
Jones, C. S., Western Glass Co., Milwaukee.

Kappesser, J. F., General Electric Co., New York.
Kauffman, W. J., Kauffman Conkell Co., Canton, O.
Kavanagh, J. E., Wm. Wharton, Jr., & Co., Philadelphia.
Keeler, H. E., Adams & Westlake Co., Chicago.
Kelly, W. H., New York.
Kennelly, J. J., New York.
Kernochan, H. P., Jr., General Electric Co., New York.
Kerper, G. B., Dayton.
Kerschner, W. R., Columbia Machine Works, Brooklyn.
Kiely, H. J., Link Belt Engineering Co., New York.
Kilburn, C., Buffalo.
Kimball, Fred M., General Electric Co., New York.
King, C. K., Ohio Brass Co., Mansfield, O.
Kingston, Wm. W., The Johnson Co., Atlanta, Ga.
Kirkland, H. B., Cutter Electric & Manufacturing Co., New York.
Kissam, Geo., Geo. Kissam & Co., New York.
Knickerbocker, C. K., Griffin Wheel Co., Chicago.
Kuhl, J. G., Mitchell Tempered Copper Co., Corry, Pa.
Kuhlman, G. C., G. C. Kuhlman & Co., Cleveland.

La Marr, W. H., Duplex Supply Co.
Lane, R. T., The Steel Motor Co., Johnstown, Pa.
Langdon, C. J., Fulton Foundry Co., Mansfield, O.
Lapham, Frank A., Cleveland Frog & Crossing Co., Cleveland.
Larens, E., General Incandescent Arc Light Co., New York.
Laughlin, F. M., Solar Carbon & Manufacturing Co., Pittsburgh.
Lawless, Edward J., American Car Co., New York.
Lawrence, F. D., Standard Electrical Works, Cincinnati.
Leidenger, Joseph, Dayton Manufacturing Co., Dayton.
Leidenger, Peter, Dayton Manufacturing Co., Dayton.
Leschen, Henry, Leschen-Macomber-Whyte Co., Chicago.
Letchworth, O. P., President Pratt & Letchworth Co., Buffalo.
Lex, Frederic A., Lobdell Car Wheel Co., Wilmington, Del.
Lindsay, H. J., Carnegie Steel Co., Ltd., Pittsburgh.
Littlefield, A. S., The Johnson Co., Chicago.
Livingston, M. L., Standard Therm. & Electric Co., Peabody, Mass.
Lloyd, Herbert, The Electric Storage Battery Co., Philadelphia.
Lockwood, Jas. E., General Electric Co., Detroit.
Loiehat, L. A. L., Kauffman-Conkell Co., Canton.
Long, E. G., Peckham Truck Co., N. Y.
Loper, A. N., New Haven Car Register Co., New Haven.
Lowell, John A., Duplex Car Co., Boston.
Lucas, G. C., The Cleveland Frog & Crossing Co., Cleveland.
Ludington, R. B., Columbia Refining Co., New York.
Ludlow, W. E., American Rail Joint & Mfg. Co., Cleveland.
Luscomb, H. H., Johns-Pratt Co., Hartford.
Luther, H. R., Barbour-Stockwell Co., Cambridge, Mass.
Lyford, O. S., Jr., Westinghouse Electric & Mfg. Co., Pittsburgh.
Lyford, G. B., Westinghouse Electric & Mfg. Co., Pittsburgh.
Lyman, H. M., M. E., Cleveland.

MacDuffie., R. L., Wendell & MacDuffie, New York.
MacGovern, Frank, Rossiter, MacGovern & Co., New York.
MacLaren, Malcolm, Westinghouse Electric & Mfg. Co., Pittsburgh.
Mahoney, C. L., The Pennsylvania Steel Co., Philadelphia.
Mallett, J. B., Westinghouse Elec. & Mfg. Co., Pittsburgh.
Mann, Albert, Electrical Engineer.
Many, F. B., The Mehling Manufacturing Co., Cleveland.
Marshall, C. F., Christensen Engineering Co., Milwaukee.
Martin, Dr. Robert W., Philadelphia.
Mathes, G. D., Walker Co., Cleveland.
Maxwell, E. L., Dilworth, Porter & Co., Ltd., Pittsburgh.
McCardell, J. R., McCardell, West & Co., Trenton, N. J.
McCarty, Norman, American Rail Joint Co., Cleveland.
McCormack, E. D., Canadian General Electric Co., Toronto.
McCoy, Frank, Pittsburgh Car Wheel Co., Pittsburgh.
McElroy, James F., Consolidated Car Heating Co., Albany.
McGhie, John, General Electric Co., New York.
McIlwain, E. M., The Bethlehem Iron Co., So. Bethlehem, Pa.
McIntosh, D. G., M. D. Partridge Carbon Co., Pittsburgh.
McLaughlin, W. E., Automatic Block Signal Co., New York.
McLeod, N. R., Washburn & Moen Mfg. Co., Worcester, Mass.
McRoy, John T., Chicago, Ill.
Meachem, J. W., New Process Raw Hide Co., Syracuse.
Meaker, J. W., Meaker Manufacturing Co., North Chicago.
Meek, J. E., H. W. Johns Manufacturing Co., New York.
Mensch, C. E., Skeene Automatic Semaphore Co., St. Louis.
Mercur, H. T., Corning Brake Shoe Co., Buffalo.
Merrick, F. R., Blood & Hale, Boston.
Moore, John J., New York.
Moore, George, Duplex Car Co., Boston.
Moore, R. E., General Electric Co., Philadelphia.
Moore, Alex. T., Jr., Walker Co., Pittsburgh.
Morrell, A. W., The Miller Knoblock Co., South Bend, Ind.
Morrell, F. A., Sterling Supply Manufacturing Co., New York.
Morrin, Thomas F., Jersey City.

Morris, Elmer P., Railway Supplies, New York.
Morse, Geo. C., Rochester Car Wheel Works, New York.
Mulford, O. J., Street Car Advertising, Detroit, Mich.
Murdock, H. L., O. R. Sackett & Co., Niagara Falls.
Murray, David, E. T. Burrowes Co., Portland, Me.
Myers, Garson, Christensen Engineering Co., Milwaukee.

Nary, W. T., North Adams, Mass.
Naugle, E. E., Naugle, Holcomb & Co., Chicago.
Nethercut, Edgar S., Paige Iron Works, Chicago.
Newcomb, F. H., Conductors' Caps, Brooklyn.
Newton, J. D., Swan & Finch Co., New York.
Nicholls, Frederic, Toronto, Can.
Nickle, Hugh, E., Kingston, Can.
Norton, H. A., A. O. Norton, Norton Jack, Boston, Mass.

Oliver, F. W., F. W. Oliver Co., Niagara Falls.
Osborne, G. F. Roger, K. P. C., Kingston, Ont.
Oswald, Edwin H., Benedict & Burnham Mfg. Co., Waterbury, Conn.

Pardee, J. H., General Electric Co.
Parker, L. H., General Electric Co., New York.
Parsons, Charles, Buda Foundry & Machine Co., Chicago.
Parsons, J. N., A. Mertes Manufacturing Co., Allegheny, Pa.
Partridge, Arthur S., St. Louis.
Partridge, J. N., Okonite Company, New York.
Partridge, James. Partridge Carbon Co., Sandusky,
Partridge, W. E., Mechanical Engineer, New York.
Peckham, Edgar, Pres. Peckham Truck Co., New York.
Pfingst, Louis, Boston.
Pike, F. N., Mgr. Hygeia Hotel, Old Point Comfort, Va.
Polk, R. H., Wm. Wharton, Jr. & Co., Inc., Philadelphia.
Pomeroy, Joseph, Pomeroy & Fisher, Paints, New York.
Post, W. B., Billings & Spencer Co., Hartford.
Porter, George F., "Kerite," New York.
Potter, D. F., General Electric Co.
Potter, W. B., General Electric Co., New York.
Powell, A., Cleveland Frog & Crossing Co., Cleveland.
Prather, Henry L., Falk Manufacturing Co., Milwaukee.
Pratt, H. T., Washburn & Moen Mfg. Co., Worcester, Mass.
Price, E. F., Acct. Light, Heat & Power Co., Niagara Falls.
Priest, E. D., General Electric Co.
Provost, George W., R. D. Nuttall Co., Allegheny.
Pugh, D. W., John Stephenson Co., Ltd., New York.
Pullen, C. L., Lobdell Car Wheel Co., New York.
Pullen, F. T., Diamond Truck & Car Gear Co., New York.
Purves, T. B., Boston & Albany Railroad.

Quigg, H. J., Erie Railroad Co., Newburgh, N. Y.

Randall, F. C., Christensen Engineering Co., Hartford, Conn.
Ransom, H. N., Consolidated Car Heating Company, Albany.
Reeve, Frederick C., Plastic Rail Bond, New York.
Reinoehl, C. W., Pennsylvania Steel Co. Steelton.
Reno, C. Stowe, Triumph Electrical Co., Cincinnati.
Reynolds, A. T., Taylor Electric Truck Co., Troy.
Rhodes, J. D., Pittsburgh Car Wheel Co., Pittsburgh.
Rice, Franklin, The Dayton Automatic Car Switch Co., Dayton.
Richard, E. J., Hudson River Power Transmission Co.
Richards, H. T., The Safety Insulated Wire & Cable Co., New York.
Richardson, Chas. A., Worcester Construction Co., Worcester.
Robert, Louis E., Sterling Supply & Manufacturing Co., New York.
Roberts, E. P., E. P. Roberts & Co., Cleveland.
Roberts, F. W., Steel Motor Co., Johnstown.
Robinson, D. H., E. P. A., Bay Line, New York.
Robinson, John C., Harrington, Robinson & Co., Boston.
Robinson, E. J., Laclede Car Co., St. Louis.
Roche, D. S., Charles Scott Spring Co., Philadelphia.
Rooke, George F., Rooke Register Co.
Rose, R. M., Duplex Supply Co., Norwalk, Conn.
Rosenthal, George D., General Electric Co., St. Louis.
Rusling, F. O., Laurenceville, Pa.
Russell, H. H., E. T. Burrowes Co., Portland, Me.
Russell, W. H., Russell Manufacturing Co., Chicago.
Russell, F. D., Rochester Car Wheel Works, Rochester.
Russell, P. G., Prindle & Russell.
Rutherford, J. A., The Steel Motor Co., Johnstown.

Sackett, H. J., Buffalo, N. Y.
Sackett, O. R., Sackett Trolley Pole Catcher, Niagara Falls.
Sammons, Charles H., The Clonbrock Steam Boiler Co., Brooklyn.
Sanford, George H., Platt & Washburne Roofing Co.
Sargent, F. W., The Sargent Co., Chicago.
Sargent, George H., Sargent Brake Shoe Co., Chicago.
Savage, F. T., Columbia Refining Co., New York.
Saxelby, Frederick, The Wells & French Co., New York.
Sayre, L. A., L. A. Sayre & Co., Newark.
Schlegel, Robert A., Paper Vending Machine Co.
Schneider, H., Troy, N. Y.
Schultz, Charles S., Dick, Kerr & Co., Ltd., London, Eng.
Schutt, H. L., Detroit Stove Works, Detroit.
Schuyler, H. P., General Electric Co.
Scott, William M., The Cutter Electrical & Mfg. Co., Philadelphia.
Scrugham, G. R., Creaghead Engineering Co., Cincinnati.
Sears, J. P., Composite Brake Shoe Co., Boston.
Seguine, W. P., Joel H. Woodman, Hoboken, N. J.
Session, E. O., Portsmouth, N. H.
Shainwald, J. C., The Standard Paint Co., New York and Chicago.
Sharp, Edward P., R. D. Nuttall Co., Buffalo.
Sheble, Franklin, Plastic Rail Bond, Philadelphia.
Shippy, H. L., John A. Roebling's Sons Co., New York.
Short, S. H., Walker Co., Cleveland.
Siegfried, Robert, Westinghouse Electric & Mfg. Co., Pittsburgh.
Silk, A. E., Jewell Belting Co., Hartford.
Silver, William S., Wm. S. Silver & Co., New York.
Sinclair, D. J., Sinclair Automatic Coupler.
Sinclair, D. J., Paledonico, N. Y.
Skeen, Robert, Skeen Signal Co., St. Louis.
Sloat, F. J. J., Cleveland Construction Co., Akron, O.
Smith, H. W., Smith & Wentworth, Boston, Mass.
Smith, William M., Chicago Insulated Wire Co., Chicago.
Smith, W. Nelson, Electrical Engineer, Watertown, N. Y.
Smith, Pemberton, New York Car Wheel Works, Buffalo.
Smith, Henry B., New York.
Snow, F. W., Valentine & Co., New York.
Snow, G. C., The Cleveland Frog & Crossing Co., Cleveland.
Spaulding, H. C., Siemens & Halske Electric Co., Chicago.
Spencer, E. J., Safety Insulated Wire & Cable Co., St. Louis.
Starr, D. A., Cornwall, Ont.
Stearns, W. H., Pennsylvania Steel Co., Chicago.
Stedman, J. H., Rochester, N. Y.
Stevens, J. F., Keystone Electrical Instrument Co., Philadelphia.
Stillman, F. H., Watson-Stillman Co., New York.
Storer, N. W., Westinghouse Electric & Mfg. Co., Pittsburgh.
Storer, F. K., Westinghouse Electric & Mfg. Co., Pittsburgh.
Storey, I. E., Storey Motor & Tool Co., Philadelphia.
Strieby, F. H., General Electric Co., Cincinnati.
Surrit, Charles A., Mertes Manufacturing Co., Allegheny.
Sutton, William, American Car Co., St. Louis.
Swartz, B. F. McKee Fuller & Co., Catasauqua, Pa.
Sweet, D. C., Sweet Wheel Grinder, Springfield, Mass.

Tackaberry, John A., John Stephenson Co., Ltd., New York.
Tandy, L. D., Engineer, General Electric Co., Schenectady, N. Y.
Taylor, John, Taylor Electric Truck Co., Troy.
Ten Broeck, W. H., Diamond Truck & Car Gear Co., Kingston.
Tenney, A. E, General Electric Co., Atlanta, Ga.
Tesseyman, H., Mast. Mech., Barney & Smith Car Co., Dayton.
Thomas, Joseph N., Steel Motor Co., Johnstown, Pa.
Thompson, N. A., Valentine & Co., New York.
Thomson, H. G., Anchor Post Co.
Thomson, G. A., The Forest City Electric Co., Cleveland.
Tiffany, William, Sterling Supply & Manufacturing Co., New York.
Tillinghast, B. D., Duff Manufacturing Co., Pittsburgh.
Tolles, C. L., Jewell Belting Co., Hartford.
Tone, Frank J., Carborundum Co., Niagara Falls.
Traverse, James, O. R. Sackett & Co.
Trawick, S. W., General Electric Co., Philadelphia.
Trefether, E. T., A. O. Norton, Boston.
Tupper, G. A., Taylor Electric Truck Co., Troy.

Van Dorn, W. T., W. T. Van Dorn Co., Chicago.
Van Wagoner, C. S., Van Wagoner & Williams Co., New York.
Vosburgh, A. C., New Process Raw Hide Co., Syracuse.

Waite, E. B., Buffalo.
Walbridge, G. H., J. G. White & Co., New York.
Walker, Henry L., Detroit, Mich.
Walker, Russell, Heine Safety Boiler Co., St. Louis.
Wampler, William M., Meaker Manufacturing Co., Chicago.
Ward, John E., Gold Street Car Heating Co., New York.
Warner, E. D., Parrish Signal Co., Jackson, Mich.
Warren, Edgar E., Milwaukee Rail Joint & Welding Co., Milwaukee.
Washburne, Wm. A., Cambria Iron Co., New York.
Wattles, James F., Rand-Avery Supply Co., Boston.
Weaver, S. H., Pittsburgh Trolley Pole Co., Pittsburgh.
Webb, H. E., Solar Carbon & Manufacturing Co., Pittsburgh.
Welch, Geo., Lawrence, Mass.
Welch, Robert W., John A. Roeblings' Sons Co., Trenton, N. J.
Wendell, Jacob, Jr., Wendell & MacDuffie, New York.
Wesner, T. H., Walker Co.
Wessels, E. J., Standard Air-Brake Co., New York.
Weston, George, Naugle, Holcombe & Co., Chicago.
Weston, Frederic B., Gold Street Car Heating Co., New York.
Wharton, Wm. W., Electric Mutual Casualty Assn., Philadelphia.
Whitcomb, William W., Composite Brake Shoe Co., Boston.
White, J. G., J. G. White & Co., New York.
White, T. C., Central Union Brass Co., St. Louis.
Whitlock, F. B., National Malleable Castings Co., Indianapolis, Ind.
Whitney, J. D., Crew-Levick Co., Philadelphia.
Whipp, Geo. S., Contractor, Brooklyn, N. Y.
Whipple, Bailey, Buckeye Electric Co., Cleveland.
Whyte, George S., Leschen-Macomber-Whyte Co., Chicago.
Wilkinsen, A. L., The Ohio Brass Co., Mansfield, O.
Wilkinson, W. H., Diamond Truck & Car Gear Co., Kingston.
Williams, B., General Electric Co.
Williams, George W., Composite Brake Shoe Co., Salem, Mass.
Wilson, Charles H., 115 High Street, Boston.
Wilson, J. E., Pettingell-Andrews Co., Boston.
Wind, F. A., Paper Vending Machine Co.
Window, Richard R., T. P. A., Old Dominion S. S. Co., New York.
Wise, Clift, General Contractor, Chicago.
Wood, W. C., New York Switch & Crossing Co., Hoboken.

Wood, Charles N., Railway Supplies, Boston.
Woodward, R. Graham, Graham-Woodward Equip. Co., New York.
Woodward, A. H., International Register Co., Chicago.
Woodworth, A. C., Jr., Consolidated Car Fender Co., Providence.
Woodworth, A. C. Consolidated Car Fender Co., Providence.
Wright, G., Westinghouse Electric & Manufacturing Co.
Wright, J. H., Taunton Locomotive Mfg. Co., Taunton, Mass.
Wurster, E. A., Falk Manufacturing Co., Milwaukee.

Yardley, John Howard, Philadelphia Car Wheel Co., Philadelphia.

Zimmermann, W. F., Westinghouse Elec. & Mfg. Co., New York.

VISITING LADIES AT THE CONVENTION

Mrs. E. D. Hibbs, Jersey City, N. J.
Mrs. W. K. McAllister, Atlantic, City, N. J.
Mrs. Chas. Green, St. Louis.
Miss Green, St. Louis.
Mrs. C. B. Reavis, Augusta, Ga.
Mrs. T. E. Crossman, Brooklyn.
Mrs. Albion E. Lang, Toledo, O.
Mrs. James R. Chapman, Chicago.
Mrs. E. W. Ash, Ashland, Pa.
Mrs. R. H. Black, East Orange, N. J.
Mrs. Theo. P. Bailey, Chicago.
Mrs. Thomas Farmer, Jr., Detroit.
Mrs. E. K. Stone, Jr., Quincy, Ill.
Mrs. A. T. Potter, Providence, R. I.
Mrs. W. S. Scull, Camden, N. J.
Mrs. F. H. Fitch, Carthage, Mo.
Mrs. W. W. Herrick, Cleveland.
Miss Anna Herrick, Cleveland.
Miss Ella Herrick, Cleveland.
Mrs. H. D. McDole, Cleveland.
Mrs. H. J. Davis, Cleveland.
Mrs. W. Worth Bean, St. Joseph, Mich.
Mrs. Will H. Hull, St. Joseph, Mich.
Mrs. Scott H. Blewitt, St. Louis.
Mrs. H. P. Schuyler, Schenectady, N. Y.
Mrs. Robt. McCulloch, St. Louis.
Mrs. W. Gibson Carey, Schenectady, N. Y.
Mrs. Lewis D. Tandy, Schenectady, N. Y.
Miss F. Fischer, New York.
Mrs. H. M. Daggett, Attleboro, Mass.
Mrs. W. J. Cooke, Chicago.
Mrs. Burt Van Horn, Buffalo.
Mrs. George W. Williams, Salem, Mass.
Miss Van Horn, Lockport, N. Y.
Miss Entwisle, Johnstown, Pa.
Miss Gertrude Seguine, Jersey City, N. J.
Mrs. Caryl D. Haskins, Boston.
Mrs. Fred. M. Kimball, Boston
Mrs. W. B. Potter, Schenectady, N. Y.
Mrs. W. F. Kelly, Columbus, O.
Mrs. John Murphy, Pittsburgh.
Mrs. James F. Wattles, Boston.
Mrs. F. C. Hinds, Boston.
Mrs. C. H. Wilson, Boston.
Mrs. S. Fred Potter.
Mrs. A. E. Pond, New Haven.
Mrs. G. A. W. Dodge, New Haven.
Mrs. E. A. Simmons, New York.
Mrs. George B. Kerper, Dayton.
Mrs. J. N. Wegory, Buffalo, N. Y.
Mrs. John McGhie, New York.
Mrs. S. L. Nelson.
Mrs. Henry H. Windsor, Chicago.
Mrs. Fred S. Kenfield, Chicago.
Mrs. John MacFayden, Chester, Pa.
Mrs. F. G. Jones, Memphis.
Miss Stivers, Burlington.
Miss Mallory, Memphis.
Mrs. Nesbit Duffy, St. Louis.
Miss Clara Cuningham, St. Louis.
Mrs. John C. Robinson, Boston.
Mrs. Charles A. Bragg, Philadelphia.
Mrs. L. A. Sayre, Madison, N. J.
Mrs. Wm. P. Craig, Orange, N. J.
Mrs. L. A. Williams.
Mrs. D. S. Moffatt, Brooklyn, N. Y.
Mrs. F. B. Perkins, Toledo, O.
Mrs. Sidney H. Short, Cleveland, O.
Mrs. Harry Dixon, Youngstown, O.
Miss Kilgour.
Mrs. R. F. Baker, Washington, D. C.
Miss Dunning, Buffalo, N. Y.
Miss Peckham, New York.
Mrs. Louis N. Downs, Battle Creek, Mich.
Mrs. Dee Allen, Battle Creek, Mich.
Mrs. Ira A. McCormack, Brooklyn, N. Y.
Mrs. Ellen H. James, Lockport, N. Y.
Mrs. E. J. Wessels, Orange, N. J.
Mrs. R. H. Beach, New York.
Mrs. H. N. Hunt, Atlanta, Ga.
Mrs. J. B. O'Hara, Chicago.

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Kammeyer, C. E., STREET RAILWAY JOURNAL, Chicago.
Kittredge, A. O., STREET RAILWAY JOURNAL, New York.
Windsor, H. H., *Street Railway Review*, Chicago.
Kenfield, F. S., *Street Railway Review*, Chicago.
Kenfield, H. J., *Street Railway Review*, Chicago.
Barnes, Geo. A., *Street Railway Review*, Chicago.
Royse, Daniel, *Street Railway Review*, Chicago.
Ashly, George J. M., *Street Railway Review*, Chicago.
Weaver, W. D., *American Electrician*, New York.
Wood, E. E., *American Electrician*, New York.
Johnston, W. J., *The Electrical World*, New York.
Stump, Clarence E., *The Electrical World*, New York.
Church, J. V. S., *The Electrical World*, Chicago.
Child, Chas. T., *The Electrical World*, New York.
Martin, T. C., *The Electrical Engineer*, New York.
Hanks, W. F., *The Electrical Engineer*, New York.
MacConnell, W. J., *The Electrical Engineer*, New York.
Shaw, A. C., *The Electrical Engineer*, New York.
Price, Chas. W., *Electrical Review*, New York.
Goddard, Stephen H., *Electrical Review*, New York.
Kornfeld, A. E., *Engineering News*, New York.
Swann, John J., *Engineering News*, New York.
O'Hara, John B., *Western Electrician*, Chicago.
Perry, Frank L., *Western Electrician*, Chicago.
Swetland, H. M., *Power*, New York.
Reynolds, John N., *Railroad Gazette*, Chicago.
Wood, Arthur J., *Railroad Gazette*, New York.
Simmons, E. A., *Railroad Gazette*, New York.
Hunt, W. T., *Electrical Age*, New York.
Harrison, Newton, *Electrical Age*, New York.
Spalding, J. W., *Municipal Record and Advertiser*, New York.
Beattie, T. Stoddard, *Municipal Record and Advertiser*, New York.
Biggar, E. B., *Canadian Engineer*, Toronto, Ont.
Crossman, T. E., Official Stenographer.

News Notes

Addison, N. Y.—J. Hinman, of Addison, is interested in a proposed electric railway from Odessa to Ithaca.

Baltimore, Md.—The property of the Columbia & Maryland Railway Company has been sold to a syndicate of Baltimore capitalists, among whom are T. Edward Hambleton, John M. Nelson and Nelson Perin. The contract for completing the line has, it is stated, been awarded to W. G. Mendinhall & Company, of 208 South Fourth Street, Philadelphia, and work will be resumed at once.

Binghamton, N. Y.—A committee appointed to investigate the desirability of building an electric railway from Binghamton through the Otselic Valley has reported in favor of its construction. The proposed road will be 46 miles in length and cost about $800,000.

Buffalo, N. Y.—The Buffalo Traction Company has petitioned for permission to extend its lines into South Buffalo.

Canton, O.—The Commissioners of Stark County have been asked to grant a franchise for an electric railway to Pittsburgh capitalists, who propose to construct a line from Canton to Alliance.

Charleston, W. Va.—It is reported that the new owners of the Charleston Street Railway have decided to begin improvements immediately. This, it is stated, will include the laying of heavier rails, also new cars and an extension of the company's line in the suburbs of about 2 miles.

Chattanooga, Tenn.—A. M. Pennock, of the Western Union Telegraph Company, of Chattanooga, writes that a company with a capital of $250,000 is being organized to build an electric railway from Chattanooga to Crawfish Springs, Georgia, and Chickamauga Park, a distance of 12 miles.

Cincinnati, O.—The Cincinnati Street Railway Company is about to change the motive power of its Walnut Hills and Vine Street lines from cable to electricity.

Clinton, N. Y.—An electric railway for Clinton, N. Y., is projected.

Depew, N. Y.—George A. Ricker, vice president and chief engineer of the Buffalo & Depew Railway Company, states that work on the company's line, which will run from the Genesee Street line of the Buffalo Railway Company to Depew, a distance of 4½ miles, will be begun in thirty days and that the road will be in operation by next summer.

Eau Claire, Wis.—The Chippewa Electric Railway Company intends to extend its lines to Badger Mills and Chippewa Falls.

Hamilton, O.—It is stated that the Hamilton, Grimsby & Beamsville Electric Railway Company has succeeded in raising the sum of $200,000 to build an electric railway from Beamsville to St. Catherines.

Jersey City, N. J.—The Consolidated Traction Company contemplates extending its system in Elizabeth from Broad Street through East Jersey City to First Street.

Kalamazoo, Mich.—L. N. Downes, president and general manager of Michigan Traction Company, writes that grading on its 27 miles of proposed road will be begun at once, and that the power houses are already completed and equipped. Contracts for the overhead equipment and track work will be let about Jan. 1. Fifteen cars will be used.

Kansas City, Mo.—A contract was signed recently by which the Metropolitan Street Railway Company agrees to build a double track electric railway from Washington Park to Fairmount Park, a distance of about 1¼ miles. The new line is to be finished by next spring, when cars will run regularly between the two parks, Kansas City and Independence.

Meadville, Pa.—The Meadville Traction Company has been granted an extension of three months for the completion of its lines.

New Britain, Conn.—E. H. Mather, electrician of the New Haven Street Railway Company, has been chosen secretary and treasurer of the Central Railway & Electric Company, and has resigned his position in New Haven, to take effect Nov. 1.

New Castle, Pa.—New Castle, Ellwood, Youngstown and Pittsburgh capitalists are about to take steps for connecting New Castle with Pittsburgh by an electric railway. One of the gentlemen interested said it was intended to begin work at once on a line joining Ellwood City with Beaver Falls, a distance of 7 miles, and build a loop to Harmony, Zelienople and Evans City. A bridge across the Beaver River at West Ellwood Junction is proposed and a charter will be applied for.

New Haven, Conn.—Work has been begun on the line of the New Haven & East Haven River Railway Company. The road will be about 3 miles in length, and the company has a capital of $150,000. It is under substantially the same management as the New Haven Street Railway Company and will probably be run in connection with it.

Newton, Mass.—The Newton Street Railway Company has asked for permission to build an electric railway through Weston to Wayland.

Norfolk, Mass.—The Norfolk Central Street Railway Company has purchased a tract of land which it proposes to devote to public recreation purposes.

Parkersburg, W. Va.—The Parkersburg & Marietta Traction Company has been incorporated to construct an electric railway from Parkersburg, W. Va., to Marietta, O.

Pasadena, Cal.—Right of way has been granted the Pasadena & Los Angeles Electric Railway Company to construct an electric railway from Fair Oaks Avenue to Doty Block.

Pensacola, Fla.—The Pensacola Electric & Terminal Railroad Company has obtained an extension of time from the city authorities in which to complete its road. W. H. Bosley, of Baltimore, is president of the company.

Philadelphia, Pa.—The Union Traction Company has asked permission to extend its lines on certain streets.

Richmond, Va.—The Richmond Railway & Electric Company has purchased a piece of property on which it proposes to erect a storage battery plant to be used in cases of emergency when, through accident or other causes, the plant now operated by the company becomes exhausted or crippled.

Rochester, N. Y.—It is stated that parties from Brooklyn, N. Y., contemplate building an electric railway in this city if a charter can be secured. The line will run from East Rochester to Gonic, branch lines being built to meet the demands of travel.

St. Louis, Mo.—The Hamilton Avenue & Baden Railroad Company has petitioned the City Council for a franchise to build a double track electric railway.

THE Cabanne Place Railway Company is also seeking for a franchise for a similar road.

Sedalia, Mo.—The Sedalia & McAllister Springs Electric Railway & Power Company has been organized to build an electric railway between those cities. The road will be 25 miles in length and operate ten cars. Work will be commenced as soon as the City Council grants franchises, Woodford Brooks, of Sedalia, the chief promoter ,writes that no contracts have been let.

A Tasteful Publication

H. Milton Kennedy, general passenger agent of the Brooklyn Rapid Transit Company, has recently prepared a very tasteful little pamphlet of pocket size giving the different routes reached by the lines of that company and views and descriptions of the various pleasure resorts in the territory covered by the system. The book is printed two in colors and also contains a map of the system. The cover is particularly attractive. The first edition of this was 100,000, and they were distributed in New York and Brooklyn through the regular time table holders in the railway stations, steamship offices, and hotels.

A New Electric Manufacturing Company

To old timers in the electric railway business the news that Frank J. Sprague and E. H. Johnson are once again in combination will be most interesting and welcome, and particularly inasmuch as the combination has for its principal purpose the exploiting of new and important inventions of Mr. Sprague and Mr. Johnson in the electric railway field where first and greatest successes were made. In the STREET RAILWAY JOURNAL for August, Mr. Sprague's multiple unit system for elevated and suburban railway work was described at length. This system will be one of the principal possessions of the "Sprague Electric Company" just formed; another will be the Sprague electric elevator system; a third will be the Johnson-Lundell underground conduit system; and a fourth the system of interior wiring, and the Lundell motors and dynamos now exploited by the Interior Conduit & Insulation Company. The new company has not yet effected an actual consolidation of all these interests, but it is expected that within a very short time the combination will be completed and under one management.

The Sprague electric elevators have come into extensive use, and a still more brilliant future is undoubtedly open to them, particularly in view of the feeling of uneasiness generated in the mind of the public with respect to hydraulic elevator accidents so common of late. It will be remembered that the Central London underground road has selected the Sprague elevators, forty-nine in all, for its fourteen underground stations, this contract involving a very large sum of money, and being probably but the first of a number to follow in foreign fields.

The Sprague multiple unit system has been adopted by the South Side Elevated road, of Chicago, for its entire equipment of 120 cars,and other large contracts for this system are in prospect for the immediate future. The interior conduit tubing system is so perfect in all its details and has come into such wide use in building operations, that this element of the new combination will undoubtedly be of great strength, while the Lundell motors and dynamos in large and small sizes will find an extensive market.

It is understood that the company will concentrate its manufacturing facilities at the Sprague Elevator Works, at Watsessing, N. J., which are finally equipped for the work of a general character to be carried on by the new company. The New York City headquarters will be at 253 Broadway.

The capital stock of the new company will be $500,000, one-half of which will be in cumulative 6 per cent preferred stock, and the other half in common stock. At present a large proportion of both classes of stock will remain in the treasury. The new capital has all been underwritten, and that its financial backing is strong may be inferred from the list of officers, as follows: president and managing director, A. B. Chandler (president Postal Telegraph Company); first vice-president and general manager, E. H. Johnson: second vice-president and technical director, Frank J. Sprague; secretary and treasurer, Edward C. Platt; directors, Albert B. Chandler, Edward H. Johnson, Frank J. Sprague, Edward C. Platt, John E. Platt, John E. Searles, John Markle, Carl Schurz, Allan C. Bakewell, W. Murray Crane, Wm. H. Baker, John O. Stevens. Among other capitalists interested in the new company, aside from the directors, may be mentioned John W. Mackay, J. Pierpont Morgan, Zenas Crane, John A. Roebling's Sons, estate of J. Hood Wright, and estate of Theodore Havemeyer.

As before stated, Mr. Sprague will be second vice-president and technical director of the new company; Robert Lundell will be in charge of the designing and manufacturing department for dynamos, motors, etc.; C. R. Pratt will be in active charge of the mechanical department, and E. R. Carichoff will be Mr. Sprague's technical assistant in the lines of electrical designing in connection with elevator and railway work.

Remarkable Feat of Construction Work

Street railway managers in the East are coming to rely upon the J. G. White Company for special and apparently impossible work when the necessity arises, and it is rare that the company's organization is found wanting. Three years ago the New York & Philadelphia Traction Company obtained a franchise to build a road in the Eastern Turnpike, Bridgewater Township, between Somerville and Bound Brook. After the franchise was granted it was found that under certain decisions of the courts it was invalid, and a new application was made by the company for the franchise. Consents of one-half of the abutting property were obtained, but before the new franchise could be perfected the Brunswick Traction Company came into the field with an application for permission to build a line over the same route. The two companies met before the Bound Brook Borough Board, and the Brunswick Traction Company was successful in securing permission to build.

The New York & Philadelphia Traction Company believing however that it had continuing rights under its old franchise, determined to lay down the track, and made arrangements with the White Company to do so at the appropriate time and place. Plans were quietly perfected, and on Saturday, Oct. 23, at 6 P. M., a train, composed of six freight and eleven passenger cars left Baltimore for Bound Brook, and was pushed through on one of the fastest runs ever made over the line, certainly for this class of work, so that it arrived at Finderne in the vicinity of Bound Brook at 11:30 the same evening. A three car train left New York also on Saturday evening. The two trains in combination contained all the appar-

atus, material and labor necessary for "a quick job," including a complete commissary department, thirty large tents, fifteen 5000 c. p. Wells kerosene oil lights, rails, ties, wire, sixteen horses, and 600 men. Nearly all the poles were already up along the line, but a pole line 2000 ft. long from a source of power, presently to be referred to, had to be constructed, and all the wire, rails, bonds, etc., put in position. On arrival at Bound Brook, work was instantly commenced by the party and prosecuted vigorously throughout the night. The Wells lights attracted instant attention and information regarding this work was soon communicated to President Radel of the Brunswick Traction Company, who went before Justice Ludlow of the Supreme Court and caused an injunction to be issued, doing this before twelve o'clock midnight. At midnight President Radel started for Bridgewater, the injunction was served, but no attention was paid to it, as it was claimed that service could not be made on Sunday. The sheriff was called and his deputies to the number of fifty were summoned, but they were heavily outnumbered and did nothing but make a few arrests. President Radel gathered some of his employes and at one time it looked as if there might be serious trouble, but the "invading party," so to speak, was so large that nothing could be done. The entire road and overhead structure were erected and the first trolley car, which had been brought from New York on a flat car, was run over the line at 11:40 P. M. Sunday night. The source of power was a dynamo on the premises of Lawyer Shaw, whose place at Finderne is one of the largest and handsomest in Somerset County. The dynamo had been sent there some time before and was supposed to be for the purpose of lighting his house and premises.

J. A. Wilson, of the White Company, was in charge of the track work, and C. G. Young of the overhead and commissary work. The entire party left town early Monday morning in order to be out of the State before the courts should have time to act.

AMONG THE MANUFACTURERS

A. McNab Little has accepted a position as traveling salesman for the Western Electric Company, of Chicago.

The Stirling Metal Company, of Stirling, N. J., has issued a circular devoted to a description of its anti-friction metal, which is having an extensive use for bearings.

The Detroit Stove Works, of Detroit and Chicago, have lately shipped about two hundred of their Jewel street car stoves to the Union Depot Railway Company, of St Louis.

The Standard Air-Brake Company, of New York, whose exhibit at the convention attracted wide attention, was the first to ask for a bill for the space occupied by it in the convention hall.

J. F. Macartney, of Macartney, McElroy & Company, sailed for Europe Oct. 23. Mr. Macartney will be gone four months, during which time he will visit the principal countries of Europe.

L. K. Hirsch, of Chicago, Ill., has for distribution among his customers and friends a very tasteful leather pocketbook. All who have received this have spoken in most complimentary terms of it.

The International Register Company, of Chicago, closed an order last month for 140 registers for the Capital Traction Company, of Washington, D. C., through its Eastern representative, Elmer P. Morris.

John Jackson, representative of the Simonds Manufacturing Company, was called home from the convention at Niagara Falls on account of the illness of his father. Mr. Jackson, Sr., died on Oct. 20.

The Ohio Brass Company, of Mansfield, O., presented to attendants at the convention a souvenir which was in great demand. It was a small button thermometer to be worn on the coat lapel, and was very popular.

The Harrison Safety Boiler Works, of Philadelphia, Pa., has recently issued a leaflet upon heating systems descriptive of its Cochrane heaters. The circular gives a diagram showing the pipe connections to a Cochrane special heater and receiver.

James L. Robertson & Sons, of New York, have issued a pamphlet entitled "Robertson's Shaking and Dumping Grate Bars." The Robertson grate bars have established a high reputation for durability and economy, and the pamphlet will give much interesting information on this subject.

The Keystone Electric Company, of Erie, Pa., has recently brought out a tasteful pamphlet entitled "Generators and Motors" and descriptive of the electrical machines built by it for light and power. The pamphlet is handsomely illustrated and will be sent to any address upon application to the manufacturers.

Young Lock Nut Company, of New York writes us in regard to its flexible pole bracket illustrated in the last issue of the STREET RAILWAY JOURNAL that as the patents for this construction are claimed by the Creaghead Engineering Company, the Younglock Nut Company will place the bracket on the market without the flexible attachment referred to.

The American Electric Heating Corporation, of Boston, Mass., reports an excellent demand for its heaters and among the orders closed recently are seventy car equipments for the Capital Traction Company, of Washington, D. C., thirty-nine car equipments for a suburban road near Philadelphia, Pa., and twenty-five car equipments for the Consolidated Traction Company, of New York.

The McGuire Manufacturing Company, of Chicago, reports an excellent demand for its combination snow sweepers and plows. Among the orders closed recently for the plows are two for the New York & Queens County Railway Company, Steinway, L. I., one for the Camden & Suburban Railway, of Camden, N. J., and five for the North Hudson County Railway Company, of Hoboken, N. J. These orders were sent to the company by its Eastern agent, Elmer P. Morris.

The Puritan Electric Company, formerly of No. 150 Nassau Street, New York, has removed its office to the Bowling Green Building, No. 11 Broadway, New York, where it has increased facilities for handling the alternating enclosed arc lamp which the company manufactures. This change was rendered necessary by the large increase in business, which the company has received since the fall season commenced, and which has taxed its facilities of production to the utmost.

The Western Electric Company, of Chicago and New York, issued under date of August, 1897, a handsome pamphlet on overhead line material, in which the list prices have been thoroughly revised. The company has now in press another pamphlet devoted to line construction material and car and motor supplies which will be ready about Nov. 15. Copies of both pamphlets will be promptly mailed upon request. The Western Electric Company has also made a very nice sample card of wires which are manufactured in its factory and is sending out this card to those who apply for it.

John McKinlock has announced that he has purchased the stock, property and good will of the Metropolitan Electric Company. Wm. H. McKinlock and W. C. Camp will act as agents for the disposal of this stock and will take other business in the general electric line as carried on heretofore by the Metropolitan Electric Company. The mammoth catalogue of the Metropolitan Electric Company will be available to those who will send $1 for the express charges, or a small order to pay for the transportation of same. This catalogue is one of the most remarkable of its kind ever published.

The Q. & C. Company, of Chicago, Ill., has just published its catalogue of shop saws and shop saw blades for 1898. This catalogue is handsomely illustrated and is printed on excellent paper. The shop saws manufactured by the Q. & C. Company are made of the very best material and are constructed in a workmanlike and substantial manner, and are giving great satisfaction wherever they are in use. These saws are particularly adapted for use in repair shops of street railway companies, and have been installed in the shops of a large number of prominent street railways.

Wm. Wharton, Jr. & Company, Inc., of Philadelphia, Pa., have suffered some annoyance during the past month on account of the similarity of the firm's name with that of the Wharton Railroad Switch Company, an entirely different corporation, which made an assignment during October. The two companies are entirely distinct and have never had any connection with each other financially or otherwise. Wm. Wharton, Jr., & Company have been doing a very large business during the past year and their manganese steel special work is becoming more popular and generally used than ever before.

The Mica Insulator Company, of New York, has issued a very attractive circular on its M. I. C. compound, which is an enamel, black in color and manufactured in four grades to suit different requirements. Each is perfect as an insulator, wet or dry, durable and elastic even after baking. It is composed of linseed oil, asphalt and rubber, and its initials, M. I. C., denote that the Mica Insulator Company is behind it, standing as a guarantee of its high quality. It is intended for the insulation and coating of all parts where required, of motors, generators, armatures, field magnets, wires, cables, overhead line construction, switchboards etc. On the folder is a copper leaf coated with the M. I. C. compound and baked for eight hours at a temperature of 300 degs. F.

The Berlin Iron Bridge Company, of East Berlin, Conn., writes us that the Collins Company, of Collinsville, Conn., in order to better its facilities, and to meet the demands of its increasing business, is making extensive improvements in its plant at Collinsville, and has placed the contract with the Berlin Iron Bridge Company, for a large addition to its forge shop. The new construction will be entirely of iron in order to have it fireproof, no woodwork being used in the construction Alxander Smith & Sons' Carpet Company, of Yonkers, N. Y., has also placed the contract for the two fireproof dye houses with the Berlin Compauy. These buildings are 50 ft. wide and 100 ft. long, built entirely of steel, no woodwork being used at all in the construction.

Warren Webster & Company, of Camden, N. J., in addition to the contracts previously mentioned in the past issues, write that the following contracts have been taken for the installation of the Webster system of steam heating: Vermont State Prison, Windsor, Vt.; Sun Light Building, Crescent Bath Building and Pope Manufacturing Company, Louisville, Ky.; Western Kentucky Asylum for the Insane, Hopkinsville, Ky.; Lambertville Rubber Company, Lambertville, N. J.; Heywood Brothers & Wakefield Company, Chicago, Ill.; Connell Office Building, Scranton, Pa.; Mende

Brothers' Factory, Philadelphia, Pa.; Parkside Apartment House, Philadelphia, Pa.; Grosvenor Dale Company, Mill No. 1, Grosvenor Dale, Conn.; Myron F. Thomas' Shoe Factory, Campello, Mass.; Chadwick Lead Works Factory, Forest River, Mass.; Cincinnati Passenger Station, P. C., C. & St. L. Ry. Co., Cincinnati, O.

The Pantasote Company, of New York City, has opened a handsome suite of offices at 29 Broadway, where in future the business of this important company will be conducted. The use of pantasote for car curtains, shades, head lining and seats, has been growing rapidly, and the volume of business is now so great as to necessitate this change to larger quarters. Up to within recently the business was conducted by and at the warerooms of Clarence Whitman & Company, one of the largest dry goods dealers in New York. Owing however to the increase in business on account of the popularity of the material, and to the fact that the railroad business was quite foreign to the dry goods business of Clarence Whitman & Company, it was decided to make a separate department of the sale of pantasote material. Mr. Whitman however is still interested in the manufacture of the material, and is vice-president of the Pantasote Company.

The General Electric Company, of Schenectady, N. Y., will shortly make a notable addition to the already extensive electrical plant of the Niagara Falls Hydraulic Power & Manufacturing Company in the power house at the foot of the cliff at Niagara Falls, N. Y., in the form of an electrolytic generator, which will be the largest of its kind ever constructed. It will be both liberally and carefully designed to enable it to cope with the very severe service of electrolytic work, i.e., for practically continuous operation. This machine will have fourteen poles and will run at 257 r. p. m., giving an output of 5000 amps. at 175 volts, or a capacity of 875 k. w. It will be of the latest type and will be directly connected to the water wheel shaft. It will be provided with a special panel switchboard with full form K equipment of instruments necessary to handle a current of 5000 amps. The General Electric Company is already well represented in the power house of the Niagara Falls Hydraulic & Manufacturing Company. Two of its six pole, 560 k. w., 300 revolution, 650 volt railway machines, both directly coupled to the same turbine shaft supply current to the Great Gorge Railway. In addition the station contains a G. E. booster and two other generators, one of 100 and one of 90 k. w.

The Standard Paint Company, of New York, manufacturer of the P. & B. electrical compounds, P. & B. tape, P. & B. armature varnish, P. & B. insulating paper, etc., has enjoyed a large sale for these products in various parts of Europe for the past six years or more. The company has satisfied consumers in all respects, but the drawback of the length of time necessary to have orders despatched from this country as well as the high tariff existing in Germany (in which country and in Great Britain the company has had a specially large trade) seriously interfered with the natural increase of the business. The company decided last January to make the P. & B. products more readily available to European markets, and after a thorough examination of the situation by the president, the decision was reached to erect a large and complete factory in the City of Hamburg. The factory is most eligibly situated, being on the River Elbe, making it possible to receive all raw products, and ship all finished goods by water to any part of the world, without any other handling than that of water transportation pure and simple. The sales office of the company is in charge of the very favorably known firm of Allut Noodt & Meyer, at 33 Grimm, Hamburg. The Hamburg Works will be ready next month to accept and deliver orders for all the P. & B. products used in the electrical industries. The business of the factory is confined to European markets. The North and South American business, and other points more accessible from the United States, will continue to be supplied by the American works of the Standard Paint Company. Robert W. Blackwell, of 39 Victoria Street, Westminster, S. W., London, is the representative of tha company in Great Britain, and for France, Belgium, Holland and the Colonies.

The Peckham Motor Truck & Wheel Company, of Kingston, N. Y., is doing an excellent business in the manufacture of both single and double trucks. The orders which have been received during the last month in this country have been large, but in addition Mr. Peckham has been awarded some very important foreign orders, which, with his domestic contracts, are keeping his works running to their full capacity. The principal foreign orders upon which the works are now engaged are those for 100 trucks for the Government Tramways of Sydney, N. S. W., and 150 trucks for the Dublin United Tramways of Dublin, Ireland, and among the large orders for trucks in this country, Mr. Peckham numbers one of 100 trucks for the Cincinnati Street Railway Company. The company has recently published one of the most attractive catalogues which have ever been issued in the electric railway field. This is entitled "A Supplement to Catalogue D," and the first part of it is devoted to handsome half tone engravings and descriptions of the Peckham standard double and single trucks. Following this matter are views of many of the details of the trucks such as the flexible gear, dust-tight and self lubricating journal box and gravity brake, track scraper, etc., while the last part of the volume is devoted to engravings of standard and novel types of cars equipped with the Peckham trucks. These include an express and baggage car for the Bangor, Orono & Oldtown Railway Company, electric locomotive for the Mason City & Clear Lake Railway Company, double decked car for the Leeds (Eng.) City Tramway Company, and long double truck cars for the Union Traction Company of Rutherford, N. J., and the Milwaukee, Racine & Kenosha Electric Railway Company.

The Standard Underground Cable Company, of Pittsburgh, Pa., has entered suit against the National Conduit & Cable Company, of New York, for infringement of a number of its patents on cables, terminals, T joints, etc. The following patents are involved in the suit: No. 242,894, relating in general to a duplex or two conductor, flat form of cable for telephone, telegraph, or electric light service, this form of cable being especially economical in manufacture and installation, and especially well adapted, owing to its practical elimination of self induction, for alternating current transmission. No. 388,477, relating to what might be termed as a "semi-concentric cable," composed of a central conductor or core, and a number of insulated conductors arranged spirally around the same, and having a cross section greater in breadth than thickness, and composed of a number of smaller wires or strands, the purpose being to produce a flexible cable of the smallest dimensions, and also, by the position of the wires with respect to each other, and by including them under one lead cover, to reduce self induction to a minimum. No. 371,808, which is claimed to cover generally the so-called "T-joint," or a metallic case or protecting shield secured around the insulated conductor joints between the main and branch cables. No. 395,546, is for a coating of tin or alloy thereof, or other material more durable than lead, as a protection against mechanical injury to the softer lead cover of the cable, and to resist the oxidizing action of acids, alkalies, and similar agents that might work the destruction of a plain lead covering. No. 574,343 relates to the well known cable terminal head, tubular in form, and split in two longitudinal sections for convenience of joining the cable conductors to their respective binding posts, the sections being made of substantially uniform cross sectional shape throughout their entire length and of such internal dimension as to make a tight joint with the cover of the cable when applied thereto, and provided with binding posts for connection with the cable conductors and the exterior distributing wires. The suit has been entered in the United States Circuit Court for the Southern District of New York, by Kerr, Curtis, & Page, of New York City, as solicitors, and George H. Christy, of Pittsburgh, Pa., and Thomas B. Kerr, of New York City, of counsel.

Trade Catalogues

Gisholt Tools. Published by the Gisholt Machinery Company. Madison, Wis. 40 pages. Illustrated.

General Catalogue. Published by Henry R. Worthington, Brooklyn, N. Y. 111 pages. Illustrated.

Bryant Cold Metal Sawing Machines. Published by the Q. & C. Company, of Chicago. 24 pages. Illustrated.

New Publications

Poor's Manual. 1897 Edition. Published by H. V. & H. W. Poor. New York. 1408 pages. Price, $7.50.

This manual has been issued annually since 1868. From year to year new features have been introduced and new departments added, resulting in a great expansion of the scope of the work, especially in later years, chiefly because of the consolidation of Poor's Handbook of Investment Securities and Poor's Directory of Railway Officials with the Manual of Railroads. In the presentation of the statements of the several companies great care is observed, many of the statements of the larger corporations being presented with considerable elaborateness, statistical, historical and otherwise. A valuable feature of this work is the very comprehensive series of tables descriptive of the funded debt of all steam railroad companies, in which is given every item of interest or importance relative to each issue of bonds that actual or prospective investors in these securities are likely to call for.

Note sur la Traction Électrique à Prise de Courant Aérien. By M. C. Walckenaur. Published by P. Vicq-Dunod et Cie., Paris. Paper. 120 pages. Illustrated. Price, 3 fr.

This is a good résumé of the present methods of electric railway installation, with descriptions of the different forms of generators, motors, trucks, cars and accessories. The discussion of American apparatus and practice comprises the greater part of the book, although some particulars are also given of foreign equipment. The illustrations are all in outline. As a whole, the book is very clear and subjects and illustrations remarkably well selected.

Johnston's Electrical and Street Railway Directory. 1897 Edition. Published by the W. J. Johnston Company, New York. 752 pages. Cloth. Price, $5.

The aim of this directory is to furnish reliable information relating to electrical, street railway and kindred interests, so arranged and classified as to be of the most practical advantage to those interested. This work, among other things, contains a list of managing officers, superintendents, electricians, etc., of the different electric lighting, street railway and other companies.

DIGEST OF CONTENTS.—NOVEMBER, 1897.

Abkurzung des Inhalts—November 1897

Verhandlungen der Convention . . . . [Seite 719.]

Wörtlicher Bericht der Verhandlungen des amerikanischen Strassenbahnvereins während der Convention, und Abkürzung der Verhandlungen der Rechenmeister-Convention.

Die Sociale Geschichte der Convention . . . [Seite 738.]

Besitz und Betrieb von Strassenbahnen durch Städtlichen Obrigkeiten, von P. F. Sullivan . . . . . [Seite 751.]

In diesem Artikel beweist Herr Sullivan dass der städtliche Besitz und Betrieb von Strassenbahnen in amerikanischen Ortschaften gänzlich unpraktisch scheint. Er giebt die folgende Beweisgründe gegen städtlichen Besitz an: Erstens ist die municipalische Verwaltung in Amerika so verschwenderisch und geschäftsunfähig, dass die Macht und Obliegenheiten der städtlichen Verwaltungen eher beschränkt als erweitert werden sollten. Zweitens ist im Auslande der städtliche Besitz von Strassenbahnen eher die Ausnahme als die Regel, und sollte selbst dies umgekehrt sein, und jener Besitz und Betrieb sich von einem finanziellen Standpunkte erfolgreich erwiesen haben, so ist es noch lange nicht bewiesen dass amerikanische Ortschaften diese Beispiele folgen sollten oder könnten, oder falls dies geschähe, dass der Versuch erfolgreich sein würde. Herr Sullivan giebt eine eingehende Erörterung der verschwendung und Geschäftsunfähigkeit der Verwaltung der amerikanischen Municipalitäten, und bezieht sich auf eine Anzahl von äusserst auffallenden Beispielen von Diebstähle und Unfähigkeit seitens städtlichen Beamten in diesem Lande. Die Verhältnisse unter welchen der städtliche Besitz von Strassenbahnen in ausländischen Städten versucht wurde, sind sorgfältig erörtert, und der Vortragende schliesst dass erstens waren selten die Versuchen von städtlichem Besitz und Betrieb in den wenigen Fällen wo sie stattfanden erfolgreich, und selbst in solchen Fällen, in welchen Strassenbahnen durch Stadtverwaltungen erfolgreich betrieben wurden, ist es nachgewiesen dass die Verhältnisse unter welchen diese stattfanden so gänzlich von den in diesem Lande herrschenden Verhältnisse sind, dass es äusserst zweifelhaft ist, ob der Versuch in Amerika erfolgreich sein würde.

Einige der Schwierigkeiten, welche in der Construction und dem Betrieb von elektrischen Strassenbahnen vorkommen, von Geo. W. Knox . . . . . [Seite 755.]

In diesem Artikel werden verschiedene Ersparnisse nachgewiesen, welche in der Verwaltung und dem Betrieb von elektrischen Strassenbahnen möglich sind. Der Vortragende giebt erstens Nachdruck der Nothwendigkeit welche den Verwaltern obliegt, sich über die Praxis und die Verbesserungen, die auf anderen Bahnen vorkommen, und sich nicht mit derer eigenen Praxis zufrieden zu halten. Gemischte Materialien sollten nicht blindlings bestellt werden, sondern nach einer sorgfältigen Prüfung der speciellen Verhältnisse einer Bahn, da diejenige Stücke, welche für eine gewisse Bahn passen, für eine andere Bahn sich gänzlich unzulänglich erweisen können, und ausführliche Beschreibungen jedes einzelnen Stückes sollten sorgfältig vorbereitet werden. Etliche Erfahrung um die beste Art der einzelnen Materialien zu erwählen ist erwünschenswerth. Die grösste Sorgfalt in der Wahl der Wagenführer ist zu empfehlen, und dieselben nachher sorgfältig in der Ausführung ihrer Pflichten unterrichtet werden. Elektrotechnische Kenntniss ist jedoch nicht für sie empfehlenswerth, da dies sie zur Verzögerung des Verkehrs in unnützen Versuchen für Reparaturen der auf der Bahn vorkommenden Störungen verleiten würde, statt den Wagen zur Reparaturwerkstätte zurückzuführen. Statt dies sollte er unterrichtet werden in einer verständigen Weise jedes der Bahn nachtheilig scheinende Vorkommniss zu berichten, welches unter seine Beobachtung kommen könnte. Jeder Vorstehende einer Abtheilung sollte in seiner Stellung gänzlich verantwortlich bleiben, und in dem Anrathen für Verbesserungen in dem Betriebe an seine Vorgesetzen angetrieben werden. Reinlichkeit und Ordnung in Wagenschuppen und Reparaturwerkstätten sind als Antrieb zur Sauberkeit der Angestellten empfohlen. Unter anderen Verfahren werden regelmässige Versammlungen der Vorstehenden verschiedener Abtheilungen empfehlenswürdig, um sie über deren respectiven Abtheilungen angehörigen Fragen zu Rathe zu ziehen.

Die Anwendung von Accumulatoren für den elektrischen Betrieb, von Charles Hewitt . . . . . [Seite 758.]

Dieser Artikel ist in drei Abtheilungen vertheilt: Die Anwendung des Accumulatores direkt auf dem Wagen oder Lokomotive; dessen Gebrauch als Stromleitung auf von der Centralstation entfernten Punkte, und dessen Gebrauch als eine Nebenstation in der Centralstation selbst. Für den ersten Zweck betrachtet der Vortragende die Accumulatoren-Batterie als absolut unanwendbar, von wegen deren Gewicht und Abnutzung. Das in Hamburg angewandte gemischte System wird durch ihn als ein Hülfsmittel, und die Accumulatoren-Lokomotive, vie z. B., die Heilmann Maschine, als unwünschenswerth betrachtet. Jedoch wurden Accumulatoren mit grossem Erfolge als Nebenleitungsführung an den Endpunkten von langen Strecken durch die Union Traction Company in Philadelphia verwendet, von welcher Herr Hewitt elektrotechnischer Ingenieur ist. Diese Linie hat eine Geleiselänge von 408 Meilen und die Anzahl der im Dienste stehenden Motorwagen beläuft sich auf 1500. Der Endpunkt einer gewissen Linie ist 11 Meilen von der Centralstation entfernt, und die Einführung der nöthigen Leitungsführungen wurde $274,000 gekostet haben, als Zusatz für die Kosten der schon auf der Linie ausgeführten Leitungsführungen. Die auf jener Strecke erforderliche Kraftfähigkeit belief sich auf 750 k. w., und sollte eine specielle Station gebaut worden sein, würde sie $85,000 gekostet haben. Eine Hilfsbatterie, mit einer ebenen Stromführung über die ganze Strecke wurde für kaum mehr als ein Drittel dieses Betrags eingeführt. Die Kosten des Betriebs der Batterie, ausschliesslich der Zinsen und Abnutzung, waren ungefähr 7 cents per Kilowatt-Stunde, und wird die Abnutzung ungefähr auf fünf prozent jährlich berechnet. Die Entladung per 24 Stunden schwankte zwischen 456 Kilowatt-Stunden und 150 Kilowatt-Stunden. Ausführliche Betriebszahlen werden gegeben.

Kraftvertheilung und die Verwendung der Wechselstrom-Zuführung für gewöhnlichen Strassenbahnen, von Maurice Hoopes [Seite 763.]

Der Vortragende erörtert zuerst die in der gewöhnlichen 550 voltischen Vertheilung ermöglichenden Ersparnisse, und empfiehlt häufige Kraftversuche, weiter beschreibt er eine Methode für die Prüfung der Rückstroms, welche er den einzelnen Widerstandsprüfungen bevorzieht. Er classificirt die Methoden für Langstreckenvertheilung wie folgend: 1. Ein specieller Generator, mit Vermehrung der Spannung betrieben, und soviel wie möglich übercompoundet; 2., ein Booster; 3., das Tripeldraht-System; 4., das Wechselstrom-Zuführungs-System. Mit jedem dieser Systemen kann die Accumulatoren-Batterie verwendet werden, wo unmittelbare Schwankungen enfernt sind, jedoch sind sie nicht von praktischem Werthe in solchen Fälle wo sie zur Ladung der Kraft während einer Stunde für Verwendung während der nächsten Stunde verwendet werden sollen. In der Erläuterung (1.), des speciellen Generators, bezieht er sich auf die Möglichkeit, gewöhnlich eine Spannung von 700-750 Volts durch eine normale 550 Volt-Maschine zu erhalten, indem der Feldmagnet-Widerstand vermindert, und die Geschwindigkeit des Generators erhöht wird. Jedoch erzeugt manchmal eine höhere Spannung als 600 Volts eine Störung in dem Motor-Controller auf dem Wagen. Unter (2.) beschreibt er die Art und Weise in welcher ein gewöhnlichen Generator zweitweilig in einen Booster umgewandelt werden kann, indem blos die Serie-Drähte verwendet werden und die Geschwindigkeit vermindert wird. Die für diesen Zweck auf dem Schaltbrette erforderlichen Aenderungen sind nicht complicirt. In einer heutigen Station welche nur wenige hohe Einheiten besitzt und in welcher es unwahrscheinlich ist, dass einer der grossen Generatoren für diesen Zweck erspart werden könnte, oder wo dies nicht als zweckmässig erscheint, wird gewöhnlich die kleinste Maschine, welche den Nachbetrieb besorgen soll, für das Boosterwerk verwendet. (3.) Die Nützlichkeit des Dreidrahtsystems für den Eisenbahndienst wird gewöhnlich überschätzt, da die beiden Seiten des Systems schwierig im Gleichgewicht gehalten werden können. Jedoch citirt er einen einzelnen Fall, auf der Lowell- und Vorortbahn, in welchem es vorzüglich verwendet wird. (4.) Das Wechselstrom-System ist in solchen Fällen ausführbar, wo der Vertheilungspunkt zu weit von einer Station entfernt ist, um dass eine befriedigende Anwendung anderen Methoden möglich ist, und wo die Ladung zu schwach ist um den Bau einer speciellen Station zu rechtfertigen. In einer vergleichenden Angabe der Werthen der verschiedenen Systemen, beweist er dass die Erfolge mehr von dem Verhältniss zwischen der Maximum- und Durchschnittladung als von irgend welcher anderen Bedingung abhängt. Wenn das Verhältniss genügend hoch ist, erweist die Wechsel-Stromzuführung ein bedeutendes Ersparniss. Jedoch ist in dem Eisenbahnbetrieb dieses Verhältniss gewöhnlich sehr niedrig, und der Schreiber ist der Meinung dass in den meisten Fällen die Kraftvertheilung durch Gleichstrom zu empfehlen ist.

Ueber die beste Methode, Entschädigungsfälle beizulegen, und die Verhütung von Unfällen mittels Schutzvorrichtungen oder durch andere Mitteln, von W. J. Hield . . [Seite 770.]

In der Vergleichung einer Entschädigungsforderung ist es von der grössten Wichtigkeit dass so bald wie möglich nachdem der Unfall geschah eine ausführliche Auskunft der Ergebnisse erhalten werde. Beweise müssen so b ld wie möglich erlangt werden, und der Bericht so ausführlich wie möglich der Verwaltung abgesandt werden. In jedem unvergleichten Falle, besonders wenn der Unfall ein sehr bedenklicher ist, ist es wünschenswerth dass eine Untersuchung durch einen oder mehreren Aerzte behufs der Bahn stattfinde. Hilfe und Dienstanerbieten unmittelbar nach dem Unfalle sind einem Vorschlage für eine Vergleichung vorzuziehen. Es ist selten nothwendig, die Nachlässigkeit der Bahn zu bekennen, jedoch sollte der Kläger gütig behandelt, und womöglich, ein beeidigtes Zeugniss von ihm erhalten werden, in welchem die besondere Umstände des Unfalls festgesetzt sind, und welches die Wichtigkeit der Beschädigung und den Betrag der Forderung bestimmt. Eine entgiltige Erlassung der Forderung muss womöglich von dem Kläger erhalten, und der Inhalt derselben ihm ausführlich erklärt werden. Der Vertreter der Bahn muss standhaft, jedoch gutmüthig, sein, um dem Kläger nicht gegnerisch zu scheinen. Schutzvorrichtungen, jedoch nur von der einfachsten Art, sind wünschenswerth. Jene welche durch den Wagenführer bewirkt werden müssen, sind nicht zu empfehlen. Die Plattformen aller Motorwagen des Minneapolis und St. Paul Systems, dessen Generaldirektor der Vortragende ist, sind mit einem Schutzgitter versehen, welches nach vorn durch den Wagenführer vor der Abfahrt geschlossen, und bei

jedem Anhalte eröffnet wird. Dieses Verfahren ist durch den Verfasser als sehr empfehlungswerth erachtet. Er beweist dass das Publikum sich schnell daran gewöhnt, und dass dessen Verwendung die Geschwindigkeit der Fahrt keineswegs beeintragt. Die moralische Wirkung der Schutzvorrichtung und des Gitters ist vortrefflich, da sie die Passagiere so wie die Wagenführer gegen Unfälle beschützen, und den Eindruck auf die Gemeinde machen, dass die Bahn jeden Unfall aufrichtig zu vermeiden sucht.

Disciplin der Angestellten, von George H. Davis . [Seite 767.]

Der Verfasser beschreibt ein System von Disciplin welches auf der Canal & Claiborne Strassenbahn-Gesellschaft in New Orleans verwendet wird, deren General-Direktor er ist. Die Anstellungen und Beförderungen sind auf einem regelmässigen Zivildienst-System gegründet, und werden Prüfungen für Applikanten zu jenen Stellungen gehalten. Der Wagenführer muss ferner gewissen physikalischen Erforderungen entsprechen, und durch drei Oberbeamten und sieben Angestellten, die schon im Dienste der Bahn stehen, empfohlen sein. Die Leistung jedes Angestellten wird täglich nach einem festgestellten Durchschnitt, in den Hauptbureaux aufgezeichnet, je nach den Berichten seines Obergesetzten, und weitere Verdienste, so wie ungünstliche Leistungen werden ebenfalls aufgezeichnet. Der Stand jedes Angestelltens wird monatlich festgestellt, und falls das Ergebniss niedriger als einen gewissen Durchschnitt kommt, wird er entlassen. Diese Art von Verdienstfeststellung wird auch für die Beförderung der Angestellten benutzt. Das System ist auf Dampfbahnen in Amerika sehr häufig benutzt, und erwies sich von grossem Werthe.

Anwendung der Elektricität auf gegenwärtig durch Dampf-betriebenen Bahnen, von N. H. Heft . . . . . [Seite 776.]

In diesem Artikel beschreibt Herr Heft, der mit der ersten Eisenbahngesellschaft verbunden ist, welche den Versuch der Anwendung von Elektricität auf Normalbahnen in den Vereinigten Staaten machte, die technische und finanzielle Erfolge, die bis jetzt erreicht wurden. Die erste elektrisch ausgerüstete Linie war die Nantasket Beach Bahn, entlang der Massachusetts Küste. Die Zweite, welche letzten Frühling für den Betrieb eröffnet wurde, fährt durch New Britain bis Hartford, auf einer Länge von 12 Meilen (18 km.). Die Nantasket Beach Strecke war theilweise nach dem Luftleitungs-, theils nach dem dritten Schienen-System ausgerüstet während die Berlin-Hartford Strecke ausschliesslich mit dem dritten Schienen-System ausgerüstet ist. Auf beiden Linien wurden die Fahrpreise bedeutend vermindert, und eine reguläre und öftere Fahrt eingeführt. Herr Heft beschreibt die verschiedenen Gestalte der Ausrüstung, so wie die Betriebsverhältnisse und Erfolge dieses Versuchs.

Die Behandlung der Umsteigekarten von der Druckerei bis zum Ofen, von John F. Calderwood, Rechnungs-revisor der Twin City Rapid Transit Co., Minneapolis, Minn. . [Seite 782.]

Die Besorgung und Behandlung der Fahrgelder von dem Empfang bis zur Bank, von Charles L. Wight, Sekretär der Toledo Traction Co., Toledo, O. . . . . [Seite 786.]

Materialien- und Vorräthen-Rechnungen, von dem Käufer ab bis zur Verwendung, von W. G. Ross, Zahlmeister der Montrealen Strassenbahn Gesellschaft . . . . . [Seite 788.]

Zeitwartung, Zahlungsbogen und Zahlungsmethode, von Frank R. Henry, Sekretär und Zahlmeister der Missouri Railroad Co., St. Louis, Mo. . . . . [Seite 788.]

Die Ausstellungen auf der Convention . . . [Seite 789.]

Eine neue Löthstange . . . . . [Seite. 808]

Diese Stange ist mit einem Schmelzmittel für die Löthung versehen.

Kreuzungssignale für Eisenbahnen . . . . . Seite 808.]

Beschreibung eines Signal-Apparates für Kreuzungen, Zugbrücken, u. s. w.

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Schwerer electrischer Eisenbahndienst in Iowa . . [Seite 810.]

Eine Neue Maschine . . . . . [Seite 810.]

Beschreibung einer neuen Gattung von Ball Maschine mit verbessertem Regulator und Schmierungsverfahren.

Tragbare Drehbank für das Drehen von Motorelementen [Seite 811.]

Diese Drehbank kann entweder durch den Fuss oder durch einen kleinen elektrischen Motor getrieben werden.

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Travaux de la convention . . . . . [Page 719.]

Rapport in-extenso des travaux de la convention de l'Association Américaine de Tramways, ainsi qu'un résumé de la convention des comptables.

L'histoire sociale de la convention . . . . . [Page 738.]

Propriété et exploitation municipales de tramways, par P. F. Sullivan . . . . . [Page 751.]

Dans cet article M. Sullivan démontre que la propriété et l'exploitation de tramways par les municipalités en Amérique est absolument impraticable. Ses principaux arguments contre la propriété municipale sont les suivants: En premier lieu, l'administration municipale dans les villes américaines est si extravagante et si contraire aux principes des affairs, que dans l'intérêt du public les droits et devoirs des municipalités auraient lieu d'être restraints plutôt qu' élargis. En second lieu, la propriété municipale à l'étranger est plutôt l'exception que la règle, et lors même que l'enterprise réussirait au point de vue financier, il ne s'ensuit pas que les villes américaines pourraient ou devraient adopter de pareils exemples, ni que ces tentatives seraient couronnées par le succès. M. Sullivan traite à fond le sujet de l'administration extravagante et non-commerciale des municipalités américaines, produisant une série de cas flagrants de vols et d'incapacité qui ont eu lieu de la part des fonctionnaires municipaux dans ces pays. Les conditions dans lesquelles la propriété municipale a été mise à l'essai à l'étranger sont revues soigneusement, et l'auteur arrive à la conclusion que, d'abord il y a eu très-peu d'essais de ce genre faits à l'étranger suivis d'un résultat satisfaisant, et ensuite, que lors même que ces tentatives ont réussi dans quelques cas isolés, il est prouvé que les conditions étaient si différentes de celles existant dans ce pays, qu'il est extrêmement douteux que cet essai réussirait en Amérique.

Quelques-unes des difficultés qui existent dans la construction et l'installation de tramways électriques, par George W. Knox. [Page 755.]

L'auteur indique diverses économies qui peuvent être réalisées dans l'exploitation et la direction de tramways électriques. En premier lieu, il insiste sur la nécessité qu'il y a de se tenir parfaitement au courant de la pratique et des perfectionnements introduits sur d'autres lignes, afin d'éviter que l'on ne soit imbu d'un sentiment de satisfaction personnelle au sujet de la méthode employée. Il y a lieu, avant de se procurer les matériaux divers à l'aveuglée, de se rendre compte des conditions spéciales d'une ligne, attendu que ce qui peut convenir à une certaine ligne ne serait nullement adapté à une autre, et les cahiers de charge devraient être préparés avec les détails concernant chaque pièce d'appareils commandée. Une connaissance approfondie de la science électrique n'est pas à désirer de la part des mécaniciens, attendu que cela les encourage à retarder le trafic en futiles tentatives en cas d'accident, au lieu de reprendre la voiture immédiatement à l'atelier de réparation. Il y a lieu au contraire de l'instruire à rendre compte d'une manière intelligible de tout ce qui peut le frapper comme étant de nature à occasioner un tort à la compagnie. Chaque chef de service devrait avoir toute responsabilité en ce qui ressort de son emploi, et être encouragé à presenter ses idées en ce qui pourrait perfectionner le service. L'auteur recommande la propreté et le bon ordre dans les ateliers de réparation et les remises, afin de stimuler l'esprit de propreté parmi les employés. Il y a lieu de recommander des assemblées régulières des chefs de service à l'effet de se consulter au sujet des affaires de leurs ressorts.

L'application de l'accumulateur à la traction électrique, par Charles Hewitt . . . . .]Page 758.]

Cet article est divisé en trois sections: l'application directe de l'accumulateur à la voiture motrice ou à la locomotive; son emploi comme feeder à des points éloignés de la station génératrice, et son emploi comme station auxiliaire à la station mère. En ce qui concerne le premier emploi, l'auteur regarde l'accumulateur comme absolument inapplicable, en raison de son poids et de l'usure qu'il subit. Le système mixte, tel qu'il est employé à Hambourg, est, d'après l'auteur, un simple bouchetrou; quant aux locomotives à accumulateurs, telles que la locomotive Heilmann, il ne croit pas qu'elles soient en demande. Les accumulateurs ont toutefois été employés avec grand succès comme feeders auxiliaires aux extrémités de lignes de grande étendue par l'Union Traction Company de Philadelphie, dont M. Hewitt est ingénieur électricien. Ce système a une étendue de 655 kilomètres de voie et possède 1500 voitures motrices. L'extrémité de l'une des lignes se trouve à 18 kilomètres de la station centrale, et le coût de l'installation des feeders nécessaires a été de $274,000, en outre de la dépense faite auparavant pour l'installation de feeders sur cette ligne. L'énergie requise sur cette section était de 750 k. w., et dans le cas où il y aurait eu lieu de construire une station spéciale, le coût en eût été de $85,000. Une batterie auxiliaire fut établie à un peu plus d'un tiers de ce prix, fournissant un voltage très-uni sur toute la section. Le prix d'entretien de la batterie, y compris les frais d'intérêt et de dépréciation, a été d'environ 35 centimes par kilowatt heure, et l'on estime que la dépréciation s'élève à environ cinq pour cent par an. La décharge journalière (24 heures) a varié entre 456 et 150 kilowatt heures. Il est donné des chiffres détaillés à l'appui.

Distribution d'énergie et l'emploi de transmission de courant triphasés dans le service de tramways ordinaires, par Maurice Hoopes . . . . . [Page 763.]

L'auteur s'occupe en premier lieu des économies qu'il y a moyen d'introduire dans une distribution ordinaire à 550 volts, et recommande des essais fréquents d'énergie. Il décrit une méthode pour l'essai du circuit de retour qu'il considère comme étant supérieure aux essais de résistances individuels. Il classe de la manière suivante les méthodes de distribution à grandes distances: (1) un générateur spécial marchant à un voltage supérieur, et généralement hypercompoundé autant que possible; (2) un transformateur; (3) le système à trois fils; (4) le système de transmission par courant alternatif. Dans chacun de ces systèmes il est possible d'employer l'accumulateur en faisant disparaître les fluctuations immédiates, mais il ne saurait être de grande valeur commerciale alors que son usage est appelé à emmagasiner l'énergie pendant une heure, afin de s'en servir durant la suivante. En passant en revue, (1) le générateur spécial, il indique la possibilité d'obtenir parfois de 700 à 750 volts à l'aide d'une machine normale de la force de 550 volts en réduisant la résistance du rhéostat et en augmentant la vitesse du

générateur. Toutefois il y a lieu de remarquer qu'un voltage supérieur à 600 volts peut, parfois occasionner des dérangements dans le moteur controleur de la voiture. En second lieu il décrit la manière de laquelle un générateur ordinaire peut être utilisé temporairement comme transformateur en faisant usage de l'induit par série seulement, et en réduisant la vitesse. Les changements nécessaires à cet effet sur le tableau de distribution ne sont pas compliqués. Dans une centrale moderne possédant seulement quelques unités de haut voltage, où il est impossible de se passer de l'un des grands générateurs ou d'en faire usage dans ce but, la petite machine généralement utilisée pour le service de unit peut être affectée à l'emploi de transformateur. En troisième lieu, l'auteur démontre que l'utilité du système à trois fils pour le service de traction est généralement exagérée, attendu qu'il est difficile de maintenir les deux côtés du système en equilibre. Il cite, cependant, un cas spécial dans lequel le système a été employé avec succès sur la ligne de Lowell (Mass.) et banlieue. En dernier lieu, il déclare que le système alternatif peut être utilisé dans les cas où le point de distribution est trop éloigné d'une station pour qu'il soit possible de faire un usage satisfaisant des autres méthodes de transmission, et où la charge est trop faible pour justifier l'établissement d'une station spéciale. Dans une évaluation comparative des différents systèmes, les résultats se basent plutôt sur la proportion entre la charge maxima et moyenne que sur toute autre condition. Dans le cas où la proportion est assez grande, la transmission par courant alternatif est à recommander comme étant fort économe. Toutefois, dans le service de chemin de fer, la proportion est généralement très-faible, et l'auteur est d'avis que dans la plupart des cas il vaut mieux faire usage de la distribution par courant continu.

Discipline des employés, par George H. Davis . . [Page 769.]

L'auteur décrit un système de discipline en usage sur la Compagnie Canal & Claiborne, de la Nouvelle Orléans, Louisiane, dont il est l'administrateur général. Le choix et l'avancement des employés sont basés sur un système régulier de service civil, et il est tenu des examens de postulants pour chaque position. Le mécanicien est de même appelé á remplir certaines conditions physiques, et doit être recommandé par trois directeurs et sept employés au service de la compagnie. La conduite quotidienne de chaque employé est enregistrée par une échelle fixe dans le bureau principal, d'après les rapports de ses supérieurs, et de plus il est tenu compte de tous actes favorables ou défavorables qui puissent lui être attribués. Il est établi chaque mois une moyenne de l'état de service d'un employé, et dans le cas où la moyenne est inférieure à un certain chiffre, il est renvoyé. Ce système a été en usage étendu sur les chemins de fer à vapeur en Amérique et s'est démontré de grande utilité.

La meilleure méthode pour arranger à l'aimable les procès en dommages et intérêts, et la façon d'éviter des accidents au moyen de fenders ou autres dispositifs, par W. J. Hield [Page 770.]

Lorsqu'il s'agit d'arranger à l'aimable un procès en dommages et intérêts, il est de la plus grande importance d'obtenir le plus tôt possible tous les détails au sujet de l'accident. Il est indispensable de recueillir de suite les dépositions des témoins, et l'on ne peut fournir trop de renseignements à l'administration. Dans toutes les causes qui ne peuvent s'arranger à l'aimable (particulièrement dans les cas graves) il est à désirer qu'un examen ait lieu de la part d'un ou plusieurs chirurgiens dans l'intérêt de la compagnie. Il est préférable d'offrir des secours immédiats et efficaces plutôt que de proposer un arrangement à l'aimable. Il est rarement nécessaire de la part de la compagnie d'admettre qu'elle soit en faute; le plaignant, toutefois, devrait être traité avec sympathie, et s'il est possible, une déposition sous serment de sa part est à désirer, donnant tous les détails relatifs à l'accident, établissant l'importance des blessures et le montant des dommages et intérêts réclamés. S'il y a moyen, il est à désirer d'obtenir du plaignant une quittance définitive pour toutes poursuites, en lui donnant une explication complète de l'arrangement. En thèse générale, il est préférable d'arriver à une entente avec le plaignant lors qu'il manifeste une disposition à accepter un arrangement équitable. Il est à désirer que l'agent de la compagnie se montre ferme, tout en tâchant de ne pas froisser le plaignant.

Il y a lieu d'encourager l'usage de fenders, pourvu qu'ils soient du type le plus simple. L'on devrait éviter l'emploi de ceux qui ont besoin d'être manœuvrés par les conducteurs. Les plates-formes de toutes les voitures motrices employées sur le système de Minneapolis et Saint-Paul, dont l'auteur est le directeur général, sont munies d'une porte-barrière que le conducteur ferme avant de lancer la voiture, et qu'il ouvre lors qu'elle s'arrête. L'auteur considère ce dispositif comme très-avantageux. Il est d'avis que le public s'y habitue très-rapidement et que sa manutention ne retarde en rien la vitesse de la voiture. L'effet moral d'un fender et d'une barrière est excellent, attendu que le public et le personnel se sentent à l'abri d'accidents, et se rendent compte que la compagnie s'efforce sincèrement de les éviter.

L'application de l'électricité aux lignes marchant actuellement à la vapeur, par N. H. Heft . . . . . [Page 776.]

Dans cet article, M. Heft, attaché à l'une des compagnies qui fut des premières à donner l'essor au service électrique à grande distance aux États-Unis, décrit les résultats financiers et techniques atteints jusqu'ici. La première ligne équipée de ce genre a été celle de Nantasket Beach, le long de la côte du Massachusetts. La second ligne a été ouvert à l'exploitation au printemps dernier, passant par New Britain jusqu'à Hartford, sur une distance de douze milles (18 kilomètres). La ligne de Nantasket Beach est partiellement construite d'après le système aérien, et partiellement d'après le système du troisième rail. Les prix des places ont été considérablement réduits sur les deux lignes, et un horaire régulier et fréquent est en vigueur. Le trafic a énormément augmenté sur les deux lignes. M. Heft décrit les différents aspects de l'équipement de cette ligne, les conditions d'exploitation et les résultats de ce nouvel essai.

La manipulation des correspondances depuis l'imprimeur à la fournaise, par John F. Calderwood, comptable de la Twin City Rapid Transit Company, Minneapolis, Minn. . [Page 782.]

Le soin et la manipulation des prix des places, depuis leur réception jusqu'à la banque, par Charles L. Wight, sécretaire de la Toledo Traction Company, Toledo, O. . . [Page 786.]

Comptabilité des materiaux et fournitures depuis l'achat jusqu'à l'emploi, par W. G. Ross, contrôleur, Montreal Street Railway Company, Montréal, Canada . . . [Page 788.]

Horaire, feuille de paie et mode de paiement, par Frank R. Henry, secrétaire et caissier de la Missouri Railroad Company, St. Louis, Mo. . . . . [Page 788.]

Les exhibitions faites à la convention . . . [Page 789.]

Bâton de soudage . . . . . [Page 808.]

Ce bâton effectue le soudage par le jet.

Signaux de croisements de voies . . . . . [Page 808.]

Poincons pour le controle de billets . . . . [Page 809.]

Un train électrique de grande longueur . . . [Page. 809]

Service lourd de traction électrique en Iowa . . [Page 810.]

Une nouvelle machine . . . . . [Page 810.]

Tour portatif pour tourner les commutateurs de moteurs. [Page 811.]

Lista de Materias—Noviembre 1897.

Trabajos de la Convención . . . . . [Pág. 719.]

Relación, palabra por palabra, de los trabajos de la Convención de la Asociación Americana de tranvías, así como un resumen de la Convención de Contadores.

La historia social de la convención . . . . [Pág. 738.]

Propiedad y explotación municipal de tranvías, por P. F. Sullivan. [Pág. 751.]

En este artículo el Sr. Sullivan mostra que la propiedad y la explotación municipal de tranvías en ciudades americanas parece enteramente impracticable. Las razones siguientes son dadas contra la propiedad municipal; en primer lugar, la administración municipal en ciudades americanas es tan extravagante y opuesta á los principios del negocio, que, en los intereses del público, los poderes y obligaciones de las municipalidades deberían ser reducidos en lugar de ser aumentados. En segundo lugar, la propiedad municipal al extranjero es la excepción más que la regla; y aun cuando el opuesto sería verdadero, y tal propiedad y explotación hubiera sido conducida con exíto del punto de vista financiero, eso no es una razón porque ciudades americanas deberían ó podrían seguir tales ejemplos, ni que la tentativa sería seguida por exíto. El Sr. Sullivan trata el sujeto de la administración extravagante y opuesta á los principios del negocio de las municipalidades americanas en un modo detallado, y refiere á unos de los más flagrantes casos de hurto y de incompetencia de la parte de oficiales municipales en este pais. Las condiciones bajo las cuales propiedad municipal fué experimentada al extranjero, son examinadas cuidadosamente, y el autor concluye que, en primer lugar, hay muy pocos casos en los cuales el resultado de la explotación municipal en ciudades extranjeras fué satisfactorios, y aun en esos casos demostrado que las condiciones son tan enteramente diferentes de las condiciones predominando en este pais, que es muy dudoso si la ventura podría probar un exíto en América.

Algunas de las dificultades que existen en la construcción y la explotación de tranvías eléctricos, por Geoge W. Knox. [Pág. 755.]

Este artículo refiere á varias economias que se puede introducir en la explotación y la dirección de ferrocarriles eléctricos. El autor primeramente conseja á los directores que estudien cuidadosamente la práctica y los perfeccionamientos introducidos sobre otras líneas, en lugar de ser satisfechos con la práctica de sus líneas propias. No se deben adquirir acesorios ciegamente, sino despues de un estudio cuidadoso de las condiciones especiales de la vía, por lo tanto que lo que puede ser conveniente para una línea no sería satisfactorio para una otra. Las especificaciones deben ser preparadas cuidadosamente para cada pieza de aparato mandada. Un cierto importe de experiencia está necesario para conocer las mejores formas de acesorios. Los maquinistas deben ser escojidos con gran cuidado, y entonces enseñados en sus trabajos. No es deseable que tienen mucha experiencia en electricidad, porque eso puede invitarlos á retardar el tráfico en tentativas inutiles de reparar un disturbio sobre la línea, en lugar de volver el coche inmediatemente á los talleres de reparación. En vez el maquinista debe ser instruido de

dar una relación inteligente de todo lo que puede observar al detrimento de la compañía. Cada jefe de servicio debe tener entera responsabilidad en su departamento, y ser incitado á ofrecer sugestiones á sus oficiales superiores para perfeccionamientos en el servicio. Limpieza es recomendada en las cocheras y los talleres de reparación, para incitar los empleados á pulidez. Una de las prácticas más recomendables consta en asambleas regulares de los jefes de los varios servicios, al efecto de consultarlos sobre sujetos relacionados á sus departamentos.

La aplicación del acumulador á la tracción eléctrica, por Charles Hewitt . . . . . [Pag. 758.]

Este artículo está dividido en tres secciones: La aplicación de la batería directamente al coche ó á la locomotora; su uso como "fender" á puntos muy distantes de la estación generatriz, y su uso como estación auxiliar á la estación propia. Para el primer uso el autor considera la batería como enteramente desconveniente, por razón de su peso y deterioración. El sistema mixto, como es empleado en Hamburgo, está considerado como un último recurso, y la locomotora del tipo Heilmann no es deseable. No obstante, acumulatores han sido empleados con mucho exíto como feeders auxiliares á las extremidades de líneas de mayor longitud por la Union Traction Company de Philadelphia, de cuya el Sr. Hewitt está el ingeniero electriciano. Esta línea tiene una longitud de vía de 408 millas, y su material móvil se compone de 1500 coches motores. La extremidad de una cierta línea está colocada á 11 millas de la estación de fuerza motriz, y la instalación de feeders ya construidos sobre la línea. La capacidad potencial requista sobre esta sección especial es de 750 kilowatts, y una estación particular hubiera costado $85,000. Una batería auxiliar fué instalada para poco más de un tercero de este importe, dando un voltaje muy uniforme sobre toda la sección. El coste de operación de la batería exclusivamente del interés y de la depreciación fué cerca de 7 centavos por kilowatt-hora, y la depreciación está estimada á cerca de 5 por ciento por año. La descarga por 24 horas varió entre 456 y 150 kilowatts. Son dadas figuras detalladas de operación.

Distribución de energía, y el uso de la transmisión por corriente polifásica para tranvías ordinarios, por Maurice Hoopes. [Pág. 763.]

El autor refiere en primer lugar á las economías que pueden ser obtenidas en la distribución ordinaria de 550 volts, y recomende frecuentes ensayos potenciales; él describe también un método para probar el retorno, el cual es superior, á su opinión, á las pruebas de resistencia individual. El autor clasifica los métodos de distribución á gran distancia como sigue: 1. Un generador especial accionado á voltaje acrecentado, y hypercompound lo más que posible; 2., un transformador; 3., el sistema trifilar; 4., el sistema de transmisión por corriente alternativa. El acumulador puede ser aplicado á cualquier de esos sistemas si las fluctuaciones inmediatas son removidas, pero es de poco valor comercial en caso que su función consta en el almacenaje de energía durante una hora para uso la hora siguiente. En una discusión (1) del generador especial, el autor refiere á la posibilidad de obtener generalmente entre 700 y 750 volts con una máquina timbrada á 550 volts, disminuyendo la resistencia del rheóstato, y aumentando la velocidad del generador. Pero un voltaje superior á 600 volts puede causar algunas veces disturbios en el contralor del motor sobre el coche. Refiriendo al (2) el autor describe el modo de cambiar temporalmente un generador ordinario en un transformador, por medio del uso del cable de serie sólo y de la reducción de la velocidad. Los cambios requistos por eso sobre el cuadro de distribución son sencillos. En una estación moderna, que consta solamente de unos generadores de gran potencia, no es probable que ningún de los podría ser empleado, ó sería deseable para ese uso, y en ese caso la pequeña máquina generalmente instalada para el servicio de noche puede ser aplicada al trabajo de transformador. (3) El valor del sistema trifilar para el servicio de ferrocarriles está generalmente sobreapreciado, pues es difícil mantener los dos lados del sistema en equilibro. El autor, aunque se refiere á un caso especial sobre la línea del Lowell y Suburbano, donde el sistema trifilar está usado ventajosamente. (4) El sistema de corriente alternativa es aplicable sobre líneas cuyo punto de distribución está demasiado distante de una estación para admitir un trabajo satisfactorio por el uso de los otros métodos de transmisión, y donde la carga está demasiado pequeña para justifiar la construcción de una nueva estación. En un estudio comparativo de los valores de los diferentes sistemas, los resultados son más dependientes de la relación entre la carga máxima y media que de ningún otra condición. Cuando la relación está bastante alta la transmisión por corriente alternativa será de gran economía; pero en asuntos ferroviarios, la relación está generalmente muy baja, y en la opinion del autor, el mejor resultado en los mayores casos puede ser obtenido con la distribución por corriente continua.

Disciplina de empleados, por George H. Davis . . [Pág. 767.]

El autor describe un sistema de disciplina en uso por la compañía ferroviaria Canal y Claiborne á Nueva Orleans, La., de cuya está el director general. El nombramiento y la promoción de los empleados son basados sobre un sistema regular de servicio civil, y son tenidos exámenes de solicitantes para todas plazas ó colocaciones. El conductor de un coche motor debe también cumplir ciertos requisitos físicos, así como ser recomendado propiamente por tres oficiales y siete empleados ya en el servicio de la compañía. El servicio diario de cada empleado está consignado según una escala fijada en la oficina principal, desde actas hechos por sus superiores y méritos y desméritos adicionales son consignados para conductas especialmente desirables ó desprobadas. Cada mes se verefica la relación de cada empleado, y si el resultado falta una cierta figura, el empleado está despedido. La registración media obtenida de este modo está también valiosa para promover los que dan satisfacción. El sistema ha sido en uso sobre ferrocarriles de vapor en América muy extensivamente, y se ha demostrado de gran valor.

El mejor método para ajustar casos de daño, y prevención de casualidades por el uso de fenders (salva-vidas) ú otros procedimientos, por W. J. Hield . . . . [Pág. 770.]

Cuando debe ser ajustado un caso de daño, es muy preciso de adquirir un conocimiento de él tan pronto que posible en su historia. Es util de segurar testimonio prontamente, y no se pueden dar demasiado detalles al departamento del tren. En todos los casos que no son ajustados (particularmente en casos graves), un exámen por un ó más médicos en favor de la compañía es deseable. Socorros y ofertas de servicios inmediatamente despues de una casualidad son más deseables que ofertas para un ajuste. Es raramente necesario admitir el descuido de la compañía, pero el demendador debe ser tratado con simpatia, y cuan o es posible una relación jurada debe ser obtenida de él, dando su historia del accidente, y estableciendo definitivamente el importe del daño y el resarcimiento pedido. Se debe obtener del demendador un descargo completo de todas pretensiones cuando posible, y claramente explicar su contenido á él. En modo general es conveniente ajustar todos casos cuando los demendadores son imparciales en sus pretenciones. El ajustador debe ser firme, aunque de buen humor de modo á evitar una contiendo con el demendador. Fenders son deseables, pero sólo los del tipo más sencillo. Los que requieren la maniobra del maquinista no son recomendados. Las plataformas de todos los coches motores del sistema de Minneapolis y St. Paul, de cuyo el autor está director general, son provistos con una barrera de seguridad cerrada de frente por el maquinista cuando el coche está puesto en moción, y abierta cuando el coche está parado. Este expediente está muy aprobado por el autor, porque el público se acostumbre prontamente á él y no retarde su operación la marcha del coche. El efecto moral de un fender y de la barrera es excelente, porque segura al público y los maquinistas contra casualidades, y demostre á la población que la compañía sinceramente desea evitar accidentes.

Aplicación de la electricidad á los ferrocarriles ahora movidos por vapor, por N. H. Heft . . . . . [Pág. 776.]

En este artículo, el Sr. Heft, jefe del servicio de ingeniería de la primera compañía que ha introducido la aplicación de electricidad sobre líneas de gran distancia en los Estados Unidos, describe los resultados técnicos y financieros obtenidos hasta el presente tiempo. La primera línea que fué instalada es la de Nantasket Beach, al costado de Massachusetts. La segunda línea fué abierta á la explotación la última primavera á travez de New Britain hasta Hartford, sobre una distancia de 12 millas (18 kilómetros). La línea de Nantasket Beach fué instalada en parte con el sistema aéreo y en parte con el sistema del tercero carril, mientras que la línea de Berlin Hartford fué instalada enteramente según el sistema del tercero carril. Sobre ambas líneas los precios de pasaje han sido reducidos considerablemente, y un horario regular y frecuente adaptado. En ambos casos el tráfico ha acrecentado enormemente. El Sr. Heft describe las varias formas de instalación de esta línea, las condiciones de su explotación y los resultados obtenidos por ella.

La manipulación de los billetes de correspondencia desde la imprenta hasta el horno, por John F. Calderwood, oidor de la Twin City Rapid Transit Company, Minneapolis, Minn. [Pág. 782.]

El cuidado y la manipulación de los precios de pasaje desde su recepción hasta el banco, por Charles Wight, secretario de la Toledo Traction Company, Toledo, O. . . [Pág. 786.]

Cuentas de materiales y surtidos desde el comprador hasta el uso, por W. G. Ross, contralor de la Montreal Street Railway Company, Montreal, Canada . . . . [Pág. 788.]

Registro de horas de labor, lista de pago y modo de pagamento, por Frank R. Henry, secretario y tesorero de la Missouri Railroad Company, St. Louis, Mo. . . [Pag. 788.]

Las exhibiciones á la convención . . . . [Pág. 789.]

Señales de cruzamientos de vías . . . . . [Pág. 808.]

Descripción de un aparato de señales para la protección de pasajes á nivel, de puentes giratorios, etc.

Bastón de soldadura . . . . . [Pág. 808.]

Este bastón está provisto con un flujo para la soldadura.

Punzones de billetes . . . . . [Pág. 809.]

Un tren eléctrico de gran longitud . . . . . [Pág. 809.]

Servicio pesado de tracción eléctrica en Iowa . . [Pág, 810.]

Una nueva máquina . . . . . [Pág. 810.]

Descripción de un nuevo tipo de máquina Ball, con un regulador y un sistema de engrase perfeccionado.

Torno portatil para formar conmutadores de motores . [Pág. 811.]

Financial Notes.

Boston, Mass.—The Lynn & Boston Railroad Company will issue $1,200,000 twenty year 6 per cent debenture bonds. The proceeds are to pay for betterments, now running at the rate of about $300,000 a year.

Bourbon, Ind.—Dr. Matchette, of Bourbon, is secretary of a company which projects building an electric railway from Goshen to Bourbon via Wakarusa, Nappanee and possibly Plymouth. J. J. Burns and Wm. Sears, of Chicago, are also interested.

Brookfield, Mass.—The Warren, Brookfield & Spencer Street Railway Company has been granted permission to build an extension to its line from North Brookfield to East Brookfield.

Brooklyn, N. Y.—James Jourdan is to be retired from the receivership of the Kings County Elevated Railway Company, and Treasurer Frothingham will be appointed in his place.

Chattanooga, Tenn.—The Chattanooga & Lookout Mountain Railroad Company has been organized for the purpose of building and operating an electric railway to the top of Lookout Mountain. President Crass states that the road will be completed as rapidly as possible, and will cost about $100,000.

Chicago, Ill.—The Chicago City Railway Company has decided to change the motive power on its trunk lines from cable to electricity.

THE Chicago, Milwaukee & St. Paul Railway Company will equip its Evanston division with electric power.

A RECEIVER for the General Electric Railway Company has been applied for.

Cincinnati, O.—The Cincinnati, Mt. Washington & Bethel Electric Railway Company has been organized to build an electric railway between the above named towns, a distance of 22 miles. J. B. Martin, of 2410 Gilbert Avenue, Cincinnati, who is interested, writes that the company will begin work in the spring. The road will operate ten cars and carry light freight.

Cleveland, O.—Richard Palmer, of the Cleveland & Chagrin Falls Electric Railroad Company is reported as stating that there will be a general consolidation of all the suburban lines running into Cleveland.

Columbus, O.—The Columbus Street Railway Company and the Columbus Central Railway Company, comprising the street railway system of Columbus, have virtually agreed to consolidate, a conference looking to that arrangement having been agreed upon. It is understood that the first named company is to pay $3,000,000 for the Central property and assume the latter's indebtedness.

Exeter, N. H.—The Exeter Street Railway Company has petitioned for authority to increase its capital stock $50,000 and to extend its line.

Fitchburg, Mass.—A new corporation is about to be organized under the name of the Fitchburg & Suburban Street Railway Company. Its capital is to be $50,000, and its line will be about 5 miles long, extending from Fitchburg to Leominster. H. L. Pierce, H. Porter Hall, Charles T. Foster, J. A. Stowell, H. G. Lowe, J. G. Tyler and F. P. Porter, of Leominster, are interested in the road.

Fort Wayne, Ind.—Frank De Hass Robison and L. A. Russell are at Fort Wayne trying to settle the affairs of the Fort Wayne Consolidated Electric Railway Company, which is in the hands of a receiver. The court has been petitioned to issue receiver's certificates in favor of Fort Wayne creditors, amounting to $15,000.

Galveston, Tex.—R. B. Baer, of Houston has been appointed receiver of the Galveston City Railroad Company upon the application of the Guaranty Trust Company, of New York City which company also applied for the foreclosure of the $1,000,000 consolidated mortgage.

Green Bay, Wis.—The Fox River Electric Railway Company and the Green Bay Electric Light Company will probably be consolidated and extensive improvements made in the properties.

Greenbush, N. Y.—The stockholders of the Greenbush & Nassau Railway & Power Company have decided to increase the capital stock of the company from $180,000 to $325,000.

Hamilton, O.—The Hamilton, Venice & Okena Electric Street Railway Company has been incorporated to build a single track along Colerain pike. The company has $10,000 capital stock and headquarters in Hamilton, Butler County. The incorporators are O. V. Davis, Peter Schwab, W. C. Shepherd, W. P. Schwab and Eugene Mueller.

Kalamazoo, Mich.—The Michigan Traction Company has secured control of the Citizens' Street Railway Company, of Kalamazoo, and the Citizens' Street Railway Company, of Battle Creek, and will build an electric line to Battle Creek via Gull Lake.

Lewisburg, Pa.—The contract for the construction and equipment of the Lewisburg, Milton & Watsontown Passenger Railway has been awarded to the Tennis Construction Company. The road will be 10 miles long, and the power house will be located at Milton. The projectors of the enterprise are Edward Morrell, E. A. Tennis and Henry V. Massey. Construction work has already been commenced.

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Los Angeles, Cal.—A foreclosure suit has been begun by the Los Angeles Safe Deposit & Trust Company against the Pasadena & Mt. Wilson Railway Company. The action is brought by the holders of the $600,000 bond issue of the company to secure possession of the property.

McKeesport, Pa.—The East End Passenger Railway Company has been incorporated by John K. Skelly, W. E. Hartman, John R. Christy and R. C. Rankin, of McKeesport, and William Beal, of Pittsburgh, to build an electric railway from McKeesport to the driving park in Versailles Township, a distance of 1 mile. It is the intention of the company to build the short line first and then to increase its length so as to touch several nearby towns.

Madison, Wis.—The Madison City Railway will be sold under foreclosure proceedings on Dec. 1, on petition of the New York Guaranty & Indemnity Company, which holds bonds amounting, with interest, to $174,412.80.

Milford, Conn.—It is stated that the Milford Street Railway Company has secured its right of way and will soon let contracts to build its lines, which will connect at the Housatonic Bridge with the Bridgeport Traction Company's system and run through Milford to Woodmont.

Milwaukee, Wis.—The Milwaukee Electric Railway & Light Company has decided to build its own cars hereafter, and the repair shops of the company in Milwaukee will be equipped for that purpose.

Montreal, Can.—The Montreal Street Railway Company has declared a semi-annual dividend of 4 per cent and 1 per cent extra.

New Haven, Conn.—The New England Street Railway Company has declared a regular dividend of three-fourths of 1 per cent.

New Orleans, La.—Robert R. Zell, chief engineer of the Orleans & Jefferson Railway Company, states that all contracts for

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Street Railway Journal.

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CONDUIT RAILWAY CONSTRUCTION OF THE METROPOLITAN STREET RAILWAY COMPANY, OF NEW YORK

What has probably been the most important and extensive work in railway construction in this country during the past three years, that of the Metropolitan Street Railway Company, of New York, is now drawing to completion. The system of this company comprises 228 miles of track in the city of New York, including in this length the system of the Central Crosstown Railway Company and of the Second Avenue Railway Company, which latter, although under nominally separate management, is controlled by the capitalists interested in the Metropolitan Street Railway Company.

Since the opening of the Broadway, Columbus Avenue and Lexington Avenue lines by cable, the problem of the best motive power to substitute for horses has been a most important one to the managers of the Metropolitan Street Railway Company. As is well known, the underground conduit system was installed, about three years ago, on what is known as the Lenox Avenue system, and which comprised the lines on Lenox Avenue, 116th Street, Manhattan Avenue and a portion of Lexington Avenue. After the construction of this system the lines of the company operated by mechanical power aggregated 32.12 miles, measured as single track (16.06 miles of double track). This was divided as follows:

Broadway, cable	10.20 miles.
Columbus Avenue, cable	6.52 "
Lexington Avenue, cable and electric	8.62 "
116th Street & Manhattan Avenue, electric	3.76 "
Lenox Avenue, electric	3.02 "
Total	32.12 miles.

As opposed to these, the mileage operated by horse power aggregated 157.55 miles, not including the Second Avenue Railroad and the Central Crosstown system, aggregating 42 miles, the control of which, as stated, has passed to persons interested in the Metropolitan Street Railway system; both of these were also operated by horse power.

In the selection of the best mechanical power to install there were several factors which exercised an important influence on the choice. One of these was the fact that owing to local prejudices it was impossible to secure the privilege of installing the overhead trolley, although the latter was regarded with the greatest favor by the management. A second factor of considerable importance was the fact that owing to the peculiar topography of New York there is comparatively little interchange of cars between the longitudinal and crosstown routes. In other words, the system is composed of some six or seven long North and South lines extending lengthwise of Manhattan Island, upon which cars run at frequent intervals without branching off, and a larger number of crosstown lines upon which a separate system of cars is run, which do not use the North and South tracks to any considerable extent. This fact did not make a uniform system of motive power so necessary as in many cities where a main trunk line with many branches is the rule.

There was still a third factor which bore an important part in the proper selection of a motive power. This was the fact that the crosstown lines are all comparatively short, while the North and South lines carry a great deal of traffic, many of the passengers riding long distances

FIG. 1.—VIEW ON MADISON AVENUE, NEW YORK, SHOWING COMPLETED CONDUIT CONSTRUCTION

For this reason high speed on the crosstown lines is not a very important requisite, as slow speed on these lines does not add a very considerable percentage of time to the average ride. It should be added that a system of transfers exists between practically all of the longitudinal and cross-

FIG. 2.—LAYING YOKES AND INSERTING TIE-RODS 42D STREET ENTRANCE TO FOURTH AVENUE TUNNEL

town lines owned by the company, except on the Twenty-third Street crosstown line.

From the above considerations it will be seen that the question first presented to the managers of the Metropolitan Street Railway Company was the selection of an improved motive power on the longitudinal lines, the change on the crosstown lines being of minor importance.

The advisability of this change was accentuated by the enormous travel concentrated during the last three years upon the Broadway line with its two divisions above Twenty-third Street, the only portion of the system equipped with mechanical power. The traffic on this line during this period has really been greater than the capacity of the line to handle it, so that although cars have been run at as frequent intervals as the switching facilities at the down town terminal would permit, the cars have been crowded and for this reason many passengers have taken the elevated lines when they would have preferred to have traveled by the surface cars. The immediate plans of the company, therefore, soon after the opening of the Broadway cable system, included the equipment with some form of mechanical power of one or more parallel lines on both the East and West sides of the City

The experiments of the company with compressed air motors are familiar to the readers of the STREET RAILWAY JOURNAL through several articles, particularly one in August, 1897. This motive power presented many theoretical advantages, one of which in particular was that no street excavation was required, an important feature in a city like New York, where many of the streets, especially in the lower portions of the city, contain beneath the pavement a ramified system of subsurface pipes. The results of the experiments of the company with compressed air, while not distinctively unfavorable, were such as to convince the directors that for the lines of heavy traffic certainly the underground electric conduit system, the only other one seriously considered, was preferable. For this reason the decision to install the latter on the main longitudinal lines and the Twenty-third Street and Fifty-ninth

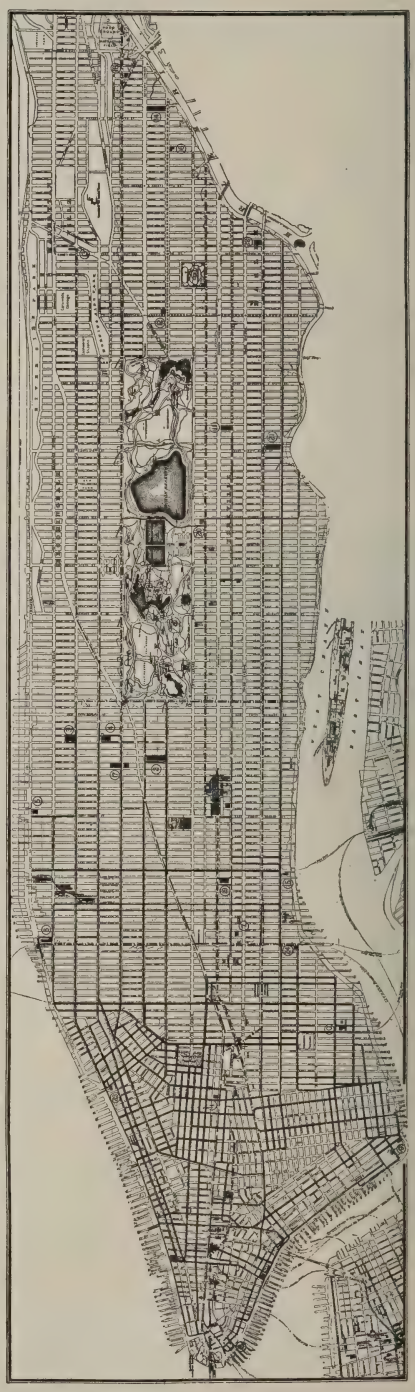


FIG. 3.—MAP OF NEW YORK, SHOWING LINES OF THE METROPOLITAN STREET RAILWAY CO. AND SECOND AVENUE RAILROAD CO. New electric lines are shown by dashes and dots, present electric lines by dots, present cable lines by dashes, present horse lines by solid lines.

Street crosstown lines was reached last winter, but owing to legal difficulties actual construction was not commenced until Aug. 2. In the meantime the acquisition by the capitalists interested in the company of the Second Avenue Railroad afforded the opportunity for the equipment by improved power of another north and south line, making the aggregate length of track to be immediately equipped with improved power 59 miles, measured as single track. These comprised as shown on the map Fig. 3, the Tenth Avenue line extending from Sixty-fifth Street to 125th Street, the Eighth Avenue line from Fifty-fourth Street to 159th Street, with a branch on Macombs Lane, the Madison Avenue line from the Post Office to 138th Street with branch on Astor Place; the Second Avenue line from Eighth Street to 128th Street; the Twenty-third Street line from the North River to the East River and the Fifty-ninth Street line from Tenth Avenue line to First Avenue. Work was commenced Aug. 2, as stated, and at present the Madison Avenue line and Tenth Avenue line have been entirely completed, the Second Avenue line and the two cross town lines have been about half completed, and the Eighth Avenue line has been nearly completed above 116th Street.

The method of construction has been materially different from that adopted in the first system installed, that on Lenox Avenue, and can be defined as building from the surface down instead of from the foundation up. The depth of the excavation necessary was materially reduced, being only 30¾ ins. from the street surface to the bottom of the concrete, against considerably greater depth for cable construction and for the earlier electric construction on Lenox Avenue. Other minor changes have been made in the form of conductors, method of hanging, bonding, etc., as will appear in the description of the present system as given later.

The general method employed was as follows: After the street had been excavated for a width of 18 ft. 9 ins., a depth for conduit of 30½ ins., and between tracks of 15 ins., the yokes were placed in position. The track and slot rails and iron lining of the conduit were then laid on the yokes and bolted in place. The tie rods were then inserted and the whole structure blocked up, surfaced and lined. The concrete, formed of 7 parts of ¾ in. broken stone, 4 parts of sand and 1 part of Portland cement, was then placed under and around the iron sheathing,

FIG. 5.—CONDUIT READY FOR CONCRETE—FOURTH AVENUE NEAR 9TH STREET

after which the earth was replaced and the street was repaved. The actual time which elapsed between the opening of a section and street and the time when the track was paved up averaged from ten to fourteen days.

At many points, particularly in the lower portions of

FIG. 4.—BOLTING ON SLOT RAILS—AMSTERDAM AVENUE AND 117TH STREET

the city, the work was seriously complicated by the network of underground pipes encountered. Those who have not had experience with street excavation in New York will have difficulty in realizing the number and variety of these pipes which have been laid at intervals by different companies during the last thirty or forty years. These had all to be removed when in the way of the proposed conduit and either placed at one side or lowered below the construction A good idea of the difficulties encountered in this direction, however, is shown by Fig. 19, which gives a view of the excavation made at Fourth Avenue and Fourteenth Street. The intersection of Fourth Avenue and Twenty-sixth Street and of Fourth Avenue and Twenty-third Street were other points where the work of conduit construction was greatly complicated by the number of pipes found. At the latter corner the underground

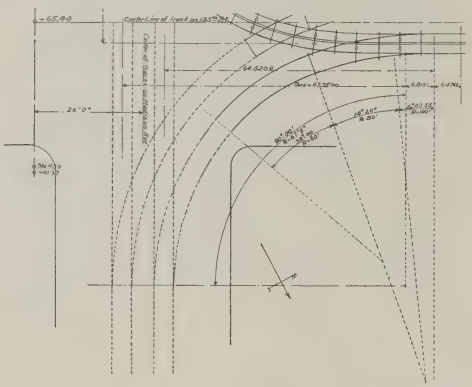


FIG. 6.—PLAN OF CURVE AT MADISON AVENUE AND 135TH STREET SHOWING LOCATIONS OF YOKES AND INSULATORS

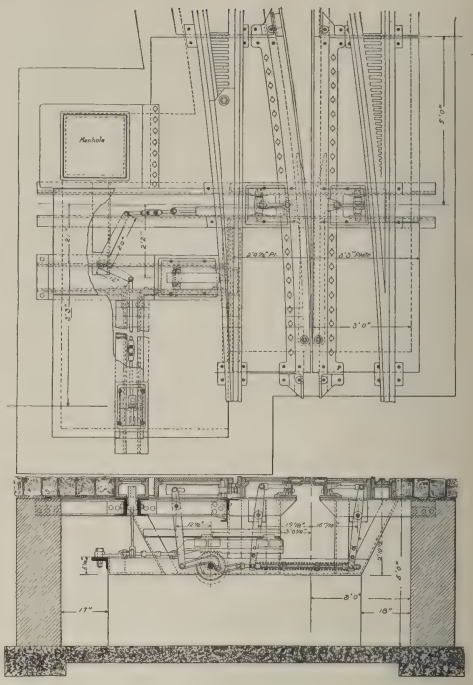
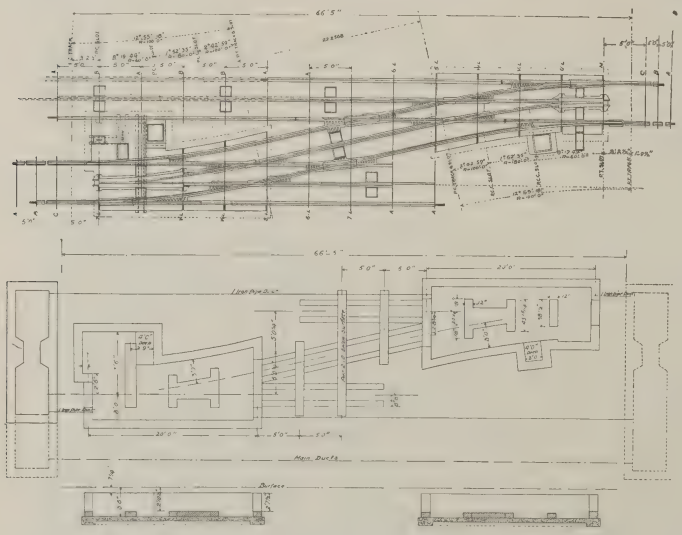


FIG. 9.—PLAN AND SECTION OF ENTRANCE SWITCH FOR STANDARD CROSSOVER



FIGS. 7 AND 8.—GENERAL PLAN AND MASONRY PLAN AND SECTIONS OF STANDARD CROSSOVER

conductors encountered included the following: One 2 in. Edison pipe, two 2½ in. Edison pipes, one 3 in. Manhattan light pipe, ten 3 in. electric subway pipes, two 4 in. Western Union pipes, one 4 in. gas pipe, seven 6 in. gas pipes, two 8 in. gas pipes, one 10 in. gas pipe, one 12 in. gas pipe and one large trunk line sewer pipe.

In ordinary straight track construction the yokes which weigh 425 lbs. apiece are spaced 5 ft. centers. A hand hole covered corrugated iron plate is located above each insulator, the latter being located 15 ft. apart. The manholes are spaced at irregular intervals, depending upon local conditions, but average about 150 ft. apart on straight track. At these points the conduits drain into the sewers and the entrance to the manhole is usually between the two tracks. The pitch at the bottom of the conduit has a minimum of 2 ins. to the 100 ft. in the case of level track to give drainage.

The method of curve construction is shown clearly in Fig. 6 which is a general layout of the curve at Madison Avenue and 135th Street. The ordinary cast iron yokes are used and the insulators are placed nearer together than on straight track, being, as shown, spaced 5 ft., 10 ft. and 15 ft. apart. Transition curves are used. Fig. 18 gives the masonry foundation of a double curve at the corner of Sixth Avenue and Fifty-ninth Street. At switches and crossings the conductors are interrupted and the cars pass over these points by momentum. At such places the conductors are made flaring to make the entrance of the plough into them easier.

A standard crossover is shown in Fig. 7. The one shown is that installed at the intersections of Eighth Ave-

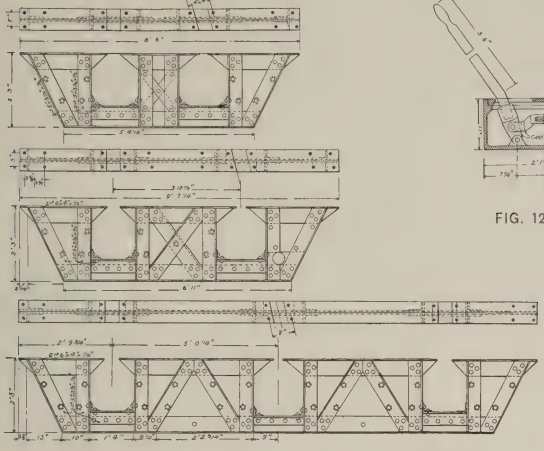


FIG. 10.—MADE UP YOKES NOS. 5, 6 AND 7—STANDARD CROSSOVER

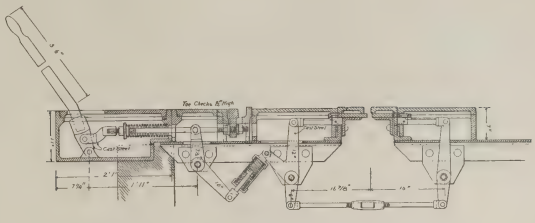


FIG. 12.—SECTION OF CROSSOVER RUN-OFF SWITCH MECHANISM

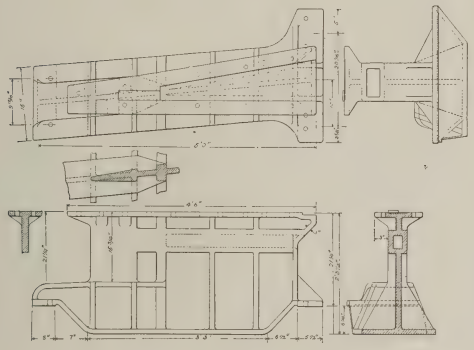


FIG. 11.—GUSSETT POST

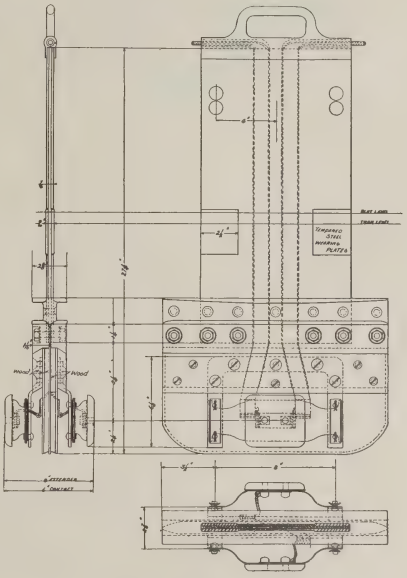


FIG. 13.—CROSS SECTION AND SIDE AND END ELEVATIONS OF PLOW

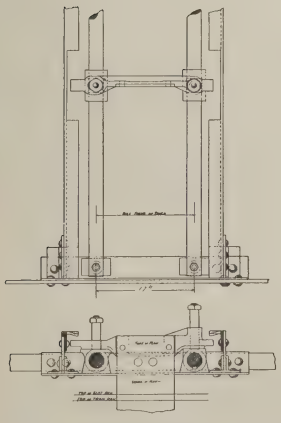


FIG. 14.—ARRANGEMENT OF PLOW SUPPORT ON TRUCK

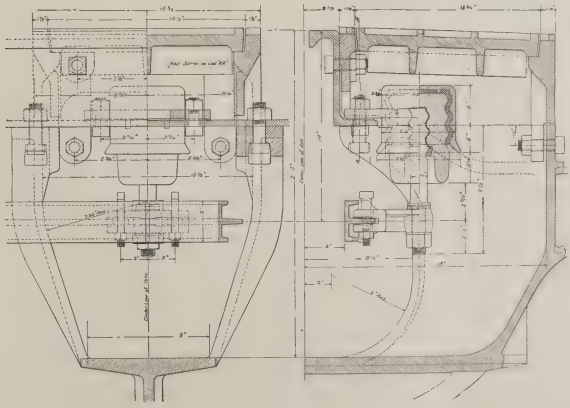


FIG. 13.—SECTIONS AND SIDE ELEVATION OF INSULATOR

nue and Fifty-ninth Street, Macombs Dam road and 155th Street, and Eighth Avenue and Fifty-fourth Street. The left hand gusset post at the entrance to the crossover is illustrated in Fig. 11. The yokes between the gusset post are made of wrought iron bolted up, as shown in Fig. 10. Two different forms of track switches are used; one at the entrance operated by a lever, and one at the exit which is automatic. Referring to Fig. 9, which illustrates the former, it will be seen that both switch tongue and slot rails are moved in unison by a lever. The latter can be removed at will by the operator who can thus lock the switch in either position. The automatic switch is shown in Fig. 12. This, however, is also fitted with a removable lever so that the switch can be thrown open to permit cars to use the crossover in the reverse direction if desired.

All special work is hardened steel, although owing to the large amount of special work required and the inability of the manufacturers to supply all that was necessary in time for opening of the lines, a certain amount of cast iron special work has been installed temporarily for this winter's service. The orders for special work, track and slot rails, were divided equally among William Wharton, Jr. & Company, Pennsylvania Steel Company and the Johnson Company. The cast iron yokes were supplied by Pennsylvania Iron Works Company.

without removing the slot rails. The complete metallic systen is used, the track rails not being used as a return, and the ordinary 500 volt system is employed.

A cross section, plan and side elevation of the plow is illustrated in Fig. 13. It has a total width at the slot level of $\frac{9}{16}$ in., and immediately above and below the slot level of $\frac{7}{16}$ of an inch. The wear of the slot rails is taken up by tempered steel wearing plates 2½ ins. square and $\frac{5}{16}$ in. thick. The shank of the plow is made up of three steel plates, the two outside ⅛ in. in width and the middle $\frac{3}{16}$ in. in width. The conductors which are wrapped

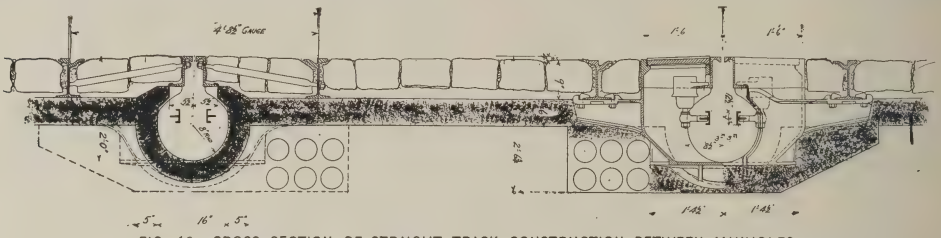


FIG. 16.—CROSS SECTION OF STRAIGHT TRACK CONSTRUCTION BETWEEN MANHOLES

copper ribbons are carried down through the plow to the contact shoes or wipers, connection being made between them by flexible cables. The shoes are about 4 ins. × ½ in. and are of cast iron. The tension is supplied by the side steel springs which keep the shoes extended 8 ins. apart when free, and 6 ins. apart when in contact with the conductors. The pressure when in contact with the latter is light, being only about 6 lbs. This has been shown on the Lenox Avenue line to be sufficient to secure good electrical contact. The guides which are carried above the broad foot of the plow are of cast steel and are to direct the course of the latter after the car has passed a switch or crossing.

The method of supporting the plow on the car truck

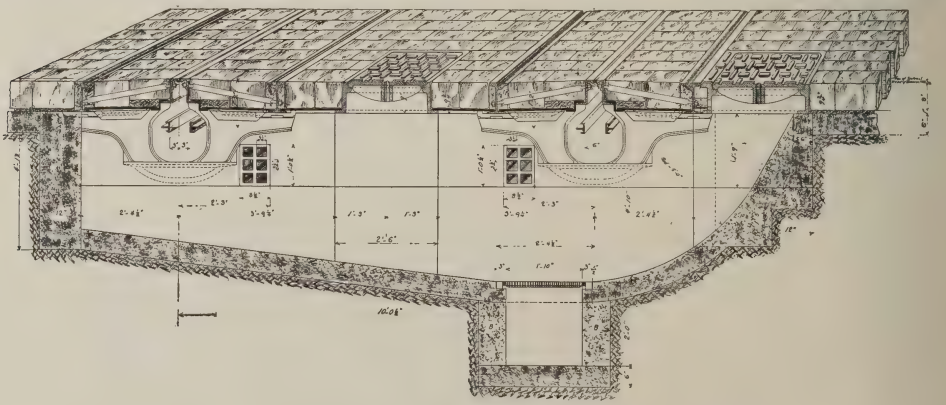


FIG. 17.—CROSS SECTION OF STRAIGHT TRACK CONSTRUCTION AT MANHOLES

The form of insulator used is illustrated in Fig. 15. It is very similar to that employed on the Lenox Avenue line, and is made up of a cast iron circular cup 5½ ins. in diameter fitted with wings by which it is bolted to the slot rails. Within this cup is another of porcelain which is held firmly in the former by cement and which contains a 1½ ins. wrought iron shank supporting the conductor rail. The latter is of iron in T shape and weighs 21 lbs. to the yard. It is in 30 ft. sections bonded together by copper bonds. In these short lengths the conductor rail can be slipped in the conduit from the hand holes is very simple. A yoke of cast iron, as shown in Fig. 14, is first bolted to the top of the plow. Each end of this yoke is pivoted on a vertical bolt. The latter is attached to a sleeve which slides upon a 2½ in. steel cross rod, which is bolted to the side frames of the truck. This gives the plow a certain flexibility vertically and transversely to the car, while holding it rigidly in a direction longitudinal to the car. Stop blocks are placed above the ends of the plow yoke to prevent a play of the plow up and down greater than ¾ in.

All feed wires are carried underground at the side

of the conduit. Various forms of feeder conduits are employed, those in use being of the Camp and McRoy types and cement lined ducts.

Some particulars of the organization and methods employed for carrying on this work will prove of as much interest as a technical description of the construction itself, as the amount and character of the work exceed anything of the kind ever attempted before in street railway construction. Had shortness of time been no object the undertaking would have been a comparatively easy task, but when once the horse cars had been taken off any particular line, every day's delay before the resumption of traffic meant a loss of many thousand dollars to the company. For this reason, long before right to commence actual construction was granted, every conceivable plan to expedite the work was matured in the offices of the company, and steps were taken to complete the work as quickly as possible after commencement.

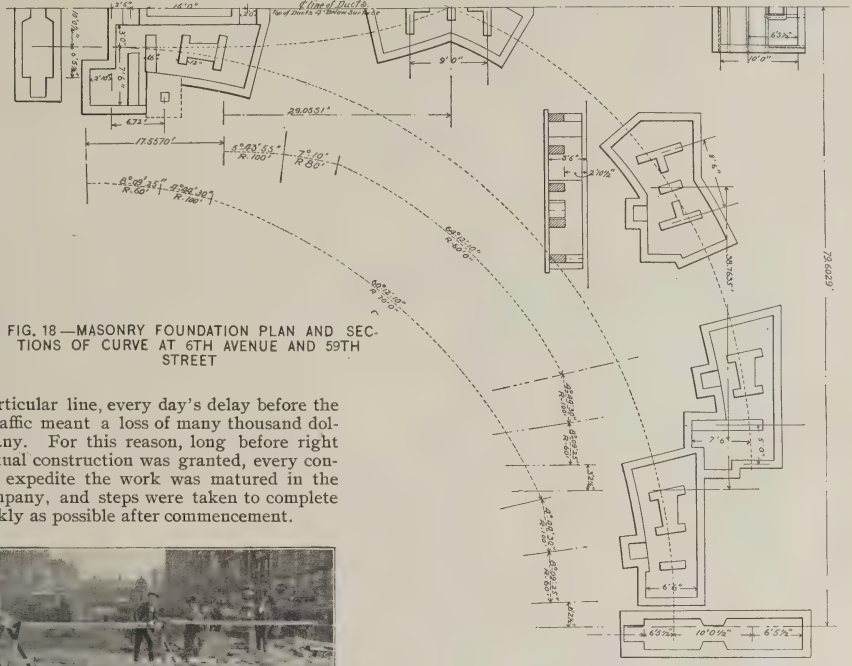


FIG. 18.—MASONRY FOUNDATION PLAN AND SECTIONS OF CURVE AT 6TH AVENUE AND 59TH STREET

FIG. 19.—EXCAVATION SHOWING PIPES ENCOUNTERED AT 4TH AVENUE AND 14TH STREET

It was early decided to do all construction by contract, but on a percentage basis. This, as will be seen, allowed the company the greatest amount of supervision over the construction, and the possibility of throwing on any particular portion of the work a greater force of employees if it should be deemed necessary. The first step was, therefore, the selection of some contractor of long experience in city street construction, and of sufficient capacity from both an engineering and financial standpoint to take charge of work of this magnitude. These qualities were possessed in an eminent degree by John D. Crimmins, to whom, therefore, the whole contract for the conduit construction was given. As no one contractor could undertake to perform all of the work, four sub-contractors were also employed. Throughout the entire work the general contractor reported directly to the engineering department of the company, which supplied all the plans possible for the prosecution of the work and exercised a general supervision over it.

Previous also to the time when permission to commence actual construction was received from the city, the company established at different points about the city, storehouses to which much of the material to be used in the actual construction was shipped, so that when the actual work of building was commenced, the company had in its storehouses all the materials down to the bolts, nuts and washers for 25 miles of conduit. During the progress of the work, material was received constantly, of course, from the manufacturers, and was taken directly to the point of use, the storehouse supplies being used as reservoirs to expedite the construction.

As already stated, the Madison Avenue line was the first to be equipped. This was selected, first, because it was the most important from a traffic standpoint of all the lines to be electrified, and second, because the company had only one longitudinal line, Lexington Avenue, on the east side of the city, equipped with improved motive power. The traffic on the Lexington Avenue line, which has been in operation only about two years, has already outgrown the facilities of the company for carrying passengers with reasonable comfort. Much of this traffic had been attracted from the Madison Avenue line on account of the better service, and it was thought that as soon as Madison Avenue line shoud be electrified, part of this traffic would return to the latter line. In this connection it may be of interest to state that the east side of the city, taking Central Park as a dividing line, is much better from a traffic standpoint than the west side, the longitudinal

lines on the east side carrying some three times as many passengers as those on the west. This is owing to the fact that the population density is much greater in that section.

The most important portion of the Madison Avenue line was that on Fourth Avenue between Forty-second Street and Astor Place, a distance of 1¾ miles. This portion connects the Broadway Cable line and all of the crosstown lines below Forty-second Street with the Grand Central Railroad Station. Traffic was stopped on this line Aug. 31, and within an hour from the time that the horse cars were taken off, hundreds of men were at work all along the line tearing up the track. One-half mile of this division extended through a tunnel, so that material on this part of the work had to be carried in and the excavated material removed from each end. Work was prosecuted day and night except on Sundays, when under

FIG. 20.—INSERTING CONDUIT LINING, 4TH AVENUE AND 31ST STREET

municipal ordinances, no work could be done, and on Sept. 30, or after twenty-four working days, the work was completed and horse cars were again running. This meant more, of course, than operation by electric cars, because it required the complete repavement between the rails, which necessarily could not be done until after all the sub-construction was completed. Nearly as rapid work was carried on at other portions of the line.

One of the most serious tasks undertaken was that of laying a new sewer main on Madison Avenue above Forty-second Street. The company learned before commencing its undertaking that the city contemplated the construction of a new sewer along Madison Avenue, and realized immediately that if a contract for this should be given by the city to a procrastinating builder, its work of railway undertaking on that street might be seriously delayed. The company decided, therefore, to control the contract, and offered to do the work for the city for $25,000 less than the cost estimated by the Board of Public Works, This offer having been accepted by the city, the company selected as its contractor a firm in New York having the highest reputation and longest experience as sewer builders, to whom the sub-contract was given. After the latter had been engaged on the work for a few weeks, and in spite of the fact that the firm was making better time than ever before in the history of similar undertakings, the managers of the company decided that it was not able to complete the work in time. They, therefore, paid the contractor his profit to drop the work, said to be about $20,000, and undertook the construction directly. As a result, instead of the 400 working days to complete the undertaking, estimated by the Board of Public Works, the whole sewer was finished in ninety days.

It is difficult to summarize either the expense or the number of men employed in this undertaking. So far as the latter is concerned, the number of men engaged in outside work on actual construction at any one time varied from 7500 to 10,000, with about 500 carts and trucks. In addition to this, there were, of course, a large number of other laborers in New York City engaged in transporting the materials to the work, but as all this was done by contract at a certain price per ton, no close approximation can be made of the total number engaged in this department of the work.

The question of cost is complicated by the fact that at many points, as already stated, the cost was greatly increased by the necessary removal of underground pipes, while at other points practically no obstructions of this kind were encountered, and second, that the expense has not yet been entirely computed by the auditing department of the company. The engineers estimate, however, that the average cost per mile of single track, including excavation, feeders, conduits and all material employed, is not far from $100,000.

The following is a list of materials used in the construction of one mile of single track.

352 tram rails, 30 ft. long.
352 slot rails, 30 ft. long.
352 conductor rails, 30 ft. long.
352 tram rail splices and bolts.
352 slot rail splices and bolts.
8448 tram rail bolts, tram rail to yoke.
4208 slot rail bolts, slot " " "
704 slot rail splice bolts.
1408 handhole curb bolts, handhole curb to slot rail.
1408 " " " " " yoke.
1408 pendant insulator bolts, pendant insulator to slot rail.
16 grip hatch bolts, grip hatch to slot rail.
16 " " " " " " yoke.

1056 conductor pin couplers, from conductor to conductor splice.
8448 wedges for tram rail bolts.
3848 tie rods, slot rail to tram rail.
352 special tie rods, slot rail to tram rail at tram rail splice.
24 grip hatch tie rods from grip hatch to tram rail.
8080 bevel washers for tie rods.

FIG. 21.—STANDARD CAR—MADISON AVENUE LINE

652 conduit plates between regular yokes.
1408 " " " " " " and handhole yokes.
44 roof plates between rails and manhole pit.
26 " " " tracks " " "
8 special roof plates at grip hatch.
8 grip hatch covers.
39 manhole steps in manhole pit.
26 manhole curb bolts, manhole curb to tram rail.
704 regular yokes.
352 handhole yokes.
704 " curbs and covers at handhole yokes.
704 pendant insulators complete.
352 conductor splices at ends of conductors.
352 intermediate brackets at center of conductors.
13 manhole curbs and covers between tracks.
13 manhole curbs and covers outside tracks.
8 grip hatches.
13 cesspool grates in manhole pit.
352 conductor bonds.
feeder ducts.

The cars employed at present on the Fourth Avenue line are of the standard Metropolitan Street Railway type, built by the John Stephenson Company. They have a body length of 22 ft., width of 7 ft. 6 ins., measure over all about 32 ft., and are similar in every respect to the Broadway cars except in lettering and in being 6 ins. wider. The trucks used on this line are the special extra strong "high speed" extra long type of the Peckham Truck Company, designed expressly for extra heavy high speed service. This truck contains a number of novel features. As its name indicates it is built for standing the heaviest strains that are likely to come upon it from the heavy loads carried on this line and the overloading of cars at one end, as is a common occurrence. To overcome this latter difficulty and to equalize the load of the car upon the springs, as well as to prevent oscillation at high speed, these trucks are provided with two under tension springs at the extreme ends of the truck frame, which can be so adjusted as to make the motors and the wheels and axles act as a counterbalance to equalize the load upon the springs and make the cars ride steadily. In addition to this equalizing feature of these trucks, they are made of extra strong construction throughout, and extra upright center posts connect the upper and lower members of the truck. The springs that support the weight of the side frames upon the journal boxes are also made of extra strong construction. The Peckham Company guarantees this special truck to run at a speed of from 20 to 40 miles per hour without oscillation, and the side frames against breakage for ten years under any and all conditions. The company is also trying on its Lenox Avenue division a few long double truck cars mounted on Brill maximum traction trucks.

To operate its present lines, the company is installing four 850 k. w. units in its Twenty-fifth Street cable station, and three units of the same size in its 146th Street station. The engines are cross compound condensing, built by Pennsylvania Iron Works Company, and the generators are of the General Electric type.

For the ultimate current generation of the system, however, the company is proposing the erection of a 70,000 h. p. central power station on the block bounded by Ninety-fifth Street, Ninety-sixth Street, First Avenue and the East River. While all of the details of this power station have not been settled upon by the engineers, the essential features of the new station have been determined and the erection has already been commenced. The most important novel feature of the station is that multiphase generators will be used, distributing current at high voltages to substations where the transformation to 500 volt direct current will be made. As some erroneous statements about this station have appeared in contemporary publications, the following data will be of interest:

FIG. 22.—INSTALLING CONCRETE—FOURTH AVENUE AND 20TH STREET.

The station will occupy an area of 201 ft. 6 ins. in width, 208 ft. in length on one side and 279 ft. on the other side. The foundation will consist of 8000 piles, upon which will be spread a bed of concrete 5 ft. thick. The boilers will be arranged in three tiers and on each side of

a central passage way, with the chimney of the station in the center. The boilers will be in batteries of two, with a nominal capacity of 500 h. p. each and will be eighty-seven in number. They will be of the water tube type with provision for forced draught. The chimney will be of brick 350 ft. in height and 22 ft. inside diameter. The coal will be kept in a coal storage bin at the top of the boiler house, from which it will be dumped by shoots in front of each boiler. The coal storage bins will have a capacity of 9000 tons, and both coal and ashes will be handled by mechanical conveyors. The engine equipment will consist of eleven vertical, cross compound condensing engines directly connected to the generators. Each of the engines will have a nominal capacity of 4000 h. p. and a maximum capacity of 6600 h. p. each and will be arranged to operate either condensing or non-condensing.

The generators will be of the three phase alternating type with horizontal shaft and will operate at about 6000 volts. This current will be led to various transformer stations at different parts of the city, where the voltage will be reduced to 550, direct current, at which pressure it will be supplied to the conductors in the conduit. The transformer stations will be from eight to ten in number, and the direct current generating units from 300 k. w. to 850 k. w. each.

The preparation of plans, specifications and all the engineer work for both street construction and station has been carried on under the direction of the company's chief engineer, F. S. Pearson, and assistant engineer, M. G. Starratt. The energetic president of the company, H. H. Vreeland, has also devoted much time to a personal supervision of the entire work.

The Electric Railway of Alexandria

L'Energie Electrique of Paris contained in a recent issue a graphic account of the opening of the electric railway at Alexandria, Egypt. According to it, the trial trip was run on Sept. 11. The Khedive traversed the road on the first motor-car and was accompanied by His Excellency Ismail Pacha Sabri, governor of Alexandria, M. Boutiron, the French consul general, M. Legrand, director of the General Traction Company, and M. Tivoli representing M. M. Renard & Cauderay. His Highness took his place on the platform of the first car, by the side of Monstapha Pacha Feymy and the motorman. The other cars contained the members of the diplomatic corps and the consulate, a num-

ON THE ROAD TO MEX

erous staff from the military household of the Khedive, the heads of the municipal departments and representatives of the press. Before the departure the employes of the company were obliged to assert their authority in expelling from the cars a large number of young effendis and Europeans who had invited themselves to the ceremony and had monopolized the seats to the exclusion of those who had a right to them.

During the entire course, the inaugural train, escorted by bands of gamins, running until they were out of breath, passed through immense crowds which received it with great acclamation. Many of the houses were decorated. In several were placed orchestras which played during the passage of the cars.

In returning, the inaugural train left the Avenue Bab Sidra in order to pass through the power house, which is situated at Karmous on the banks of the Mahmoudish Canal. The arriving cars were greeted by a detachment of cavalry from the Khedival guard and a company of firemen on foot,

IN THE ARAB QUARTER

who received them with military honors. The music of the band echoed through the court of the power station in playing the Khedival hymn.

Under the guidance of Mr. Legrand, director of the General Traction Company, and M. Daujeat, the engineer, His Highness, the Khedive, was conducted through the power house, which is installed on commodious and pleasant premises. He visited with particular interest the engine room, where two Walker dynamos of 125 k. w. capacity are driven by two engines by E. Garnier, made in Paris. On leaving, his highness congratulated M. M. Legrand and Tivoli on the excellent installation of the line and on the success of the inaugural fete.

The road, which is of 1 .44 m. gage, is laid with steel rails of the Broca type, weighing 40 kg. per metre. From the technical point of view, the line is excellently constructed. The cars made the trip without a single derailment and almost without stopping. It was a most excellent result for an experimental road with inexperienced employes. The Dickinson trolley which is used by the General Traction Company follows with marvelous suppleness the wanderings and curves of the line without recourse even to a trolley rope. The cars, designed to suit the exigencies of the climate, are ventilated and furnished with thick curtains. They are built on such a plan that they may be changed at will from winter to summer cars. Each car is divided into three parts, first and second class, and a department for ladies alone. The cars, ten in number, are all automobile and each is provided with two 25 h. p. Walker electric motors. The city government took the precaution to sprinkle the entire route to Mex, so that the ride was very agreeable owing to the absence of dust.

The line was opened to the public on Sunday, Sept. 12. There was an immense concourse of passengers. The natives above all attracted attention by their haste and anxiety to profit by this new method of locomotion. They fairly carried the cars by assault and fought for places. More than 8000 persons were carried on the tramway the first day, but with such a crowd proper control was impossible and only about 4000 paid their fares.

THE Birmingham Electric Railway Company, of Birmingham, on Sept. 9 opened its Ensley Street division, which has recently been equipped with electric power. The line extends to Pratt City, and the first car run carried a number of invited guests, including many of the leading citizens of Birmingham and Pratt City.

Electric Railway Motors

By Geo. T. Hanchett

IV—General Mechanical Construction, Motor Casings

The modern railway motor is an entirely enclosed structure. Experience with the early motors soon proved that it would not do to have any part of the motor exposed to the dust, dirt or moisture that was certain to accumulate on it in service. The first motor casings were of sheet metal or canvas, either partly or wholly covering the vital parts.

In the year 1891, motor designers began generally to appreciate the fact that a self-contained type of motor was not only marvelously compact, but that no part of the enclosed case could be considered as idle metal, as it could be utilized for the return magnetic circuit. Among the pioneer motors in this class were the famous Thomson-Houston W. P. motor and Westinghouse No. 3. As we shall subsequently see, these motors only partly accomplished the object of complete enclosure, but they are exceedingly instructive as showing how the motor has developed, and why it is built as it is to-day.

The American motors that are actively competing in the field to-day are those of the General Electric Company, Walker Company, Westinghouse Electric & Manufacturing Company and the Steel Motor Company. There are still in operation, however, numerous motors which were made by the Short Electric Railway Company, before it was absorbed by the General Electric Company, the Curtis Electric Railway Company, and even some of the Sprague, Edison and Thomson-Houston types, as made before the general consolidation. A general description of typical modern motor casings, as exhibited in some of these forms, will now be attempted.

The favorite sizes for street railway traction are 25 h. p. and 50 h. p. and they are offered for sale on the market under various familiar nomenclatures.

The General Electric Company, at the time of its formation, was producing through its Thomson-Houston branch a railway motor known as the W. P. This was produced in two sizes, the W. P. 50 and the W. P. 30, and the two motors were rated at 25 and 15 h. p. The letters W. P. stand for "water proof." The frame was cast in two halves which hinged together over the car axle, and were secured by the hinges on the one side and by two bolts in the edge of the casing on the other. The lower half was shaped like a bowl with a plow-nosed bottom, which would deflect obstacles on the track to the right or left. This motor was one of the first to use the yoke suspension, which consisted of a bar, bolted to the case and suspended at the ends on springs resting on the truck side frames. The seats for the bar and the bolt holes can be readily seen in Fig. 1.

The bearings were cast integral with the lower half and are lubricated by grease cups from above. The motor has but two pole pieces, one in each half. The upper is salient and carries a coil; the lower is consequent and without a coil. This has an advantage in that there is no field coil in the lower half of the case where dust and moisture are sure to accumulate. The upper half of the casing has two semicircular openings, one over each bearing, to facilitate inspection. The brushes, which are two in number, are set on opposite sides of the commutator in line with the parting of the casing. The commutator bearing of the W. P. motor is admittedly too small, both in diameter and length. The liners of the bearings are preferably made of brass shells $\frac{1}{8}$ in. thick, and they may be allowed to wear $\frac{1}{16}$ in. before removal.

The large openings on either side of the upper half of the casing serve admirably the purpose for which they were intended, and they ventilate the motor so that it can carry enormous overloads, but unfortunately they admit dust and water to such a degree that some kind of a covering is absolutely necessary. This is also true, as will be seen beyond, of the Westinghouse No. 3 motor (see Fig. 2.) That motor possessed the same characteristics with regard

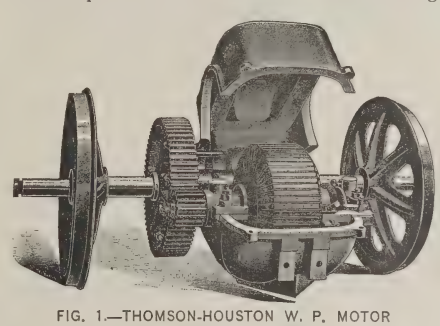


FIG. 1.—THOMSON-HOUSTON W. P. MOTOR

to carrying overloads as the W. P. 50 and 30. The lesson of ventilation has not been lost, and wherever the service permits, such as over stone ballasted roads and elevated railway work, modern motor casings are left open. The increased capacity which this additional ventilation secures is of great advantage in the larger sizes, where much power must be placed in limited space. This principle is well illustrated by Fig. 3, the cut of the Walker 200 h. p. elevated railway motor, which is open on both sides at top and bottom.

The first production in the line of railway motors, of the General Electric Company as a consolidation, was the G. E. 800, and its success will ever be remembered by all those who had to do with railway work at that time. It introduced a number of radically new features and is illustrated, both open and closed, in Figs. 4 and 5. It had perhaps the first entirely enclosed motor casing and contained many of the characteristics of its predecessor, the W. P. being similar in armature proportions, and in the fact that its armature bearings were bolted to the lower half of the field casing.

The trouble with refuse lubricant had evidently begun to be appreciated; for in this motor pockets leading to the outside of the casings were cast directly under the edge of the bearings, and were intended to catch all refuse lubricant. The convenience of being able to remove the motor

from the car axles without opening the casing became apparent, and accordingly the axle bearings were cast on brackets projecting from the casing, and the caps of these bearings were separately removable from above. There were two coils, one above and one below the armature, and four poles, two of which were consequent. This arrangement had the disadvantage of having one of the coils in the bottom of the field casing, where it was liable to receive damage from waste lubricant, dust and water, which would sometimes accumulate even when the greatest precautions were taken. The later motors used the device of sealing up the lower field coil in a sheet lead

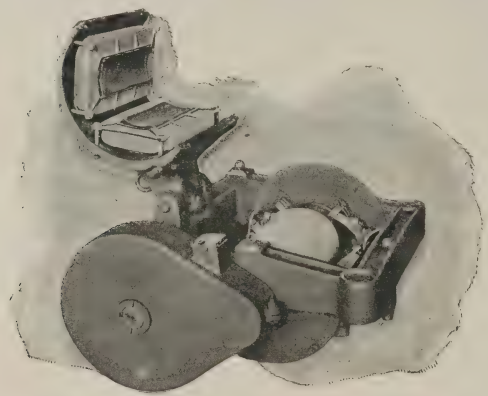


FIG. 2.—WESTINGHOUSE NO. 3. MOTOR, OPEN

receptacle, which is an effective improvement. The armature must be removed from above, which is somewhat inconvenient, a defect that has been remedied in the later designs.

The case is secured together by bolts on the back and front. The door over the commutator gives access to the brushes, and the upper half of the field casing can be very readily opened. It has been customary to make the commutator door of this motor casing tight by means of a felt gasket. The motor utilized what is known as the nose suspension, a suitable projection, engaging with the spring suspended crossbar. The bearings are lubricated by grease cups on the caps, the feeding being by gravity only. The shells are Babbitt lined, the pinion bearing being 2½ ins. × 6 ins. and the commutator bearing being 2½ in. × 4½ ins. On similar lines to those of the G E. 800 are modeled the G. E. 1200 and the G. E. 2000.

The G. E. 800 motor has been largely replaced by the G. E. 52, which is of slightly greater capacity and of much superior design; of necessity so, because of the experience gained by the operation of its predecessor. Two views are shown, in Figs. 6 and 7, of the motor, open and closed. It may be added that this motor represents in the line of its design, the G. E. 1000 and also the G. E. 57, both of which are of larger capacity.

The most obvious improvement of the G. E. 52 motor is that it can be manipulated entirely from the pit below, and the lower half of the casing swings downward by pivotal hinges on the removal of two bolts in the rear. The case is secured together by means of these hinges and bolts, and as can readily be seen in the cut, the hinges can be adjusted so as to tightly clasp the casing and insure a good magnetic circuit. Four salient poles are used. They are of laminated construction, and are bolted to the interior of the casing. The armature bearings are now bolted to the upper half of the casing, instead of the lower, the arrangement being well shown in Fig. 7. This method is called the outboard bearing plan. The arrangement permits the armature to be retained in either half of the motor on opening the case, by the simple device of leaving the bearing bolted to the upper half, or not, as desired. Another important advantage was gained in the modification of the axle bearing brackets, which are now cast integral with the upper half, an arrangement which greatly facilitates the removal of the car axle. In respect to bearings, and indeed in many other features, the general arrangement of the G. E. 52 motor is that of a G. E. 800 turned upside down.

The device of using four salient poles is generally admitted to be superior. There are more field coils, it is true, but the lowest part of the motor casing, where destructive fluids are liable to accumulate, is now clear of the field coils, and by means of a hand-hole in the bottom of the case, foreign substances can be readily removed. This hand-hole is also a distinct advantage by enabling the clearance of the armature to be measured, from time to time with a taper gage, and thus the condition of the bearings can be estimated.

The lubrication of this motor is especially profuse. All of the bearings are provided with grease cups above, and oil wells, with felt wick wipers below. The motor is fitted with the usual door over the commutator and the opening is made large so that the brushes can be conveniently removed. The suspension is of the yoke type, the crossbar being bolted to the upper half of the motor on the seats, which may be seen in Fig. 5. The pinion bearing of this motor is quite long, the dimensions being 7 ¾ in. × 2¾ ins. The commutator bearing is 6 ⅜ in. × 2½ ins. The motor is rated at 28 h. p. The bearings are babbitt lined.

The larger sizes of the General Electric motors are well illustrated by the G. E. 51 motor, shown in Fig. 8. This motor is 80 h. p. and is different in many respects from any of the same make previously described. The bearings are bolted to the upper half of the case as with the G. E. 52 motor, and the motor casing, as a whole, is bolted about the car axle. The lubrication is by oil wells and woolen wipers only. The armature bearings are directly outside the case. There are four salient poles. The commutator is accessible in the usual way, by a door above. The nose suspension is employed.

The Walker motor is essentially a young motor, being the result of the experience of its designers in other fields,

FIG. 3.—200 H. P. WALKER ELEVATED RAILWAY MOTOR

and it attained its present state of modern improvement at a bound. The earliest type which is shown in Fig. 9, will be seen at once to include in its motor case all the features which the modern products of others possess. It has been changed only in detail. Its peculiar suspension renders direct comparison a little difficult. It will be seen, however, that the axle bearing has its cap removable from below, and is lubricated by grease cups from above, in the usual way. The features of the casing will be more readily understood from the cuts of the more modern type. Figs. 10, 11 and 12 show them to better advantage, although they involve but few new principles. The details

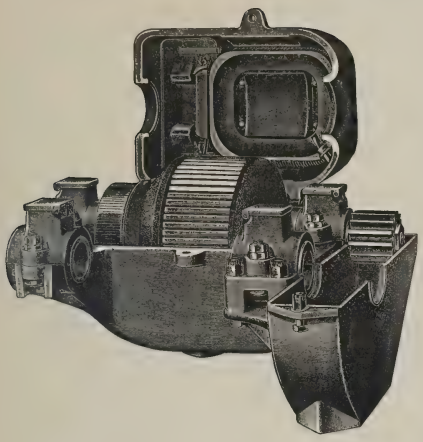


FIG. 4.—G. E. 800 MOTOR, OPEN

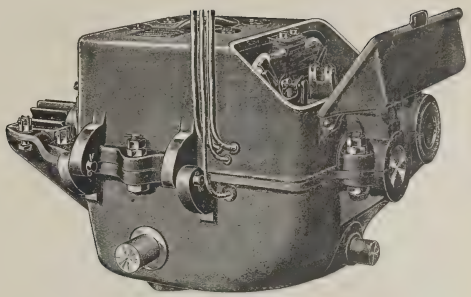


FIG. 5.—G. E. 800 MOTOR, CLOSED

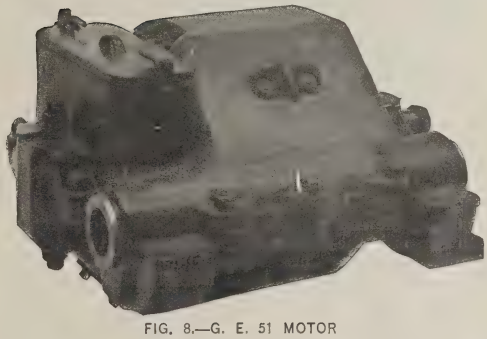


FIG. 8.—G. E. 51 MOTOR

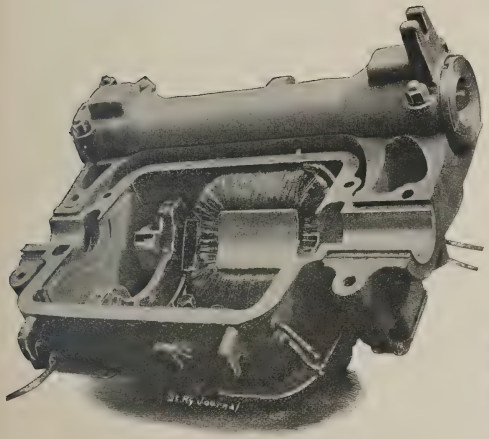


FIG. 11.—UPPER CASE OF WALKER MOTOR

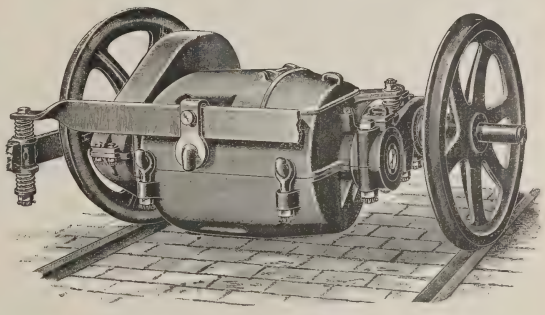


FIG. 9.—EARLY TYPE OF WALKER MOTOR

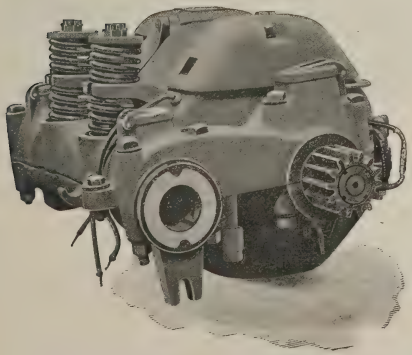


FIG. 10.—25 H. P. WALKER MOTOR CLOSED

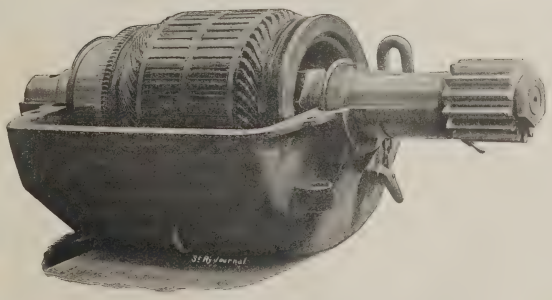


FIG. 12.—LOWER CASE OF WALKER MOTOR

of the suspension will be taken up in another chapter and need no rehearsal here. The armature bearings can be retained in the upper half of the motor, or allowed to fall with the lower half, by the use of a little auxiliary bolt, which, when screwed in place, fastens the bearings of the upper half to the casing.

The bearings are all lubricated by grease cups in the suspension arms. The bearings, although cast integral with the motor casing, are arranged so that both edges are entirely outside, and the use of a generous oil flange on

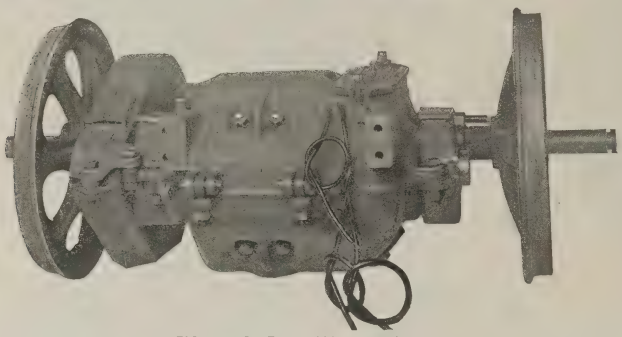


FIG. 6.—G. E. 52 MOTOR, CLOSED

the armature shaft effectually prevents any grease from entering the casing. The hinge is also a unique feature. In Fig. 11 in the upper half of the casing will be seen two projecting hooks. These engage with an elliptical eyebolt, which is secured to the lower half of the casing. This not only acts as a hinge when the lower half is swung down into the pit, but also permits of drawing the casing tightly together, and further permits the operator to readily detach the lower half by simply unhooking it from the upper one.

Two bolts and two hinges hold the casing together and are supplemented by four other bolts, which secure the armature bearings. The armature bearings are really a bearing within a bearing, for the case turns in the suspension arms to a certain extent. This motor is provided with a door over each end of the armature. As the commutator end is the more frequently inspected it is provided with a hinge door. The door at the other end is secured by a bolt. The pinion bearing of the Walker 3 motor, for that is the name by which this type is generally known, is said to be longer than any other of equal capacity. It is 8 ins. in length.

The Walker motor is one of the few modern motors for street railway service which attempts to secure ventilation of its casing. This is accomplished by holes in the covers passing diagonally upwards. These holes are really tubular openings, for the inlet inside the case is several inches above the outlet on the surface. In this way air is admitted without dust and water. There are four such openings, two in each cover. The space under the commutator is easily accessible by means of a hand hole, and through this orifice the clearance can be measured by a tape gage. The clearance can also be inspected with greater facility in a novel manner. Two peep holes are bored in the casing and are normally closed by plugs. On unscrewing the latter and holding a lighted candle in front of one of the peep holes the clearance can be easily seen by looking in the other.

The Walker No. 20 motor shown in Fig. 13 is rated at 125 h. p., and is typical of the No. 15 interurban motor rated at 75 h. p. The difference between the two consists in the fact that the smaller motor is inclosed by cast iron covers over the two spaces above and below the bearing on either side. The No. 20 shows the construction of this type to better advantage, and is therefore illustrated.

The motor is parted on a line inclined from the horizontal. It is held together by two pivot hinges in the rear, and bolts in the front. It is of the consequent pole type, four poles, and two coils above and below the armature. The four armature bearing bolts also hold the case closed. The hinge pivots can be readily removed, if it is necessary to take the casing completely apart. The motor clasps about the car axle, as in such large sizes it is necessary to have the axle very close to the casing. The cover over the commutator opening is hinged, and those over the four other apertures are bolted on. These four openings make this motor very accessible.

The bearings are babbitt lined, with cast iron shells. They are lubricated by grease cups above them. This motor is intended for service over roads where the traction is severe, but where trouble from dust and mud is slight. It is, therefore, simpler and more rugged than the average railway type, but less elaborately provided with guards and arrangements for easily taking the motor apart. From this, it is by no means to be considered that dismantling this motor is a difficult task. It is in about the same class with the G. E. 51, and is intended for similar service.

The Westinghouse Company has been developing the inclosed motor since 1891. Its first attempt was the No. 3, which was contemporaneous with the W. P. motor. This motor, shown in Fig. 2, was a radial internal pole machine, mounted in a rectangular yoke, which was fitted on the car axle. The upper half of the field was secured, as shown in the figure by a hinge on the yoke, and the lower

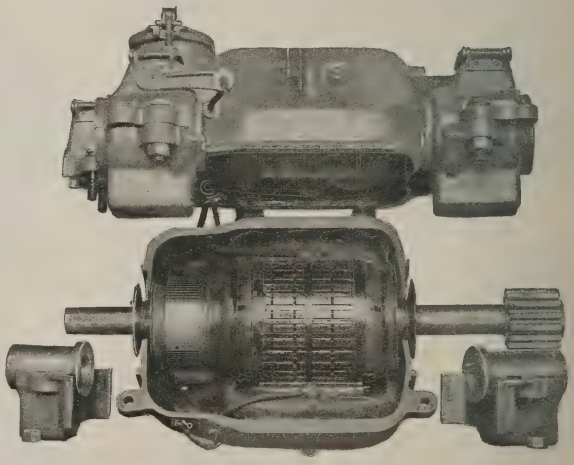


FIG. 7.—G. E. 52 MOTOR, OPEN

half can be swung in a similar manner, but in the opposite direction, by a hinge on the lower half. The bearings of the motor are in the yoke arms. The two halves of the field magnets are bolted together by four bolts, the hinge joint simply connecting the field frame to the yoke which carries the armature bearings. The yoke is cored out hollow for the sake of lightness. The openings in the lower half of the motor case, if such it can be called, are closed by semicircular iron plates, bolted to the field frame. These bolts may be removed for measuring the clearance or cleaning out the motor case, and have been found extremely

convenient for that purpose. Indeed, it is probable that from these removable plates the bottom hand-hole, utilized in the more modern Westinghouse types, has developed. The bearings are lubricated by grease cups placed over them and cast into the yoke. There are four poles, all salient. The commutator is readily accessible, as it projects beyond the field frame and is outside the casing. The bearing caps are removable from below, a feature which is

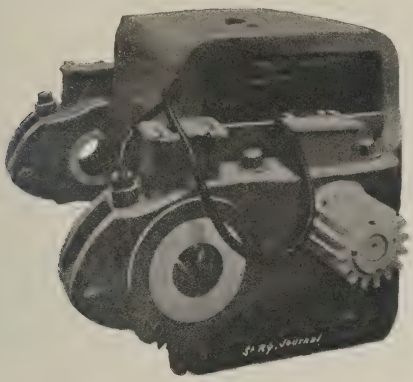


FIG. 13.—WALKER 125 H. P. MOTOR

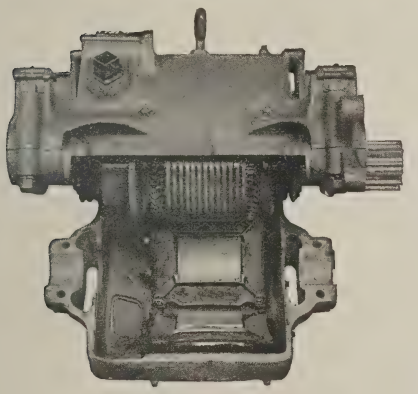


FIG. 14.—WESTINGHOUSE NO. 12A MOTOR, OPEN

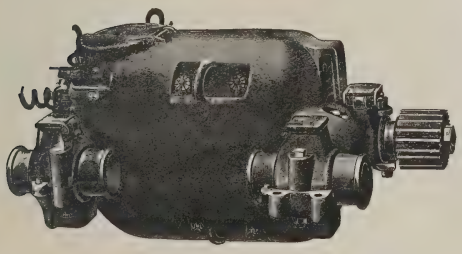


FIG. 16.—STEEL MOTOR NO. 34, CLOSED

considered desirable in modern motors, and is a distinctive feature of this early type. In the top of the field frame are two semicircular openings, which were intended for ventilation, but like those of the W. P., are preferably closed by a canvas or sheet metal covering.

The No. 3 was superseded by the Westinghouse No. 12, and that in turn by the No. 12 A, which is the company's present type. The 12 A differs so slightly from the No. 12 in the general features of the casing, that the more modern type only will be described. It is shown open and closed in Figs. 14 and 15. It is adapted to either the nose, side bar or cradle suspension, straps being cast upon the side of the upper half of the case to accommodate the two latter suspensions. The case is parted in the middle and is secured on the one side by an eyebolt hinge, and on the other by the four axle bearing bolts. The hinge is not, strictly speaking, a Walker eyebolt hinge, as will be seen from Fig. 15, but that device is used on the Westinghouse No. 38, a 50 h. p. motor. The motor is lubricated by grease cups above, and the armature bearings are entirely without the motor, being arranged in a very similar way to those of the Walker motor. Fig. 14 shows this arrangement to very good advantage. The armature may be retained in the upper half of the case, when the lower is swung down by use of special hook bolts, which are adjusted to surround the bearing before the case is opened.

The axle bearing caps bolt on from below, brackets being cast on the upper half. All the bearings are cast iron shells, babbitt lined. A hand-hole, closed by a bolted cover, is provided in the bottom of the case. The poles are four in number and each carry a coil. The motor is fitted with the usual door over the commutator.

The Westinghouse No. 38, a 50 h. p. motor, differs from the No. 12 A only in size and a few minor details, and as far as the appearance of case goes, is sufficiently illustrated by the cuts of its smaller prototype.

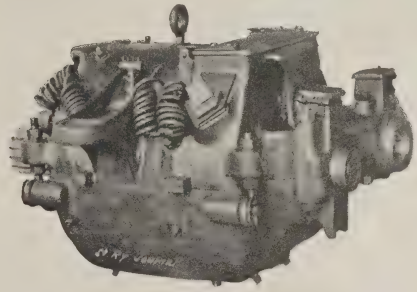


FIG. 15.—WESTINGHOUSE NO. 12A MOTOR, CLOSED

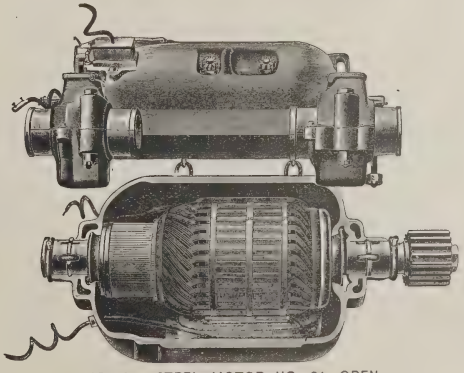


FIG. 17.—STEEL MOTOR NO. 34, OPEN

The Steel Motor Company manufactures two sizes, which it is appropriate to mention in connection with this article. These sizes are No. 20, of 25 h. p., and No. 34, of 50 h. p. With regard to cases, these motors are so alike, with the one exception of dimensions, that a general description of the No. 20 will suffice.

The motor cases are aligned by dowels, and are secured by the armature bearing bolts, which pass through cored holes. The case is suitably cast to accommodate either

the nose, or the sidebar suspension, and there is no hinge to the casing. The halves of the casing are chained together by a link support. The lubrication is very profuse. Grease cups above, and oil wells with appropriate wipers below are employed. The bearings are cast iron shells and are interchangeable, except when a 39 in. gage is used. In that case the commutator bearings are a little shorter. The usual cover over the commutator is provided. The armature may be retained in either half of the commutator, on opening the motor, by bolting the appropriate shank of the double shanked eyebolt, the eyelet of which surrounds the armature bearings, to the half of the case in which it is desired that the armature shall remain. There are four pole pieces, each having its own coil. The poles are both laminated and serrated, and are bolted to the casing on curved seats, in line with the armature bearings. The axle bearing brackets are cast to the upper half, and the caps are removable from below. The two figures 16 and 17 will assist in more readily understanding the description of the motor.

Pleasure Bay, the Resort of the Atlantic Coast Line Electric Railway

One of the most successful street railway pleasure resorts in the country is that at Pleasure Bay, near Long Branch, N. J. This resort is at the northern terminus of the Atlantic Coast Electric Railway, by whom it is owned and operated. The line extends south from this point through Long Branch, Elberon, Asbury Park and various other seaside resorts until Belmar is reached, and during the coming summer it will probably be extended as far as Point Pleasant. The fact that it had to draw upon a large population in summer, whose principal object is recreation, gives the resort, probably, an advantage over the ordinary street railway park. At the same time the methods employed to attract amusement seekers are in a number of features quite novel and of such a character as to be applicable to other resorts contiguous to cities of considerable size.

No admission fee to the park is charged to those who come on the trolley cars, the single fares on which are five cents, ten cents and fifteen cents, depending upon the distance traveled. To persons coming on foot or carriage an admission fee of five cents is charged, and bicycles are checked for ten cents, which includes admission to the park.

The park occupies an area of about nineteen acres and has been leased by the railway company for a period of thirty years. It fronts on Shrewsbury River, which, at that point, is about one-half mile wide, and contained when leased by the company a hotel and fine grove. The park was opened in 1896 for its first season, but it contained no special attractions except electric launches, fire-work exhibitions at occasional intervals and illumination of the grounds by incandescent lamps.

During the spring of 1897 a number of new buildings were erected. In many of these a number of new features were introduced, most of them suggested by the contractor, W. G. Massarene. Of the buildings the most pretentious is the pavilion shown on this page. The chief feature of this building, which is 50 ft. × 100 ft., is the fine architectural effect secured at a small cost. It has two wings 16 ft. × 26 ft. made out of two former summer houses which are connected with the main building as shown. Soda water is dispensed at one end and ice cream at the other. On the water side is a semi-circular

THE PAVILION

band stand 25 ft. in diameter, flanked by dressing rooms 10 ft. × 10 ft. In the center of the roof of the main building, which is octagonal in shape, is a flat deck 26 ft. × 52 ft. supported on four center columns. The top of this is surmounted by a crown of light wood strips or scantling tied together by telegraph wire and carrying a series of varied colored incandescent lamps which produced a beautiful effect at night. The material of the building is hemlock timber, cypress shingles, white pine trimmings and yellow pine colums. The color effect was produced by varnishing the yellow pine columns, painting the trimmings white, giving the solid wall surfaces a light green color and allowing the shingled roof to turn black with the weather. The rough timber rafters of the mansard roof project 2½ ft. beyond the supporting pillars, giving a sharp shadow line, and the ends of these rafters are covered with some sheet metal stampings of grotesque design, painted white. The main floor is only two steps above the ground, making it easy of access. Concerts were given in this pavilion every afternoon and evening from June 24, until the week after Labor Day. The entire cost of the building was $4750.

VIEWS OF BUILDINGS AT PLEASURE BAY

At some distance from the pavilion is a casino, which was erected in Colonial style from rough boards at a cost of $1425. It measures 40 ft. × 70 ft. with a veranda 10 ft wide on each side and contains a bar room. An excellent architectural effect for both day and night was

obtained in this building by making the upper part of the side walls all the way round the building of narrow vertical strips of green and white glass alternated. The effect of this is striking, while the expense was nominal.

Adjoining the pavilion is the carrousel, 102 ft. in diameter, and said to be the largest in the country. It was operated by an electric motor, and the horses were finely decorated. The building is of rough timber, supported on sixteen yellow pine posts varnished. The panels between the posts were filled with wood and tinted glass which lighted up well at night. The cornices have a good overhang, giving a sharp shadow line. The cost of the building was $3370. A peanut stand 18 ft. × 26 ft. was erected of rough timber with cone-shaped roof, Dutch gables painted dark green and surmounted by a white finial at the top. The sides of the stand were painted in tints, and the entire building cost $250. The shooting gallery is of rough spruce with paper and half coned roof, all painted in ornamental fashion. The rear of the building was finished to give a German castle effect. The entire cost was $150.

The dock shown on this page is surrounded by novel piles made of crooked trees stripped of their bark, and finished to give a Venetian appearance. At the top of each column was an incandescent lamp. The piles are painted and cost only $5 apiece. All the important signs on the grounds are illuminated. They are of wood with open letters which are backed with red cloth, and contain incandescent lamps within. They were very legible both day and night.

The most important feature of the Park from a drawing standpoint, however, was a water theatre, which was extremely novel and popular. It was made on a float 40 ft. × 50 ft. floated on empty casks and was moored 20 ft. or 30 ft. away from the shore, with which it was connected by a floating wharf. The music stand was located at the front of the grand stand about 20 ft. from the stage. The cost of the floating theatre was about $250. The idea is one which could be employed elsewhere, but care should be taken in the construction of this theatre to give greater buoyancy to the rear on account of the extra weight of the dressing rooms. The acoustic properties were excellent, and the actors could be heard 200 ft. away with ease. The entertainments were of a vaudeville character and were given every afternoon and evening except Sundays. They averaged in cost $300 a week, and the most successful piece presented proved to be Till's marionettes.

THE WATER THEATRE

PLAYING WATER POLO

GONDOLA AND CASINO

WHARF FOR ELECTRIC LAUNCHES

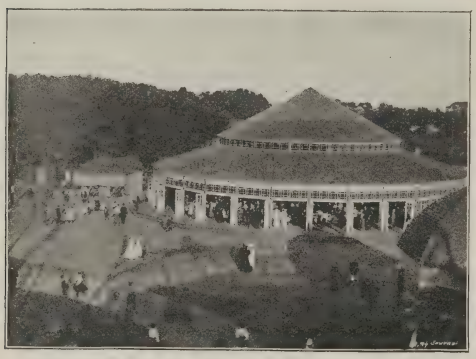
The audience sat on a grand stand on the shore, seating 1500 people. A general admission fee of ten cents was charged, with fifteen cents additional for seats in boxes, which were fitted with tables and chairs. During two weeks of the season Boyton's water show was given in the space in front of the grand stand. This proved a drawing card. The theatre was self-supporting.

On certain nights firework exhibitions were given on the shore opposite the grand stand. These exhibitions were held three times a week on the same nights every week, so that it was well known when these entertainments were to be given. The nightly cost for a very good entertainment was $200. Considerable thought was given to the best method of securing a maximum effect at a minimum cost. This, according to the managers of the park, is to make various "peaks" of display, terminating in an elaborate finale. The audience is thus gradually led up to

appreciate each extra display and they leave with the impression of the final one vividly in mind. The cost of the fireworks during the last half hour of the hour's performance should be at least two-thirds of the total expenditure and at the end a grand flight of bombs and rockets was found to be the most effective.

Another novel feature was the Aquatic Garden; this was a collection of beautiful and rare plants, including the Sensitive plant, Japanese plants and the *Victoria Regia*, whose leaves float on the water, and are capable of supporting a weight of 150 lbs. The approach to this Aquatic Garden was through a collonade of hewn trees lighted with incandescent lamps. An admission of 10 cents was charged. It was not, however, well patronized, and next year will probably be thrown open to the public.

The location on the water permitted the introduction of a number of special features which proved attractive. One of these was a fleet of four electric launches, whose batteries were stored from the trolley circuit. Two of these were fitted with longitudinal benches, and in the other two the cock-pits were open, and fitted with armchairs. They were leased by the hour, $2.50 for the first hour, and $2 for



GIANT CARROUSEL

each hour thereafter, and also carried passengers by the trip. If July had had the usual number of fair days the launches would have paid a higher return on the investment; as it was, they paid a fair return, and proved a popular feature. Another water attraction were two gondolas which were imported from Venice, and added a picturesque feature. A catchy idea in electric light illumination was a tower of light moored in the river, also floats with wooden framework, changed occasionally, to represent various forms, sometimes a sphere, again an hour-glass, then a pyramid, etc., and carrying a large number of varied colored oil fairy lamps. In fact, these lights were found to be a very economical and desirable form of light decoration, and were extensively employed with good effect.

A description having now been given of the general features, the cost of installation and operating expenses, it will be interesting to discuss the receipts from admissions and leases. Regarding the former, the net receipts from admission would not give an idea of the attendance, as passengers on the trolley cars were admitted free. The average daily attendance during August, however, the best month last summer, was about 4000, and on special nights there were on a number of occasions 10,000 people in the grounds and many more outside. The hotel and all restaurant privileges were subleased for a lump sum, and as already stated the expenses of the Water Theatre were covered by the sale of seats and admission to the grand stand. The peanut privilege was sold for $600, and the weighing machine privilege proved a very profitable one for both company and lessee at a lease of 50 per cent of the receipts. The carrousel was owned by a separate company, and was profitable, while the shooting gallery and aquatic garden were not. The experience with the electric launches has already been stated. Taken as a whole, the railway company is well satisfied with the enterprise and will enlarge its scope during the coming season, and the seating capacity of the grand stand will be increased to accommodate at least 5000 people.

Financial Characteristics and Operating Organization of the Brooklyn Rapid Transit System

On June 30, 1892, there were in operation in the city of Brooklyn, N. Y., nine independent surface railway systems, of which the Brooklyn City Railroad Company was the largest, controlling about 175 miles of track, and the Brooklyn Heights Railroad Company was the smallest, controlling only 1.16 miles of track. Three of the others, controlling about 45 miles of track, were afterwards consolidated into what is now known as the Brooklyn, Queens County & Suburban Railroad Company. Practically the entire mileage of all Brooklyn companies was then operated by horses (with a few steam dummies), but contracts for the reconstruction of most of the lines for electric operation were placed in 1892-93. The total outstanding capital stock of the five companies referred to by name was, on June 30, 1892, $7,022,480, and the entire bonded indebtedness was $5,190,000. The total gross receipts of the combined properties for the year ending June 30, 1892, were $4,411,416, and after paying operating expenses the earnings from operation amounted to $1,066,022.

These five properties have now been welded together into a single system. This was done by the creation in 1893 of a new corporation called the Long Island Traction Company, organized under the laws of West Virginia with a capital of $30,000,000. This corporation purchased and held in its treasury the entire capital stock of the Brooklyn Heights Railroad Company and the entire capital stock of the Brooklyn, Queens County & Suburban Railroad Company, while the Brooklyn Heights Railroad Company obtained control by lease of the Brooklyn City Railroad Company, guaranteeing the latter's fixed charges and a dividend of 10 per cent upon its capital stock.

In 1896 the entire assets of the Long Island Traction Company were acquired at a sale under foreclosure of collateral trust deed by the Brooklyn Rapid Transit Company, chartered under the laws of New York with a capital stock of $20,000,000. The Brooklyn Rapid Transit Company now controls, therefore, the Brooklyn Heights Railroad Company and the Brooklyn, Queens County & Suburban Railroad Company by ownership of their capital stocks, but is not an operating company. The Brooklyn Heights Railroad Company operates its own lines and those of the Brooklyn City Railroad Company, while the Brooklyn, Queens County & Suburban Railroad Company nominally operates its own lines; but the entire system is really managed as a whole, with a single organization presently to be described. The stock of the Brooklyn Rapid Transit Company has been put into a voting trust for five years, the object being to discourage speculation and to obtain for the property the advantages of a permanent organization and settled policy.

This system now consists of 254 miles of track. The outstanding capital stock of the different companies in the hands of the public is $32,000,000, and the outstanding bonds amount to $13,878,000. The gross receipts of the system for the year ending Oct. 31, 1897, were $5,356,995, and the operating expenses $3,379,046, leaving as earnings from operation the sum of $1,977,949. This was sufficient to pay all fixed charges (including $1,200,000 guaranteed dividends on the stock of the Brooklyn City Railroad Company, and $153,549 paid to the Brooklyn Rapid Transit Company as interest on a part ($3,448,000) of the latter's outstanding bonds, representing its equity in the construction account against the Brooklyn City Railroad Company), and to leave a surplus of $89,529 as the result of the operations of the year.

In the combined system are found four power houses with an aggregate capacity of 24,000 h. p., 19 car houses, 2000 cars, and about 130 miles of overhead lines. During the past two years over $2,000,000 have been expended in reconstruction of track, in re-equipment and in additions to both track and equipment made necessary by the development of the city.

These general figures will give some idea of the problems of organization and administration involved in the management of this property, and will also form the basis for a judgment as to the character of the results which have been achieved by the present management. In 1895 a controlling interest in the property was purchased by a syndicate of bankers and capitalists, headed by ex-Governor Roswell P. Flower, with whom was closely associated Anthony N. Brady, of Albany, N. Y., whose street railway interests in various parts of the East are large and are constantly increasing. The syndicate selected, as the reponsible head for the consolidated properties, Clinton L. Rossiter, at that time identified with the New York Central Railroad. Mr. Rossiter was made President and General Manager, and was given absolute authority in all matters connected with the company's organization and the development of the system.

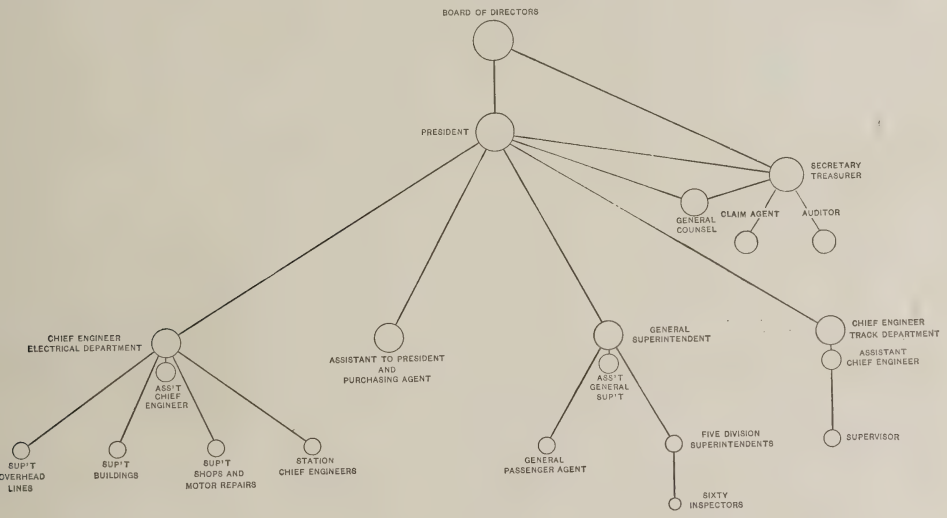


DIAGRAM SHOWING ORGANIZATION OF OPERATING FORCE—BROOKLYN RAPID TRANSIT SYSTEM

The scheme of organization as it exists to-day is shown in the accompanying diagram. The fountain head of authority is, of course, the Board of Directors of the Brooklyn Rapid Transit Company, which owns, as before stated, the entire capital stocks of the two operating organizations. The Board of Directors of the Brooklyn Heights Railroad Company is at present identical in composition with that of the Brooklyn Rapid Transit Company, and is the actual directing power of the combined properties.

The Board of Directors appoints two administrative officers, the President, and the Secretary and Treasurer. The President is responsible to the Board alone, while the Secretary and Treasurer is responsible to the Board and to the President in the conduct of his office. Col. Timothy S. Williams, who has been for several years well known throughout New York State in political and newspaper circles, occupies the position of Secretary and Treasurer, and has so organized his department as to be able to report at once upon practically any detail of operation desired, while the regular daily, weekly, monthly, quarterly and annual reports are made up within an extremely short time after the completion of the period reported upon. Colonel Williams' principal assistants are C. D. Meneeley, who occupies the position of Auditor, and P. M. Dyer that of Claim Agent.

One of the important duties of the Secretary and Treasurer is found in the settlement of claims for accidents and damages. Colonel Williams has entire authority to make settlements up to $1,000 in value, while larger amounts usually pass under the eye of the President and Executive Committee. The company's General Counsel, Sheehan & Collin, are responsible both to the President and to the Secretary and Treasurer, as is seen in the diagram.

The working force of the Secretary-Treasurer's office at present consists of two bookkeepers and eight clerks, their assistants; a cashier, three verifiers, twenty-one receivers, two clerks and two money-wagon men; a head of the transfer and secret service department, with forty-one employes engaged in counting, checking and distributing transfers (of which about 30,000,000 are issued and inspected annually); sixteen employes in the mileage department; and one ticket and lost property agent. The General Counsel and the company's claim department have at their disposal seventeen claim investigators. The President and the Secretary-Treasurer each has a private secretary and a stenographer.

The President controls the administration of the working force through four department heads, the Purchasing Agent (who also acts as Assistant to President), the General Superintendent, the Chief Engineer of the Electrical Department, and the Chief Engineer of the Track Department.

Lincoln Van Cott, now Purchasing Agent and Assistant to the President, was formerly the chief traveling auditor of the New York Central Railroad, and has had a long steam railroad experience. He is responsible only to the President, and has entire charge of the purchases of all supplies for construction and operation. In addition to these duties he is the President's personal agent in a number of administrative matters connected with the operation of the system. The working force of his office consists of two clerks only.

The General Superintendent, Ira A. McCormack, was formerly train master of the Lake Shore & Michigan

Southern Railroad. He has entire charge of traffic in all its phases, and reports directly to the President. W. W. Wheatley, formerly car accountant of the West Shore Railroad, is Assistant General Superintendent.

In securing and increasing traffic for the lines, the General Superintendent depends largely upon H. Milton Kennedy, General Passenger Agent, who has done excellent work in thoroughly advertising the system to the people of Brooklyn and New York. Some of Mr. Kennedy's special advertising plans, folders, etc., have been already described in the STREET RAILWAY JOURNAL, and are modeled quite largely after steam railroad practice.

In taking care of the traffic offered to the lines, the General Superintendent works through five Division Superintendents, and they in their turn have at their disposal a force of sixty uniformed inspectors, whose business it is to thoroughly understand the requirements of traffic every day and at all times during the day, and to handle the cars to the best advantage. They know the "habits" of every church, theatre, and place of amusement in the city, they understand the Coney Island traffic to a nicety, and they constantly have fingers on the public pulse to the end of bringing to the lines and properly handling the maximum traffic possible to obtain. As showing the character and experience of the men in Mr. Rossiter's organization, it may be said that William H. Blood, Division Superintendent of the Eastern Division, was formerly general superintendent of the Long Island Railroad; R. K. Haldane, Superintendent of the Suburban Division, and Miller Robbins, of the Central Division, have been identified with the Brooklyn Heights system for many years; and C. E. Harris, Superintendent of the Southern Division, and George Goodwin, of the Ridgewood Division, were selected from the old organizations as being specially fitted for these positions.

The entire subordinate force of the Traffic Department, exclusive of those already mentioned, consists at present of 14 office clerks, 14 depot masters, 1478 motormen, 1367 conductors, 41 starters, 42 switchmen, 25 transfer agents, 19 register takers and 37 depot men.

The Chief Engineer of the Track Department, J. C. Brackenridge, has charge of all new construction work and maintenance of roadbed. The Assistant Chief Engineer is J. H. Dwyer, and the Supervisor E. H. Packe. The Track Department has in its employ three engineers, each with one rodman, nine foremen of the working force, and one dockmaster and storekeeper. There are six draughtsmen and clerks in the office. The working forces varies of course during the year, but at the present time is about 600 men. The cost of maintenance of track in the year ending June 30, 1897, was $107,182 equivalent to $422 per mile of track, and .0041 per car mile, this figure covering of course both material and labor, but not including new construction.

The Chief Engineer of the Electrical Department is J. T. Whittlesey, and the Assistant Chief Engineer is R. P. Brown, who has direct charge of the power houses, line work and testing. The Chief Engineer administers the work of his office through the Superintendent of Overhead Line Work (and emergency crews), W. E. McManus; the Superintendent of Car Shops and Motor Repairs, David Moffatt; the Superintendent of Buildings, C. H. Bergen, who has in charge everything connected with the maintenance of buildings; and the chief engineers of the four power stations.

The entire subordinate working force of the Electrical Department consists of 48 men engaged in the maintenance of overhead lines, 423 men engaged in the shops and motor repairs, 187 men engaged in the power stations, car cleaners and 5 clerks in the Chief Engineer's office.

The gross receipts of the entire system for the year ending Oct. 31, 1897, amounted, as before stated, to $5,356,995, and the cost of the entire administrative organization, including general officers, heads of departments, principal assistants, etc., as set forth in the accompanying diagram (exclusive of the 60 inspectors), is now $80,000, equivalent to 1.5 per cent of the gross receipts.

The operating expenses of the entire system for the year ending June 30, 1897, were distributed as follows:

	Total.	Per Car Mile.
General Expenses	$ 454,689	.0174
Transportation Expenses	1,715,856	.0657
Maintenance of Track Line and Buildings	224,992	.0086
Maintenance of Equipment	372,522	.0143
Cost of Power (net for system)	273,410	.0104
Taxes	194,285	.0074
Insurance	17,038	.0007
Total	$3,252,792	.1245

The average cost of power produced in all the stations of the system for the year ending June 30, 1897, amounted to $.0062 per kilowatt hour, divided as follows:

Fuel and supplies	.0033
Labor	.0022
Repairs	.0006

It may be of interest to know that the working force of the Eastern (Kent Ave.) Power Station consists of one chief engineer, one assistant chief engineer, six engineers, forty-one pump men, firemen, ashmen and oilers, ten machinists, repair men and storekeepers, one foreman of the electrical machinery, and twelve dynamo and switchboard men, oilers, etc., a total working force of seventy-two men. The capacity of this station is 15,000 h. p., and it is well known to be one of the most economical in cost of power production in the United States, the total cost per kilowatt hour during the year ending June 30, 1897, being but $.005192.

IN tearing up a siding on the Straitsville division of the Baltimore & Ohio Railroad, the other day, the section men discovered that several of the rails had been made in 1863. Subsequent investigation revealed the fact that these rails were part of a lot that were bought in England during the war at a cost of $125 per ton in gold. The rails were still in very fair condition and for light motive power would last ten years longer.

ONE of the interesting features of the recent Brussels Exhibition was the electric tramway by which it is reached. Some forty motor cars are employed on the line, and they are equipped with two 25 h. p. Walker motors and controllers. The generating station is also equipped with Walker dynamos, the total capacity being about 150 k. w. Ornamental side poles with short arms carry the trolley wires, but as the trees along the boulevard grow these will be almost entirely concealed. On one of the services which traverse the route, buffet cars are attached to the motor cars, and light refreshments are to be obtained en route. This is certainly an innovation in electric tramway service and is probably the first instance of a dining car on an electrically drawn train.

AN interesting experience occurred on the line of the Metropolitan Traction Company in Washington, D. C. last month. As the result of a heavy rain storm a stretch of track, some 150 ft. long on F Street line, became completely flooded, the water filling and overflowing the conduit as it was unable to run off by the usual sewer connection which was cut off. According to the statement of Mr. Weaver, president of the road; although the conduit was completely filled with water for nearly two hours, the station was not short circuited, nor were the water rheostats called into requisition. The normal load of the feeder for the section is 300 amps, the load during the time the conduit was flooded, was 600 amps, and the cars were also operated on the sections on both sides of that which was under water. The water was practically pure and this partially accounts for the small additional load.

LETTERS AND HINTS FROM PRACTICAL MEN

Criticism of Doctor Emery's Paper on "Engines for Electric Traction"

EDITORS STREET RAILWAY JOURNAL:

The collateral portion of the communication of Mr. John S. Raworth in the *Electrical Review* of Oct. 20, 1897, which shows the taste of the critic by the tone of his criticism, can well be passed by without remark. The principal feature of the technical portion of the criticism is, however, calculated to impart erroneous views. The critic accuses me of "reproducing the commonplace American fallacies, the leading and most serious one being that an engine for traction purposes must be especially strong in its working parts," and then he correctly quotes from my article the following: "Its entire construction must be proportioned to stand the racking due to continued repetition of shocks." The critic continues: "This oft-repeated fallacy would be amusing were it not for the fact that it is too often believed and, worse still, acted upon; whilst all the time the fact remains that *there are no shocks and no excessive strains.*" The latter remarkable statement the critic attempts to prove by instructing myself, and Americans in general, that the initial pressure in an automatic cut-off engine is substantially constant, and then in a long involved sentence referring to "changes in the rate at which power is being generated," when power itself is the rate of work, states what I understand to mean that the variations of power developed in the cylinder from "maximum to minimum, say, from two to six times per second" are (the quotations are from the letter of the critic) "far more rapid than can possibly be produced by changes of external load." The critic cannot mean to be taken seriously in making such a statement; he must know that if a dynamo directly connected to an engine be short circuited, its speed is materially checked by a load applied with lightning rapidity. Necessarily the fly wheel tends to twist the engine shaft, and all the moving parts of the engine are brought up with a shock instead of being changed in direction smoothly by a crank motion. It is a mere question of degree when heavy loads are thrown on electrically. Again, in releasing a load suddenly, the elasticity of the parts and their weight also produce shocks, as every piece of metal transmitting the load is within certain limits a spring. Again, if there be any side strains due to overhanging cranks not balanced in one bed plate, as stated in the paper, the amplitude of the lateral movements caused thereby will be proportioned to the time in which the maximum force is applied; that is, they will be greater for heavy loads than for light ones. The question hardly needs discussion. Every one familiar with the subject knows that engines are strained more under varying loads than under steady loads, and I am therefore content with the statement in the original article, and refer to the criticism only to avoid the impression that any modification is needed.

CHAS. E. EMERY

[The letter to the London *Electrical Review* referred to, in the above communication, by Doctor Emery, is reproduced herewith in full.—Eds.]

ENGINES FOR ELECTRIC TRACTION

I regret to have to call your attention to a serious danger which at the present time threatens our young English electrical engineers, due to the extensive circulation in this country of an American publication devoted to street railway interests.

If the writers in that journal were content to enumerate the miles of tramline, of which the cars are driven by electric transmission of power in the various cities of the Union, and other triumphs of the electrical engineer, no harm would be done, but when they descend or ascend to the production of educational articles on "Engines for Electric Railway Power Stations," the danger is exactly proportional to the amount of faith which the fine printing and beautiful pictures of the said journal may excite in the minds of its readers.

We are now entering upon an epoch of great activity in electric traction, during which some millions of pounds sterling will be expended on steam and electrical machinery; after the first year or two, the spending of the greater part of this money will devolve upon our indigenous engineers, and the breadth of their intelligence and education will determine whether capital will be economically employed, or whether it will be recklessly squandered as it has been in the United States.

England is a rich country, but is not rich enough to afford waste of any kind, least of all waste of engineering labor and material at a time when the total productive power of the country cannot keep pace with the demand.

The writer of the above-mentioned article on "Engines for Electric Railway Power Stations," is Charles E. Emery, Ph. D.

No direct evidence is apparent as to the grounds on which the worthy author was created a doctor of philosophy, but there is abundant circumstantial reason for believing that his versatility in the use of the American language must have weighed well with his examiners. In the course of the article he succeeds in working up the verb "to operate" to a grand total of fifty-seven times.

This, however, is merely average American journalese, but when the doctor had fairly warmed to his work, he grinds out some of the finest flours of emery composition that are to be found in contemporary literature.

For instance, here is a gem:

"The side thrust on the engine frame is at the level of the center of the cylinder. It may be resisted where the bedplate or legs of the engine frame join the foundation, if that be immovable, but it is comparatively narrow and frequently rests on earth, which is slightly flexible, instead of rock, so that the lateral force, relatively small though it be, operating at a height of 8 ft. to 12 ft. above the foundation, does rock the foundation and the engine upon it slightly in lateral direction, or at least give them a perceptible lateral jar as full pressure steam is taken at the beginning of a stroke."

After reading the above paragraph your young friends will feel like the Queen of Sheba, there will be "no more spirit in them," for under no circumstances can they hope to beat it.

When, however, the worthy doctor descends to the consideration of mechanical problems his genius leaves him and he contents himself with reproducing the commonplace American fallacies, the leading and most serious one being that an engine for traction purposes must be specially strong in its working parts, "its entire construction must be proportioned to stand the racking due to the continued repetition of shocks."

This oft-repeated fallacy would be amusing were it not for the fact that it is too often believed, and, worse still, acted upon; whilst all the time the fact remains that there are no shocks and no excessive strains.

Every automatic expansion engine takes practically the full boiler pressure at every stroke, whether the load be light or heavy, and in every stroke the total pressure commences at maximum and falls to minimum, consequently in the normal working of such an engine under constant load, the changes in the rate at which power is being generated per inch of travel of piston varies from maximum to minimum, say from two to six times per second; that is to say, the variations are far more rapid than can possibly be produced by changes of external load.

But suppose an excessive load be suddenly thrown on the dynamo and the engine be called upon to give off its maximum power, does not that strain it? Certainly it increases the torsion on the crankshaft and the wear on the bearings for a minute or two up to, but not exceeding, the amount of the similar effects in electric lighting engines, which are usually worked steadily at full power. Take the Willans engine, which is lightly built; it is quite common practice to have several of these engines at work for hours every day, with the stop valve fixed wide open, developing their absolutely maximum power; and moreover doing it with complete satisfaction to everybody. Now if one of these engines were put on to a traction load all the variations would obviously be reductions of power, and consequently the torsion on the shaft and the wear on the bearings would be less with the varying load than with the maximum load.

I regret to have to trespass on your valuable space simply to kill a dead dog, but this particular dog has a habit of getting up and wagging his tail after each successive killing, nothing less than cremation will ever settle him.

After all that has been said, correctly or incorrectly, about strains or shocks, there remains a very serious possible trouble which may, and often does, arise out of a sudden variation of load —this is the formation of water in the cylinders and receiver when the load is suddenly increased.

The first effect of an increase of load is to cause the governor to raise the mean pressure and with it the mean temperature of the steam passing through the engine. This steam striking against surfaces at a lower temperature is partially condensed and throws down water to an extent which, in long stroke engines, may be serious. The strains caused by even small quantities of water in the cylinder are very violent and often desrtuctive, therefore an engine to be suitable for traction purposes should have good drainage and sufficient clearance. Corliss and slide valves give the greatest safety, whereas piston valves give no natural relief to the water, which can only get out through the spring valves. Steam jackets applied to the cylinders and receiver provide an absolute cure.

From one point of view, Dr. Emery's article is excellent. It gives a good bird's eye view of American practice in horizontal engines, and the pictures are admirable. His next article, which is promised for January, 1898, will be awaited with interest.

Oct. 26, 1897. JOHN S. RAWORTH.

Exchanging Kinetescope Films

THE KINGSTON, PORTSMOUTH & CATARAQUI ELECTRIC RAILWAY COMPANY

KINGSTON, ONT., Sept. 6, 1897

EDITORS STREET RAILWAY JOURNAL:

We have used an animated picture machine in our park this year with considerable success; it has proved the best paying attraction we have yet put on. We bought the machine outright, and believe that other companies have done the same, but as the cost of exchanging films is almost prohibitive, we suggest that companies owning machines and films might form an exchange bureau, and thus be able to furnish a change of views at small expense. We should like to hear from any who have purchased these machines, their opinion of the plan stated.

Yours truly,
J. HALLIDAY, Electrician.

Power Station Economies

NOV. 15, 1897.

EDITORS STREET RAILWAY JOURNAL:

In looking over the papers read at the Niagara Falls convention, I was struck with the very able paper of Colonel Heft, and especially that part referring to the economy of the power plant. I find upon close observation that the economy referred to is not attributed altogether to design, but to special circumstance and conditions, among which are burning sparks which cost seventy cents per ton. It is possible, however, that enough seventy cent sparks may have to be used that would pay for a better grade of fuel. The cheapest fuel is not always the best. Let us see. The average cost at the three stations referred to, according to report is three mills per horse power or four mills per kilowatt hour using sparks. This is very good and would be welcomed by many an electric railway manager.

But the cost has been considerably lowered by lowering up the engines to maximum load. The plant appears to me to be an ideal one in which to install a storage battery, as the difference between ordinary running and full load is from 33 to 36 per cent.

I believe that a good grade of fuel would give, however, equally as good results if not better. In support of this let me refer to the STREET RAILWAY JOURNAL, Jan., 1897, where an article on the cost of power from the able pen of L. D. Tandy will be found. In this a plant is mentioned doing ordinary railway work and developing 1 k.w. hour for 2.8 mills, using coal costing $2.40 per ton.

Again, referring to "Power" for November, 1897, I find a "comparative test" recorded, between direct connected compound condensing and belt driven single condensing. The cost per kilowatt hour on the compound condensing engine was 3.4 mills, coal at $2.55 per ton.* So I find what appears sometimes good practice and close management is after all a circumstance or a condition.

To draw comparisons in railway work is very uncertain, as the conditions of every road vary so much. But the more we can get practical men to give their experience and methods, and like Colonel Heft to do so openly and above board, we shall be greatly benefiting each other in this comparatively new field of labor.

A READER.

*This test is given elsewhere.

The Civil Service System of Discipline

CANAL & CLAIBORNE RAILROAD COMPANY,
NEW YORK, Nov. 9, 1897.

EDITORS STREET RAILWAY JOURNAL:

After reading with very great interest your valuable and comprehensive issue of the Journal for November, 1897, I desire to call to your attention the editorial referring to the methods of discipline of the Canal & Claiborne Railroad Company of New Orleans, La., as the "Brown system." In the paper recently read before the American Street Railway Association by myself, the system used by us was outlined in detail and nothing but the ordinary methods of civil service, as applied by the government, extended and modified, to conform to the practical conditions of street railway operation have been used. We use absolutely no feature of the "Brown system," except that we keep a record of each employe's work. We do not attempt to abolish suspensions. We always suspend an employe immediately after the occurrence of a serious irregularity, he remaining off duty until a careful investigation can be made.

The main feature of the competitive civil service system, as applied by us, is *competition* with the resulting promotion and betterment of the employe, and the consequent improvement of the service. We strive after the highest *efficiency* and *education* of employees, discipline alone being a small part of the consideration, since it naturally follows and must be a part of efficient service.

I believe if you will carefully consider the two systems as applied, you will find that they have little connection. I think that you will also find in the modifications and additions which we have made to the government civil service system, as outlined in my paper, to meet the requirements of street railway operation, the first instance of such application and so far as we know the only one now in use. GEORGE H. DAVIS.

Time Killing in the Shop

NEW YORK, Nov. 10, 1897.

EDITORS STREET RAILWAY JOURNAL:

During a recent visit to a street railway repair shop in a neighboring city, I could not but notice the extreme deliberation displayed by the workmen. It seemed as if they were all trying their hardest to do as little as possible in the way of useful work. A man was melting the old babbitt out of some motor boxes, preparatory to relining them. He would walk out into the next room, pick up one box, and return with it to his forge, where he would melt the babbitt from that box, clean it, and then go into the next room again for another box, and would then go through the same operation with that one. By putting a half dozen boxes into the lead kettle, he could have done them all in about the time it took to do one. Another man was burning off the paint from sheet iron dashboard signs. He, too, would walk 50 ft., get a single sign and carry it to his fire. There he would heat a small portion of one end, then heat another portion, taking six heats to each sign, and there was a large pile of them on the floor to be burned off.

It would pay, in a case like this, to build up a little brickwork around the fire, leaving just room inside the brick for three or four of the signs to be slipped in edgewise. A dozen could be burned off by this inexpensive rig while two were being burned off in the time killing way that was followed.

There was a great deal of similar doings in this shop; about all the men seemed to want to make a job last as long as possible. It will pay for the management to keep an eye on the shop where such things are going on, for the time that is lost in a year by "sojering" would much more than pay for a good man who could keep everybody at work. Something is wrong with the foreman of that shop; he needs *exchanging*. OBSERVER.

LEGAL NOTES AND COMMENTS*

EDITED BY J. ASPINWALL HODGE, JR., AND GEORGE L. SHEARER,
OF THE NEW YORK BAR

CHARTERS, ORDINANCES, POWERS, ETC.

NEW YORK.—Plaintiff boarded a car on defendant's street railway, and paid his fare. Before reaching the point to which plaintiff wished to go, the car stopped, and the conductor directed plaintiff to take the next car, as the one he was on went no further. Plaintiff boarded the next car while the conductor was inside, and, upon his returning to the platform, he demanded fare from the plaintiff, and, upon plaintiff's refusal to pay it put him off the car. *Held*, that this was not an attempt to exact more than the legal fare, within the meaning of section 39 of article 2 of the general railroad act, and gave the plaintiff no right of action for the penalty therein provided.—(Stewart & Met. St. Ry. Co., 46 N. Y. Supp. 44.)

MISSOURI.—An electric street railway laid at grade is not an additional servitude, and does not impair the property rights of abutting owners.

A general allegation that the construction and maintenance of a street railway will injure plaintiff in a manner different from the inconvenience suffered by the public and other abutting property owners, without stating any substantive facts, is a mere conclusion, and affords no ground for injunctive relief.—(Placke & Union Depot Ry. Co., 41 S. W., Rep. 915.)

NEW YORK.—The consent by a city to street railroad company to run its cars at such speed as shall enable it to secure to the public better and more speedy transit, such speed not to exceed ten miles per hour is not a contract between the city and the company that it should always thereafter have the right to operate its cars at the rate of ten miles an hour. The general railroad act would seem to prohibit such a contract, and it is doubtful whether the regulation of the rate of speed of cars in streets could be the subject of a contract by the legislature or the common council.—(City of Brooklyn, Nassau Electric Ry. Co., 46 N. Y. Supp. 651.

FLORIDA.—The well-established rule is that a municipal corporation can exercise only such powers as are granted to it in express terms, or those necessarily or fairly implied in or incident to the powers expressly granted. or those that are essential and indispensable, not simply convenient, to accomplish the objects and purposes of the corporation.

The powers conferred upon cities and towns by the general act (section 17, p. 248, McClel. Dig.) to regulate, improve, alter, extend, and open streets, lanes and avenues, and to cause encroachments and obstructions, decayed buildings and ruins to be removed, did not authorize the municipal corporation of the city of Ocala to vest, by contract, in a street railway corporation, an exclusive right to construct railroad tracks on all the streets of the city as then laid out, or that might thereafter be laid out for a period of ten years.—(Florida Cent. & P. R. Co., v. Ocala St. Ry. Co., 22 South. Rep. 692.)

MISSOURI.—The privilege of laying its tracks on designated streets, to run cars theron and to receive fares, are franchises of a street railroad company, though derived directly from the city under ordinances passed under the grant of power contained in the city charter.

The fact that such franchises are, in a sense, contractual in nature, is not a barrier to a proceeding by the state by quo warranto on the relation of the city to oust the company of its franchises, though there is an ordinance provision that, in case of default by the company, a forfeiture of its franchises may be had by proceeding instituted by the city in its own name.

A proceeding in equity is not the proper remedy to enforce the forfeiture of a franchise.

There is such a non-user of its franchises as warrants a judgment of forfeiture where a street railway company, required by ordinance to run its cars sixteen hours every day, totally neglects its duty and runs no cars for three years.

A city cannot contract with a street railroad company, by ordinance or otherwise, that non-user of its tracks for a specified period shall not operate as a forfeiture of its franchises.

Nor can the city take away the state's right to proceed by quo warranto for ouster of the company's franchises on the ground to forfeiture, by providing by ordinance that if proceedings by the city are not begun within six months after a forfeiture has accrued, the city shall be deemed to waive the effect of such forfeiture.—(State v. East Fifth St. R. Co., 41 S. W. Rep. 955.)

NEW YORK.—Section 91 of the "Railroad Law," providing that a street railroad shall not be built, extended, or operated without the consent of the owners of one-half the property on the line and of the local authorities, is to be construed with section 102 of the same law, providing that a street railroad shall not be constructed, extended or operated in a street in which another railroad is constructed without the consent of the corporation owning the latter-but that one street railroad company may obtain, upon application to the court, the right to use the tracks of another company for a distance less than 1000 ft. The latter does not provide an alternative right, but is an additional requirement, and, in order to obtain the right to operate its road over the tracks of another company, under section 102, a street railroad company must first obtain the consent of the property owners and of the local authorities.

When a railroad company runs its cars over an extensive route, receives its own passengers and collects its own fares, it is operating its own road throughout, though its cars, for a part of the distance, run over the tracks of another company, and such operation, as well as the laying of tracks, is prohibited by section 18 of article 3 of the constitution, and by section 91 of the railroad law, unless the consent of the property owners along the line and of the local authorities is first obtained.

The consent of the abutting property owners and of the local authorities to the construction and operation of one street railroad is not sufficient to authorize the use of the tracks by another company for the operation of its road, even though the first company acquiesces, but such consent must be obtained for the operation of the second road.—(Colonial City Tr. Co. v. Kingston City R. Co., 47 N. E. Rep. 810.)

CONNECTICUT.—Pub. Acts 1893, c. 169, § 8, forbids any street railway to be constructed or extended from one town to another in the public highways, so as to parallel other street railways or steam railroads, except on application to the superior court, or a judge thereof, and a finding that public convenience and necessity require such construction, and provides that the decision of the trior on this question shall be final and conclusive. *Held*, that a judgment on such application is not subject to review, unless the special jurisdiction conferred by the act has been exceeded, or the methods of judicial procedure essential to the due course of law have been violated.

The applicant's financial ability to build the proposed road being a circumstance to be considered in determining whether public convenience and necessity require its construction, the trial court does not exceed its jurisdiction, or violate essential methods of judicial procedure, by receiving evidence upon that point, and finding as a fact that the applicant has not such ability.—(In re Shelton St. Ry. Co., 38 At. Rep. 362.)

CALIFORNIA.—Where a street railway franchise has become forfeited by failure to perform the conditions on which it was granted, the city granting such franchise cannot waive such forfeiture, or be estopped to claim it, as the power to institue an action to declare forfeitures is vested in the attorney general.

Civ. Code, § 502, fixing the time within which a street railway for which a franchise may have been granted must be completed, and declaring a forfeiture if not completed within such period, was amended, in 1895, by an act repeating the language of the former law as to the time within which the work must be done, and as to forfeiture, and authorizing the board granting such franchise to fix such time, and to extend the same, and also providing that such "act shall not effect any franchise or right of way granted before its passage." *Held*, that such provisions as to the time within which the work must be done, and as to forfeiture, were not thereby repealed and re-enacted, so as to defeat a right of forfeiture arising before the amendment.

Where it appeared that defendant merely pretended to operate its street railway, by running one car over the tracks every day, merely to hold the franchise, and without intent to accommodate the public, nonuser was sufficiently shown.

Where a street railway franchise had been granted for ten years and the track had been laid on a street in a thickly-settled portion of the city for more than six years, and such franchise was held solely for other purposes than the accommodation of the public, a fine of $5000 was not unreasonable.

*Communications relating to this department may be addressed to the editors, Johnston Building, 30 Broad Street, New York.

McFarland, J., dissenting.—(People v. Sutter St. Ry. Co., 49 Pac. Rep. 736.)

New York.—By-Laws 1854, c. 140, the legislature conferred upon the E. R. R. Company, a corporation incorporated under the general railroad act, a franchise to operate its road in the city of New York; the fee of some of the streets through which it was to run being in the city. By-Laws 1874, c. 478, the legislature required the E. R. R. Company to extend its tracks through certain streets, to run its cars thereon as often as public convenience should require, and provided that, when the extension should be completed, the company should use, maintain, and operate its railroad, during the term for which it was incorporated, upon and along the streets on which its railroad was already in use, and upon and over the extension. *Held* that, as the legislature had power to confer a franchise, both for the building of the new lines and for the operation of the road over the old tracks, and to subordinate any right or interest of the city of New York in the streets to the operation of such public use, any rights in respect to the railroad of the company, acquired by the city by contract or otherwise, which were inconsistent with the grant of the act of 1874, including a right claimed to belong to the city to acquire possession of the road, were at least suspended during the period for which the company was directed to operate its road; and the company could not be restrained from making improvements to its road, for which it had acquired the necessary consents of property owners and public authorities, on the ground that such improvement would impose an additional burden on the exercise of the city's alleged right.—(Potter v. Collis 46 N. Y. Supp. 474.)

PATENT DECISION

The Green Patents Nos. 465,407 and 465,432 for improvements in electric railways whereby the rails are employed as conductors and the wheels of the car as a means of maintaining continuous electrical connection between the rails and the motors, if valid, are not infringed by the ordinary overhead trolley construction.—(Kelly v. Springfield Ry. Co. 81 Fed. Rep. 617.)

LIABILITY FOR NEGLIGENCE

Indiana.—Where the nature of an accident discloses that an injury to a passenger might as well have happened through his own negligence as that of the common carrier, the fact of the injury raises no presumption that the carrier was negligent.

The fact that a street railway company carries a passenger beyond his stopping place, whether negligently or not, does not excuse his negligence in attempting to alight further on.

Plaintiff gave notice too late to have a street car stopped at a crossing where he desired to alight, but the car slowed up in an unsuccessful attempt to stop there, and thereafter, while standing upon the platform of the car, which was moving between crossings, and in attempting to change his position from the platform to the step below, preparatory to alighting, he was thrown from the car by the gradual increase in its speed. He knew the rule of the company that the cars stopped for passengers at street crossings only. *Held*, that the company was not negligent.—(Dresslar v. Citizens St. R. Co., 47 N. E. Rep. 651.)

Michigan.—Plaintiff having been injured while in the front end of an open street car that ran into a car in front of it, a witness, who was in the rear end of the front car, and saw the rear car coming, may testify as to what he and other passengers did when the collision became imminent, as a part of the res gestæ, on the question of plaintiff's contributory negligence in jumping off.

A motorman, while running a car with no defect in its appliances, and while the track was in good condition, collided with a car ahead that had stopped. He knew nothing of his duties forty-one days prior to the accident, and had spent only nine days in learning. He had read the book of instruction only once, and did not know whether, at the time of the accident, he knew he was bound to keep 200 ft. from the car ahead. *Held* proper to submit the question to the jury as to whether he was inexperienced and incompetent.—(Holman v. Union St. Ry. Co., 72 N. W. Rep. 202.)

California.—In an action for the death of a son four and a half years of age, it appeared that plaintiff lived about 100 ft. from the street on which defendent operated its electric railway, to which deceased had been admonished not to go; that on the occasion in question the boy came in fifteen or twenty minutes before the accident, and was told not to go out, but went, got on the track, and was killed. *Held*, that such conduct on the part of the mother did not constitute negligence per se.

Though such conduct should constitute snch negligence, it would not be conclusive against plaintiff's right to recover, where there was evidence that such child went on the railway track a sufficient distance in advance of the approaching car to have enabled those in charge thereof, by the exercise of ordinary care, to have stopped before striking him.

Where plaintiff's cause of action rested solely on his right to recover for the loss of the services of his child resulting from his death, a verdict for $6000, for the death of a boy four and a half years, ordinarily bright, healthy, affectionate and obedient, whose expectancy of life, if realized, would have carried him considerably beyond the age of majority, was excessive.—(Fox v. Oakland Cons. St. Ry., 50 Pac. Rep. 25.)

Maine.—The plaintiff, in alighting from one of the defendant's open cars of a horse street railway, accidentally stepped on a rolling stone lying in the street between the car and the sidewalk, and received an injury to her ankle.

Held that, in determining the question of the defendant's negligence, it is proper to consider that the company could not select the places in the streets where its track should be laid or its cars run. It could not construct nor control any places at which passengers were to step on or off its cars. It had to locate its track and run its cars where the public authority directed. It had to leave the center, sides, and surface of the streets to the same authority. Passengers entering or leaving the cars had to use the streets in the condition in which they were left by the authority in control of them. Such passengers were not in the care of the company till they got on the car. They were no longer in its care when they stepped off the car. And in this case the defendant's cars were drawn by horses, and operated without regular stations or established places for passenger to get on and off the cars.—(Conway v. Lewiston & A. H. R. Co., 38 At. Rep. 110.)

Tennessee.—A driver of a vehicle, before attempting to cross an electric street railway track at a street intersection, is not bound at his peril to know that a collision will not occur, and need only make such observation and acquire such information as would convince a reasonably prudent man, in a like situation, that the passage could be made in safety.—(Saunders v. City & Suburban R. Co., 41 S. W. Rep. 1031.)

Missouri.—In an action for causing the death of plaintiff's child, where it appeared that such child, in the absence of its father, and while its mother was engaged in conversation on a business matter, temporarily escaped from her presence, and was run over by a cable car, and there was evidence that the accident might have been avoided by due care on the part of defendant's gripman, the negligence of the parties was properly submitted to the jury over defendant's request for an instruction for a verdict in its favor.

There was no error in permitting witnesses to testify that there were no obstacles to prevent defendant's gripman from seeing plaintiff's child as it approached the railway track, and also to state which way such gripman was looking at the time of the accident.—(Levin v. Met. St. Ry. Co., 41 S. W. Rep. 968.)

New York.—Plaintiff approached street railway tracks, driving at the rate of 8 miles per hour. When his horse was 5 ft. from the eastern track, which was nearest to him, he noticed a car from one-half to three-fourths of a block away, approaching on the western track. When half way across that track, the car had come to within 18 ft. of him, and was moving so fast that he could not cross before it struck the hind wheels of the wagon. *Held*, that the questions of negligence and contributory negligence were for the jury.—(Hunter v. Third Ave. R. Co., 46 N. Y. Supp. 1010.)

New Jersey.—The conductor of a trolley car, who had undertaken to let off at a given destination the plaintiff, who was a stranger, carried him past it. He then let the plaintiff off on the company's right of way, and directed him to walk back on the track. While obeying this instruction, in the nighttime, the plaintiff followed the track onto a trestle, where he was struck by a car of the defendant, coming from the opposite direction. *Held*: That in giving this instruction the conductor was acting as the agent of the company; that whether he gave it, and whether it was an act of negligence, was properly submitted to the jury, as also was the question of the contributory negligence of the plaintiff in going on the trestle if so directed. *Held*, also, that if the plaintiff was warned by the conductor not to go on the trestle, he was guilty of contributive negligence; also that the motorman whose car struck the plaintiff was under no duty to be on the lookout for pedestrians on the trestle.—(Young v. Camden G. &. W. Ry. Co., 37 At. Rep. 1013.)

Massachusetts.—Defendant's street car had a closed end, with a window, out of which the conductor could lean in replacing the trolley on the wire after passing a low bridge. Plaintiff, an experienced conductor, in order to more easily make the connection, stepped behind the car and stood on the bunter, when he was thrown off, at a place where he knew the track was uneven, by a jolt which he testified was more severe than usual. *Held*, that plaintiff could not recover.—(McCauley v. Springfield St. Ry. Co., 47 N. E. Rep. 1006.)

New York.—Plaintiff was thrown from a wagon by another person by a collision with a cable car of defendant at a street crossing. The court charged that it was not negligence to attempt to cross in front of a car if more than 50 ft. distant, and if the car was capable of being stopped in the space of between 15 and 25 ft., leaving it to the jury to determine those facts. *Held* error.—(Cass v. Third Ave. R. Co., 47 N. Y. Supp. 356.)

U. S. Court.—In the absence of proof that either of two

street railway companies had any right, by usage or otherwise, of precedence at the intersection of their roads, the law presumes that they stood on a footing of equality, each owing to the other the duty of exercising reasonable care.

The servants in charge of a street car were negligent in attempting to cross the track of another company at the point of their intersection when they saw, or should have seen, that a car of that company, of which plaintiff was in charge, was already in motion, and that a collision would probably result.

Though the plaintiff's view of defendant's car was temporarily obstructed by an intervening object, plaintiff was not negligent in attempting to cross the intersecting track, as he had the right, having first put his car in motion, to rely on the fact that the servants in charge of defendant's car would not attempt to make the crossing until it should be safe to do so.—(Met. St. R. Co. v. Kennedy, 82 Fed. Rep. 158.)

NEW YORK.—Where plaintiff was thrown out of a wagon by a collision with a street car through his own negligence, it does not prevent him from recovering if he is rendered unconscious thereby, and lying on the track, is run over thereafter by another car, the driver of which does not use due care.—(McKeon v. Steinway Ry. Co., 47 N. Y. Supp. 374.)

NEW YORK.—Where disinterested evidence shows that plaintiff, a passenger on a street car, alighted while the car was in motion, after a signal by the conductor to stop, a verdict for plaintiff will be set aside, though she states that the car came to a full stop, and started while she was attempting to get off.—(Pierce v. Met. St. Ry., 47 N. Y. Supp. 540.)

MISSOURI.—W. was the foreman of a company operating a cable street railway. It was his duty to see that the cars were started on their regular trips in the morning, with the proper men in charge. He directed the movements of the men, and manipulated the grip, if necessary, in getting a train in position for the start. With the gripcar standing on the main track, and coupled with a trailer on the side track leading from the car house, W. undertook to move the train. It was about to enter on its first trip of the day, and had not yet been turned over to the employes. At that moment the gripman attempted to pass from the trailer to the gripcar, and the car started so abruptly that the gripman was thrown off, and in the way of a train on a parallel track. The catching of the cable demanded W.'s close attention, and he had also to keep a lookout ahead. *Held* that, as a matter of law, W. was not chargeable with want of ordinary care towards the gripman.—(Keown v. St. Louis R. Co., 41 S. W. Rep. 926.)

PENNSYLVANIA.—In an action for injuries to a woman by falling from an open street car, the evidence for plaintiff was that the car collided with a cart, and passed on rapidly, not being under control, and that after it had gone about 230 ft., and the speed had been slackened, plaintiff fell from the side of the car; there being no evidence of any jerk of the car, or other cause for her fall. For defendant, two passengers testified that, just before she fell, plaintiff was standing, though she had been warned to keep her seat. *Held*, that a binding instruction for defendant should have been given.—(Jackson v. Phil. Tr. Co., 37 At. Rep, 827.)

NEW JERSEY.—The fact that the electric company and the railroad company have an agreement between each other providing for a derailing switch on the tracks of the electric railway, as a precaution against collision at a crossing and providing also, in addition thereto, that before an electric car shall be permitted to pass over such crossing the conductor of the electric car who shall be operating such derailing switch shall look in both directions, and listen for the approach of the railroad train, will not excuse the railroad company from giving the statutory signals as a warning of such approach; and where the neglect to give such signal, in an action on the part of the railroad company against the electric company, appears as contributing to the collision, the railroad company cannot recover, notwithstanding the negligence of the conductor of the electric car in operating the derailing switch, and his neglect to look in both directions, and to listen for the approach of the train.—(N.Y. & G. L. Ry. Co. v. N. J. El. Ry. Co., 37 At. Rep. 627.)

RHODE ISLAND.—A declaration against a street railroad company alleging that it is so carelessly operated one of its cars that without plaintiff's fault, it ran against his wagon, injuring him, is sufficient on demurrer, though it does not state in what particular defendant was negligent.—(Goldrick v. Union Ry. Co., 37 At. Rep. 635.)

NEW YORK.—A child about six years of age sued for damages from injuries caused by being run over by a trolley car. The evidence showed that the car was from 50 to 100 ft. away when plaintiff left the sidewalk, but there was a conflict of testimony as to whether a wagon upon the track intercepted the motorman's view of the child. The car was going at such rate of speed that it was stopped in a little more than its own length. *Held*, that there was evidence to sustain the verdict.—(Muller v. B'klyn Heights R. Co., 45 N. Y., Supp. 954.)

NEW YORK.—Where plaintiff's daughter, 10 years old, jumps from an electric car because of a blaze of fire coming from alongside of the motorman, which blaze was so great that it was noticed 50 or 60 ft. away, it is sufficient to authorize the jury to infer negligence on the part of the defendant, and it was error to dismiss the complaint.—(Poulson v. Nassau El. Co., 45 N. Y. Supp. 941.)

NEW YORK.—It is a question for the jury whether defendant's electric car was negligently started when it gave such a jerk that plaintiff and others who were standing up were thrown on the floor, and a motorman testifies that the proper way to start a car is to apply the power gradually, in which case no one who is standing up will be thrown down.—(Grotsch v. Steinway Ry. Co., 45 N. Y. Supp. 1075.)

PENNSYLVANIA.—Where the motorman was able to stop an electric car within about its length, when halfway between two cross streets, its speed was not sufficient to justify a finding of negligence of the motorman, causing injury to a child struck by the car.

Where an electric car struck a child which suddenly went from the sidewalk onto the car track at about the middle of a block, and there was no one on the last cross street to be warned, and no one to get off or on the car at that point, the failure of the motorman to sound the bell at such street was not negligence.—(Kline v. El. Tr. Co., 37 At. Rep. 522.)

NEW YORK.—A finding that defendant's street car driver was negligent in not stopping the car before it ran over plaintiff, a child three years old, is sustained by evidence that, as the car approached the place of the accident, plaintiff started to cross the street, and was about 10 ft. in front of the horse when she reached the outer rail; that she was knocked down by the horse, and the front wheel of the car passed over her; that the driver was looking towards the opposite side of the street at the time; and that the car was running about 5 miles an hour, but could have been stopped within 12 ft.

Van Brunt P. J., dissenting.—(Nugent v. Met. St. Ry. Co., 45 N. Y. Supp. 596.)

NEW YORK.—A street railroad company is liable for injuries to a passenger after she left the car, where the injuries were caused by the negligent placing in the street of rails taken from the track in making repairs, which rails it was necessary to cross in reaching the sidewalk.—(Wells v. Steinway Ry. Co.)

MASSACHUSETTS.—It appeared that the plaintiff was a passenger on defendant's street car; that at a crossing where the car always stopped a passenger on the rear platform rang the bell; that the conductor was inside the car, and called the crossing, and nodded to plaintiff, who had already told him that she wished to stop there; that many passengers rushed out, plaintiff being about the last; that as she was about to step from the platform the same passenger who rang the bell for the stop rang the signal to start, and plaintiff was swung off by the sudden starting of the car. The conductor testified that he heard neither signal, and had not authorized the passenger to ring the bell, but there was evidence that passengers sometimes rang the bell to start, as the conductor knew. *Held*, that it was a question for the jury whether defendant had failed in its duty in not taking greater precautions to prevent its car being started before plaintiff had time to get safely off.

Evidence tending to show a habit of passengers on defendant's road to give the signals for stopping and starting cars was competent, because defendant had reasonable cause to know anything that was habitually and openly done in its cars, and the evidence bore directly on the question of defendent's due care in permitting, or failing to guard against such acts.—(Nichols v. Lynn & B. R. Co., 47 N. E. Rep. 427.)

MASSACHUSETTS.—Negligence and contributory negligence are questions for the jury where a girl nine years old, after waiting for a street car to pass, looked in both directions, and, seeing no car approaching, went on the track, and was struck by a car going in the opposite direction from one which had just passed, and which was running 10 or 11 miles an hour, no gong being sounded, and the street being a much frequented one.—(Rosenberg v. West End St. Ry., 47 N. E. Rep. 435.)

KENTUCKY.—The facts that a car has stopped at the side entrance of an hotel, that the bell has rung, and that a number of the passengers have arisen from their seats and started for the door to get out, justify a passenger in acting on the assumption that he was expected to alight.

In an action to recover for injuries received by plaintiff while alighting from a street car, though the petition avers that the car was stopped for the purpose of allowing plaintiff to get off, he may recover on the hypothesis that it was stopped under such circumstances as to justify him in believing it was stopped for that purpose.—(Belt El. L. Co. v. Tomlin, 40 S. W. Rep. 925.

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THE STREET RAILWAY JOURNAL for 1898 will be conducted on broad lines—broader even than in the past. The building of new tramways and the rapidly extending use of improved motive powers abroad is constantly imposing additional responsibilities upon those who have to record the progress of the industry. American readers have a right to know the "new things" developed in the best practice of other countries, and foreign readers urgently need an adequate medium for the exchange of ideas and experience gained in conditions different from those found in America. Both American and European manufacturers need a quick and reliable international news service conducted according to modern methods.

* * * * *

The difficulties of thoroughly covering the street railway practice of all countries in a single publication have now become so great that we have decided to commence, in January, the regular monthly publication of an "International Edition" of the STREET RAILWAY JOURNAL, to circulate in all countries of the Postal Union, except the United States and Canada. The International Edition will contain that portion of the matter found in the American edition which is applicable to foreign practice, together with a number of special departments and features interesting to foreign readers, among these features being an enlarged "Digest of Contents" in German, French and Spanish. The American edition will be recast in form in such a way as to introduce a number of new departments and branches of inquiry of value to American readers. It is intended that nothing shall be omitted from either edition which will be of interest to those to whom that edition is especially directed. The STREET RAILWAY JOURNAL will have correspondents in the principal cities of every important country in the world, with instructions to send to our New York and London offices detailed information about the street railway happenings in their respective territories. Both American and International editions will have the benefit of this world wide news service.

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Among the contributors to the STREET RAILWAY JOURNAL for 1898 will be found some of the foremost engineers and technical writers on both sides of the water. Particular attention will be given to the following subjects:

Heavy electric railroading—progress and development in the electrical equipment of elevated, surface, steam and railroad lines.

Managing organizations of large street railway properties.

Street railway accounting.

Legal Decisions—a prompt report of all important cases and decisions.

Power station records and the cost of power production.

Street railway engines, boilers and accessory steam appliances in American practice.

Electric Railway Motors—a detailed comparison of the different types now in use.

Repair shop practice.

IN a paper read before the American Society of Mechanical engineers, Prof. W. S. Aldrich again urges the advantages of rating electric power plants upon the heat unit standard. The previous paper by Professor Aldrich, presented at the last meeting of the society, was referred to at length in these columns at the time of presentation, and in his present paper a number of additional arguments are brought forward by the author for consideration. He points out that the average performance of electric light and power stations is much less economical than those of pumping stations and other classes of power plants, and quotes the records of pumping stations, which if possible of duplication in electric stations would indicate the production of between 400 and 500 watt hours per pound of coal. He believes that this high economy is due to the adoption of heat unit specifications and to subsequent contract trials of pumping plants, and thinks it is not too much to expect that similar standard heat unit specifications and contract trials of electric power plants will advance this industry also along the same engineering lines. While the wide range of load variation in electric stations may have some effect on their efficiency, he quotes certain authorities to show that this factor need not be an important one in lowering the economy, so that it is doubtful whether all the blame for the poor showing in economy in electric power stations can be laid on steam engines. One practi-

cal difficulty of introducing the system, however, which the author does not seem to take into account, is that there are few previous records on this basis of power stations with which the results of any particular test can be compared. This difficulty, however, is one which is met in the introduction of any new system and if regarded would act as a bar to any improvement. It would not seem very difficult in making power station tests to determine both the ratio of the kilowatt hours to the pounds of coal burned and to the B. T. U. supplied, thus establishing a set of records which would aid in future comparisons.

THE extensive work of the Metropolitan Street Railway Company in underground conduit construction is referred to at length in another part of this issue. This undertaking is probably the most stupendous which has ever been carried out in electric railroading, and the successful completion of a large part of it is a subject of congratulation both to the engineers and managers of the railway company, and to the manufacturers who took part in supplying the equipment. A large portion of the engineering has been in a comparatively unexplored field, and the expense of installation has been correspondingly great. Others who may later instal a similar system will get the benefit of the experience and expenditure of the Metropolitan Street Railway Company, and while the number of cities in which the underground conduit will be laid will be limited, owing to its large initial cost, there will undoubtedly be some localities in which similar installations will be made, particularly in Europe.

* * * * *

An interesting side-light upon the actual working of an underground electric road, as proposed by the Rapid Transit Commissioners of New York, is given in the operation by the Metropolitan Street Railway Company of its line running through the Fourth Avenue tunnel. Citizens of New York are well acquainted with the discomfort of traveling through tunnels by steam traction, and the difference between the foul smelling and poorly lighted Park Avenue tunnel of the New York Central Railroad, and the electrically operated and lighted Fourth Avenue tunnel of the Metropolitan Street Railway Company is striking. While the cars in the latter do not of course attain the speed proposed in the rapid transit subway, yet the rate is sufficient to give a fair idea of the possibilities of the underground system.

ONE of the few sources of income available to street railway companies outside of the transportation of passengers is that of carrying the United States mails. The number of railway companies now engaged in this work is about 125. The STREET RAILWAY JOURNAL published in May and August, 1896, a concensus of opinion as to the profit of carrying the mail. The general verdict was that in itself it was unprofitable, but that there were certain inducements other than of a financial character which made the service advisable. As the subject of remuneration was discussed at the Niagara Falls Convention and as a considerable difference of opinion existed as to the method of the government in computing same, a brief history of the government policy as to the transportation of mail on street railways will be of interest. On June 9, 1896, Congress in making appropriations for the service of the post office department for the year ending June 30, 1897, provided for the payment of $150,000 "for the transportation of the mail by electric and cable cars on routes not exceeding 20 miles in length." The Postmaster General thereupon appointed a committee for the purpose of securing information upon which to recommend the bases of compensation for this service. The report of the committee, which consisted of the Second Assistant Postmaster and four officials of the railway postal service, was based on the actual cost of operating cars, as reported by a number of street railway companies, and was briefly as follows: for mail cars measuring 16 ft. inside measurement, one cent per car mile for each lineal foot of car space the full width of the car; for cars up to and including 20 ft. in length, one cent per foot for the first 16 ft. and one-half cent for each additional foot; for cars of greater length inside measurement than 20 ft., one-quarter cent additional per car foot mile for each foot in excess of 20 ft. For trail cars the committee recommended a rate of one-half cent per car foot mile for 20 ft. or less and one-quarter cent per car foot mile for an excess of 20. ft. For carrying the mails in closed pouches the committee recommended a rate of three cents per car mile regardless of the space occupied, which upon most lines is inconsiderable, but to provide against an excessively low rate for roads of short mileage, or where the amount of mail carried was very small, minimum rates were adopted of $150 per annum for lines performing 2000 car miles of service or less; $175 for lines performing not more than 3500 miles or less than 2000 miles; $200 for lines performing not more than 5000 miles or less than 3500 miles; and $250 for lines performing not more than 8333 miles or less than 5000 miles. The committee found, however, that if these rates were followed, the appropriation then made would be insufficient to pay for the service, and further suggested that the rates for *post office cars* for the ensuing year should be 75 per cent only of the amount previously stated, and that the change in rate of compensation for carrying mail in closed pouches should be postponed for one year, or until Congress should have made sufficient appropriation to put into effect the rates to which the committee considered that the railway companies were entitled.

* * * * *

The street railway mail service has proven so satisfactory to the public, local postmasters and general post office department, however, that Congress on March 3, 1897, voted to increase the annual appropriation to $250,000. The recent report of the Second Assistant Post Master General upon the electric and cable car service in operation July 1, 1897, shows a total annual rate of expenditure at that time of $223,000; and since that date, we understand, considerable additional service has been authorized by which the annual rate of expenditure has been brought up to about the amount of appropriation. In making the appropriation for this service, however, Congress added a proviso which limits the rate of compensation which may be paid per mile to the amount received by the companies performing the service at the time of the enactment of the act. As the post office department was at that time paying for carrying closed pouches the rates recommended by the committee, but for the operation of postal cars only 75 per cent of the rates recommended, it could not exceed those amounts in allowing for the service under the new appropriation.

IT is always a matter for regret when an attempt is made to arouse personal or international prejudices in the discussion of purely professional problems. The world is large—there is merit in the scientific and practical work of all countries—and cordial recognition of this merit is often a stronger preface to criticism of details than is a sneer, or an adverse generalization. We think it unfortunate, therefore, that a certain English engineer should have chosen to write to the (London) *Electrical Review* in an ill-natured way about a purely technical subject, that of engines for electric traction, and should have taken occasion to strengthen (?) his argument against "common-place American fallacies" by sneeringly questioning the right to a respectful hearing of an American engineer who has been for more than thirty years an international authority on steam engines and the cost of power production, and who has been the recipient of a number of honors from engineering societies and institutions of learning. Certain well known fables of Æsop naturally suggest themselves in this connection.

* * * *

In the letter referred to, the extraordinary statement is made that it is "an American fallacy" to believe that an engine for traction purposes must be specially strong in its working parts to stand the racking due to the continual repetition of shocks, and that, on the contrary, "the fact remains that there are no shocks and no excessive strains." We could hardly believe that this statement is meant to be taken seriously, did we not find it repeated by the same engineer, in an equally impatient and sarcastic manner, in a discussion before the (London) Institution of Electrical Engineers. We are led to wonder if the author's opinion is shared by British engine builders. If so, the fact that American engines are being generally purchased by British tramway companies in competition with engines of home manufacture is perhaps explained, for we are quite sure that there is now, and will, for some time to come, continue to be, a "prejudice" on the part of well informed tramway engineers of all countries for the strongest and most solidly built engines that can be constructed.

* * * *

Not to recapitulate the briefly stated but conclusive arguments which Dr. Emery, in another column, brings forth in support of the "fallacy," we will only say that with a little more of the experience which lies deep in the memory of American managers and manufacturers, there will come, we imagine, some modification of the views expressed in the letter to the *Review*, and their author will perhaps, be able to guide the British engine builder into safer paths. In the early days of electric traction in this country, engines which had proven entirely satisfactory for electric lighting were found altogether too light for railway service of nominally equivalent power requirements. It was no unfrequent occurrence to see an engine "brought up standing" by a heavy load suddenly thrown on with the starting of a number of cars at a particular moment or by a short circuit, while to have a belt fly off from the same causes was the lot of most managers. Do not happenings of this kind imply unusual strain and shocks? Can experienced engineers look with equanimity upon the liability to an instantaneous fluctuation of load—an *electrically instantaneous* fluctuation we mean—of from 10 per cent to 120 per cent of an engine's rated horse power? The theory that light engines can stand such fluctuations, and that electric railway engines are not subject to unusual strains and shocks is wrong, and the practice is infinitely wrong. We are afraid that the "young English engineers," for whose correct education so much solicitude is rightly felt by one whom we must presume, in the absence of information, to be an "old timer," will still give respectful attention to this particular "American fallacy" if they purpose following in the footsteps of that fine ancestry of British engineers which has given them such traditions of magnificent accomplishment in all parts of the world—accomplishment which is, by the way, just as fully recognized and highly appreciated in America as in Great Britain.

The Case for Municipal Operation of Street Railways

We have looked in vain until now for a separation of the arguments for public ownership of street railways from those for the ownership of gas, electric light and other industries operating under municipal franchises, and for a summing up of the special advantages claimed for the people in doing away with private management of street railways. It has been too much the fashion to lump together all quasi-public industries and assume that there would be equal reason for dealing with each and all upon the same lines of public policy. We welcome, therefore, the appearance in a recent number of *Municipal Affairs* of a paper by Hon. John DeWitt Warner, entitled "Should Greater New York Operate its Street Railways?—Yes."

Mr. Warner has—honestly, perhaps, but none the less unfortunately—committed the grave dialectic fault of understating his opponent's case and ignoring the chief advantage claimed for private ownership of street railways. His argument is consequently built upon an inadequate foundation, and for this reason alone could not be deemed in the least degree conclusive, even as applied to New York, to which city he expressly limits its force. He considers that the objections against municipal operation, as commonly stated, are but four in number:

1. That the public through the municipality cannot legally undertake such operation.
2. That even if legal this would be socialistic and against the policy of our institutions.
3. That it would be politically demoralizing.
4. That as compared with private management, municipal operation is economically wasteful.

Now these are, in fact, but the mere out-posts, as it were, around one great central argument for private ownership, which may be expressed (though inadequately) as follows:

Individual courage, enterprise, progressiveness and responsibility, in municipal transportation matters—obtained only when private capital is at stake—are necessary for the most rapid and complete development of the municipal organism and for the best living conditions of the people.

In its practical application, this argument means that one hundred years' experience with private ownership of transportation facilities in any given city will bring about for that city a larger area and population, a better distribution of the population, far more comfort to residents, and a lower death rate, than would result from one hundred years' experience with municipal ownership—this, provided that private ownership be not hampered by excessive or unreasonable restrictions by the municipality.

It is this argument that Mr. Warner has failed to even touch upon. It is entirely distinct from, and vastly more important than the question whether municipal operation would, or would not bring about lower average fares or a larger treasury revenue.

We have space for but a brief summary of Mr. Warner's arguments on the lines which he has chosen. His contention that there is ample legal precedent for public operation of quasi-public industries is certainly well founded, and so far as we know, there is no disposition

among advocates of private ownership to urge the contrary. He claims that municipal operation is not socialistic, and draws the following distinction between socialism and civilization: "Socialism and communism are objectionable in that they assume to direct the energies of individuals in behalf of the common weal. Civilization, on the other hand, uses the common purse to give more freedom and opportunity to each to follow his chosen bent."

Names are not important. It must be confessed that "socialism" and "communism" are frequently used as bugaboos, and Mr. Warner's cleverly drawn distinction seems plausible, particularly in connection with other "glittering generalities" in which he indulges in this connection. The real evil complained of, however, by whatever name called, is found in the degradation of a large proportion of the total working force of any community from a position of public sovereignty to one of public servitude—the sinking of individualism in bureaucracy—and the sapping of personal ambition as an incentive to efficiency and to the development of personal character. Mr. Warner pays a high, and doubtless a deserved tribute to our army of postal employes, holding that they constitute neither a servile class nor a demoralizing factor in our politics, and that "there is not a more self-respecting, hard-working body of men in the country, or one that better earns the wages it gets." We add—*or one in which the personal element is more ruthlessly crushed out.* The names of men in the working force of the post office department which have ever become known to the public as representing unusual ability or efficiency could probably be counted on the fingers of a single hand, while the number of employes who have been promoted from the lower to the upper classes of service through sheer ability and merit is, we imagine, extraordinarily small in comparison with the total number of employes in the department—far smaller than would be found in any privately conducted enterprise. If Mr. Warner's theory of public ownership be carried from the control of municipal enterprises to the government control of railroads, express service, steamship lines, telegraph, and other branches of industry for which there is nearly or quite as much logical reason, there will eventually be so large a proportion of the total work of the country done by those dependent upon the public treasury, that the remaining work, which Mr. Warner desires to leave to those who are "free to follow their chosen bent," will be lodged in far more restricted fields for independent effort.

We cannot agree at all with Mr. Warner that "no political danger would be involved" in the creation of an immense public service bureaucracy. If the past history of American politics teaches anything, it teaches us that the post office and other branches of the government service have been used with tremendous power in political contests, and as a rule the only reason why their power has not been all-sufficient is that the proportion of the number of postal employes to the total population of the country has been but small. With an enormously larger public service staff, the danger will obviously be far greater.

When Mr. Warner urges that "municipal operation is economically sound," he is forced to admit that he cannot fall back upon precedent in support of his contention, and the sum and substance of his argument is that municipalities ought to be able to take advantage in the future of the experience of private owners in the past, so as to avoid many of the errors into which the latter have fallen; —moreover that, particularly in New York City, an immense increase in the value of the franchises will come in the future and should be possessed by the public. This last argument is not, however, of any value in support of public *operation*, since New York and other cities could realize upon the increasing value of the future by methods other than those of taking direct charge of the properties. His proposition must be dismissed as "not proved," and may further be regarded as highly improbable, if not impossible.

We have looked with considerable interest to see in what way Mr. Warner proposes to obtain possession of the franchises which have been given by the people, and which are claimed by their present owners to be "vested rights." He says on this point that "our government is one of limited powers and is incompetent either to grant away essentials of sovereignty or irrevocably to delegate the exercise of government powers. More than this—all law questions aside—it is ridiculous to imagine that this generation on a matter of public weal will consider itself bound by a past one, or to expect that future generations will respect this once dead hand. If, therefore, public control of public franchises is right, then it is inevitable, and recognition of this and prompt preparation for it is the only sensible policy." This is an easy way of dismissing matter and will, of course, receive the attention it deserves. Calmly assuming that "public control of public franchises *is* right," Mr. Warner then states that "the main question to be discussed is as to what, if any, consideration for, or compensation to private individuals should be conceded," and he concludes that while "the fact is that any compensation made to so-called owners is not a matter of absolute right—the right and duty of the public to exercise its franchises coming [illegible]—the real question is therefore in each case reduced to inquiry as to what between two innocent parties is fair.

We cannot complete our review of this interesting paper without briefly referring to two curiosities of statement and opinion, which, while not strictly speaking germane to his main argument, are nevertheless remarkable as showing how oddly people sometimes look at things. Mr. Warner says: "With the exception of the one street railway that is jointly operated by the municipalities of New York and Brooklyn, are not the fares on the enormously crowded crosstown lines, where the normal traffic is a short distance one, kept at an extortionate rate, while for no greater charge 15 or 20 mile exchange routes are elsewhere operated?" Now the Brooklyn Bridge cable railway is almost exactly one mile in length, and its cars travel over that mile without stopping and at an actual cost per passenger carried probably less than that of any railroad or street railway in the world, all the working conditions being most favorable. Nevertheless, the two municipalities charge a three cent cash fare and two and one-half cents by ticket for passage. Down in the river below the bridge a number of ferries, controlled and heavily taxed by the city and operated by private parties, carry passengers from shore to shore, a distance of perhaps three-quarters of a mile for one cent in commission hours and two cents cash fare in other hours, or one and eight twenty-fifths cents by ticket. In New York and Brooklyn the number of surface railway passengers who do not pay less than two and one-half cents per mile for their traveling is extremely small, while soon, at the instance of the private capital controlling these surface railways, passengers are to be carried across the Brooklyn Bridge in their cars for nothing, *i. e.*, for no greater charge than the regular rates for travel in each city. To regard the Brooklyn Bridge railway as an example of municipal liberality to the people is, we think, something of a curiosity.

Mr. Warner is apparently much impressed with the injustice to the short distance rider of paying a fare equal to that of the long distance one. The fact is, that the long distance rider on a street railroad is carried at a loss, the medium distance rider at cost and the short distance rider at a profit. How much that profit is, or what the lines of demarcation are between the three classes of riders, are determined by the conditions in each city and upon the number in each class, and if Mr. Warner will admit that no passenger should be carried by street railroads without profit, he would probably find that the minimum rates of fare could be made but slightly lower than at present for the short distance rider, while they would be larger for the medium and long distance riders. But this would be a narrow view of a profound subject, and we are sorry to say that he refuses to take the broader one, which is that *wherever is found a system of graded fares running from the heart of a metropolis outward to the suburbs, in that city you inevitably find tenement house districts and conditions of living far inferior to those made possible by uniform transportation rates.*

Controlling Instruments on Power Station Switchboards

By George Moffat

The controlling instruments used on a switchboard include the rheostats, circuit breakers, switches, lightning arresters and even fuses, besides all automatic devices which govern or control the board in any way. Of these the switch is the simplest and possibly the most important member of the board, and yet there is a diversity of opinion as to which is best; some prefer the plain switch of either cast or rolled copper, while others favor the "quick-break."

The principle of all these snap or quick-break switches is practically the same; that of having the blade fit sufficiently snugly in the jaws and of drawing it back with a spring to make a rapid break as the blade leaves the jaws, thus avoiding an arc. But when a double throw switch of the quick-break type is wanted, the only practical method is to have the blade in three parts — longitudinally — with the handle attached to the middle part, which is of a slightly less cross section, so that it will not bind in jaws. From this central blade spiral springs may be attached to the outer blades, producing a very strong, serviceable switch, but one that will increase the cost of board if many are needed. Of course such a switch has a high factor of safety on account of the quick-break feature, but it is a question whether this is really needed. The chief drawback to such a switch will be that after much use it becomes shaky and if thrown in suddenly may strike the sides of the jaws instead of entering them. The flash caused by such treatment will take the temper out of the springs and the possible result is the switch will lose its quick-break quality and being in two or more sections, will start an ugly arc, liable to destroy switch and possibly worse.

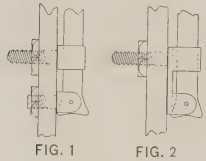


FIG. 1 FIG. 2

Cast copper is not pure copper on account of the difficulty attending the casting of pure copper free from holes, and for this reason alone, if for no other, is not suitable for switches. Still there are many made and sold, and I have seen some of 4000 amps. rated capacity, but they heated excessively when less than half of that current was sent through them. Rolled copper is difficult to work, but is the best for this work.

The method adopted by most makers for fastening the switch to the board is shown in Fig. 1. It will be seen that the lower jaws and blade center, or hinge, are separated. It would be much better to have them as in Fig. 2. Being in one piece they are stronger, and, if necessary to repair, it will be much easier to get them into perfect line by inexperienced men.

A circuit breaker is an automatic switch which may be adjusted to any desired current, and its function is to protect the generator by limiting the current to a predetermined amount. The manner in which this is accomplished is to have adjustable weights or springs attached to a releasing trigger, and, when released, the current is momentarily diverted through a shunt, where it is broken by supplementary contacts and the arc extinguished magnetically, or carbon pencils introduce high resistance and the flashing takes place at that point, these pencils being renewable. The former method is the better for generators or where very large currents are to be broken, as the "magnetic blowout" principle will prevent serious arcing, but when used for feeder panels or where small currents are opened quite often, it is not as serviceable as the carbon point breaker. The reason for this is that as the supplementary contacts are out of sight they are liable to get spotted, without it being known. This will prevent the breaker from opening promptly in response to demands of the line. On the other hand, the carbon points, being easily and quickly adjusted and repaired, can be kept in order. But for large currents the carbon contact breaker will not prove as satisfactory as might be desired, because contacts are liable to be consumed, and sometimes the jaws are burned. The best arrangement then is to use breakers of the magnetic blowout type for all machines, and mains if used, and for all feeder panels to adopt the breaker with carbon pencil contacts.

Mercury is also used on the smaller breakers, but has not met with success, owing to the splashing attending sudden opening, and they are no improvement over the carbon pencil. The Westinghouse Company, the Walker Company and one or two others use the carbon contact breakers exclusively, while the General Electric Company uses the magnet.

In Figs. 3 and 4 are shown two forms of breaker made by the Westinghouse Company. Fig. 3 is the one used for feeders and for large machines, when the negative is broken; the feeders, of course, break the positive side. That shown by Fig. 4 is installed with smaller machines and breaks the positive and equalizer leads. The Walker breaker is somewhat similar, but breaks one side of circuit only and the handle is placed above instrument instead of in front. That made by the General Electric Company is shown in Fig. 5, and also illustrates the manner of connecting the switch. This breaks the negative side, and the handle for resetting is placed low so that the instrument can be placed high on the board, which avoids the blowing of the breaker in operator's face. When a large breaker of this type "blows" from a short circuit the report is deafening. In this instrument the current is normally carried through a large brush which rests upon square studs, and through the coil shown in lower left hand corner of the breaker. When this current becomes excessive

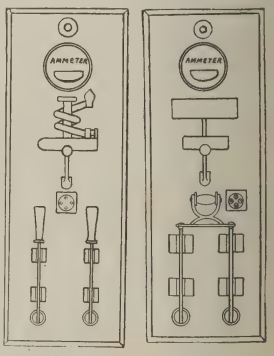


FIG. 3 FIG. 4

a trigger or latch is released and with it the brush. Supplementary contacts are provided and so arranged that when the circuit is broken these are placed in strong magnetic field for an instant during which they are also opened. In the other forms shown in Figs. 3 and 4, the carbon contacts simply remain in contact for an instant longer than the jaws of breakers. In either form it is only a question of transferring the arcing points from the main contacts to supplementary ones, that burning and damages may be avoided. One form of Cutter breaker is shown in Fig. 6.

In rheostats we want a simple compact machine, and as they are subject to heating they should have great radiating or dissipating power. It must be fireproof or in a short time it will consume itself, and as it will be subject to vibration to a certain extent, the coils or other resistance should be sufficiently supported that there will be no risk of short circuiting any of the coils, which, by the way, very often happens. Durability will depend on the likelihood of oxidation and electrolysis. The instrument must be perfectly insulated that there may be no possibility of open circuiting, for in many cases such an accident would be very serious and with a shunt field the result might be disastrous.

The proper size of rheostat will be found to vary for machines of same capacity, but of different makes. On a 400 k. w. generator one may need 6 amps. and another 9 amps. but generally speaking the proper sized rheostat for shunt machine will be one in which the resistance exceeds the resistance of the shunt by about one-fifth; a shunt field with a resistance of 75 ohms would need a rheostat of about 90 ohms which on a 600 volt circuit would be 3.63 amps. for first step and 8 amps. for last step with all resistance out. In a machine properly compounded it will seldom be necessary to move the rheostat after starting the machine and proper voltage is attained.

Some makers use what they are pleased to call "a series field rheostat shunt" which is a graded shunt to series field, built up of strips of German silver, and put there with the intention of helping the machines to work in multiple harmoniously. The Westinghouse Company employs on its large rheostats cast iron coils which are open to the air for radiation and are insulated and separated by fireproof material—asbestos sheeting. The General Electric Company and most others use the Carpenter enamel rheostat. The principle of this rheostat is to hold the resistance wire in intimate mechanical contact with an iron supporting plate, which is provided with ribs on the back for extending its radiating surface that heat may be rapidly dissipated.

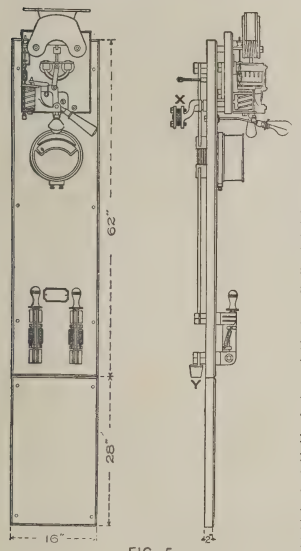


FIG. 5

The makers of this rheostat attain this object by the use of enamel which insulates it from and attaches it to the radiating plate. The enamel completely surrounds the wire and thus proiects it from injury and also admits of smaller sized wire being used, making a very compact piece of mechanism. On account of its large radiating surface, the rheostat will dissipate continuously 500 watts on a 10 in. × 10 in. plate. When motor generators are used in the station for any purpose as boosters, lights, etc., we will have in addition to the ordinary form of rheostats another style familiarly called starting boxes, which are connected in series with armature. These are generally constructed of cast iron coils or a number of spirals in multiple, but no matter what the form may be, their function is only to start the motor, and they should not be left in circuit. Five seconds is long enough.

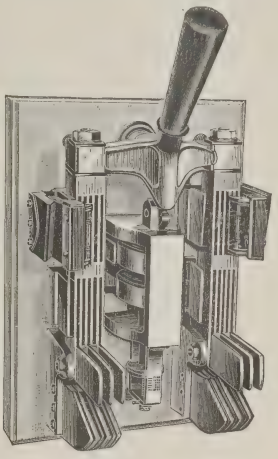


FIG. 6

In most stations where motors are operated the only protection is a fuse—a snare and delusion for any but the smaller circuits. Their utter unreliability is well known. A few makers have recently adopted a releasing mechanism to act in case the current supply fails, as the opening of the circuit breaker of the circuit on which the motor is. These are very good, as they cut in all the resistance of the rheostat, or starting box, thus saving the motor from excessive current when the breaker is replaced.

Of all the electrical appliances likely to get a "bug" the rheostat is the first. It is generally stowed away in some dark corner which is not otherwise available, and if it is of the open coil variety it will soon accumulate its portion of dirt and filth. The sweeper is instructed to keep away from it and the accumulation continues. In one station this was the practice until it was reported that one of the machines did not work properly, it took the lion's share of the load, and cutting in resistance did not help matters any. After studying and puzzling his brain over all manner of theories the station engineer finally located the trouble. A monkey wrench had fallen into the rheostat, short-circuiting the coils.

When considering lightning arresters we will discover that a few firms do not install them. The General Electric Company and the Westinghouse Company adhere to the same plan adopted by each in its circuit breakers, the former has its "magnetic blow-out," and the latter uses pencil points, although this type is no longer being installed, having been superseded by the Wirt lightning arrester. In the first mentioned the arrester has a spark gap in a magnetic field, one side of which is connected through windings and non-inductive resistance to ground and the other to the generator bus bar. Under ordinary conditions there is no current flowing in the coil, but when a spark jumps the gap and is followed by the current it acts as did the circuit breaker—it blows it out.

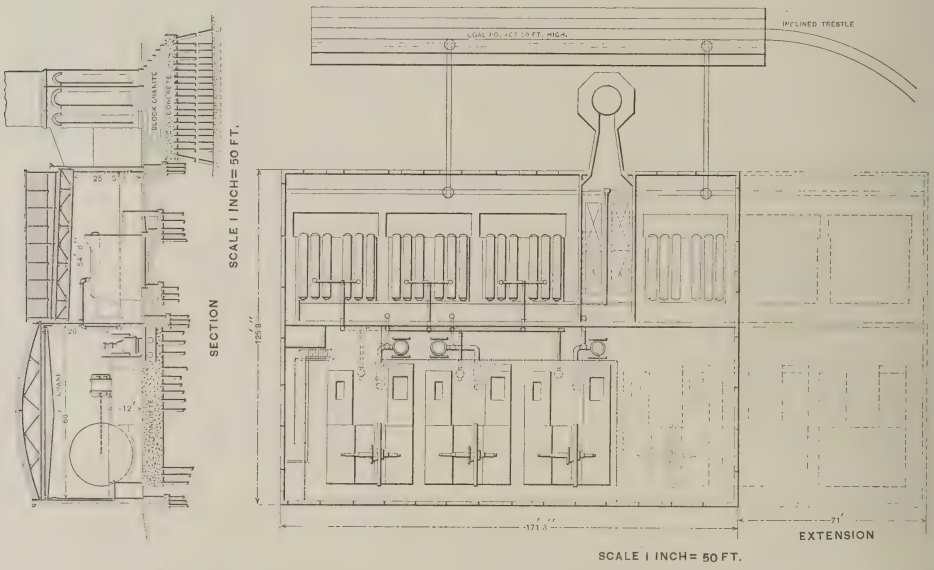
Often special instruments will be needed, but their character will vary with the requirements. If there be a storage battery plant connected with the station, special automatic switches may be needed, and if a booster be used, it may also be necessary for some special arrangement to insure safety. These are, however, of special rather than general interest, as they are used in but few stations, although in many cities the problem of how to maintain the voltage constant in the outlying districts and suburbs is receiving very serious attention.

IT is reported that the Illinois Central Railroad Company will make a uniform fare of five cents on its suburban lines from Chicago with certain limits. This will be done, it is said, in order to compete with the electric lines which it parallels.

Harvard Power Station, Boston

Early in the spring of 1897 the management of the West End Street Railway Company decided upon the erection of an additional power station for the requirements of its Cambridge traffic. After a series of investigations as to the suitability of locations, the present site was decided upon as being most advantageous. The property was bought with the view of accommodating a station of an ultimate capacity of 7200 k. w. and the work of erection begun May 10, 1897. The station as built will accommodate four units of 1200 k. w. each, there being a blind wall at the rear to allow for extension.

The station is of the best selected hard burned brick with free-stone trimmings; it has a frontage on Boylston Street of 126 ft., with a depth of 172 ft., and in general appearance resembles the company's Dorchester power station. The boiler room floor is on a level with the street, the engine room floor being elevated above this at a height of 12 ft. The roofs of the boiler and engine rooms



PLAN AND CROSS SECTION OF NEW HARVARD POWER STATION—BOSTON

are iron trussed, tile arched and covered with composition, and were built by the R. Guastavino Company.

The engine room, which is next to the Cambridge Parkway, has an ultimate capacity of four, and contains three, 1800 h.p. horizontal, cross compound Allis engines, with independent jet condensers, direct connected to three 1200 k. w. multipolar generators of the General Electric Company's make. The engines and generators were designed for a speed of 80 r. p. m. On the basement floor, which is on the same level as the boiler room floor, are the condensers, air pumps and boiler feed pumps, both steam and power. The engine room floor is cut away at this place so that these may be in full view at all times of the engineer in charge.

The equipment of feed pumps consists of one steam pump 14 ins. x 8½ ins. x 10 ins. capable of supplying water for 6000 h. p. boiler capacity, and three power pumps driven by an electric motor through a counter-shaft, each capable of supplying about 5000 gallons of water per hour at a crank shaft speed of 30 r. p. m. The feed water heaters, of which there are three, are of 800 h. p. capacity each.

In the boiler room are six 500 h. p. water-tube boilers with extension furnaces, designed to carry a working pressure of 180 lbs., and arranged in three batteries of 1000 h. p. each. The smoke flue is carried to and around the economizer, space being provided for the installation of another economizer of equal capacity. Underneath each section is a by-pass. The stack is of brick and 226 ft. in height; it is 11 ft. in diameter inside and lined with fire brick, and is of ample size to take care of an ultimate boiler capacity of 6000 h. p. It rests on piles which are covered with concrete to a depth of 5 ft., with a granite capping of 8 ft. 6 ins. in thickness made up in five courses.

As the plan shows, the engines and boilers are placed back to back, and all the piping in the engine room is beneath the floor. By this arrangement no obstruction is offered to the free use of the traveling crane. This latter is of 7 tons capacity and is operated by hand.

At the northern end of the engine room on a platform raised 8 ft. above the floor is the switch-board, which commands a view of all the engines and generators. This is made up of the usual generator and feeder panels, and is equipped with the complement of instruments and appliances found on such boards, as circuit breakers, ammeters, voltmeters, switches, etc. Leading from this platform is the office of the chief engineer, in which is located the recording voltmeter, recording steam pressure gage and telephone.

Directly under this office on the basement floor is the test room, where are located the instruments and apparatus necessary for testing the underground cables, such as galvanometers, batteries, standard resistance, and keys for making the various connections. These cables are carried from the station in a conduit through which the return wires are also brought back.

Coal will be handled at this station by a trestle and coal pocket adjacent to and in the rear of the building. From this pocket and through chutes in the bottom will be loaded the coal or charging cars, which will run into the boiler room on a narrow gage track. This track will also be utilized by the cars that will remove the ashes from the boiler room.

The Plant of the Marion City Railway Company

By J. G. SWAIN

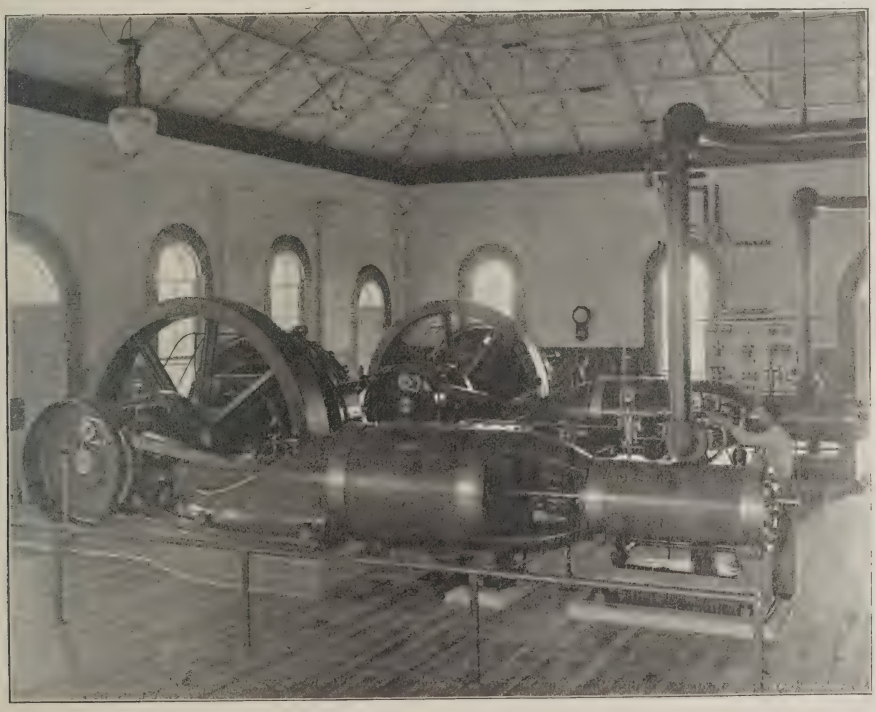
The towns of the Indiana gas belt are well supplied, not only with local railways but with a network of interurban lines, which together with those proposed and which have a reasonable promise of building will make traveling throughout the entire region on electric roads a possibility. The lines operated by the Marion City Railway Company, of Marion, Ind., constitute a representative system of both local and suburban character. The greater part of the system is in Marion, from which point a division extends 3 miles south to Gas City and Jonesboro, passing the Soldiers' Home, 1 mile out from Marion. From the Soldiers' Home to Gas City the road for a part of the distance runs along the banks of the Mississiniwa River, a stream of moderate size, but sufficiently attractive to invite those who ride for pleasure. Other routes extend to the Marion Cemetery, to West Marion and to York, in all 25 miles, of which 6 are double track.

The greater part of the system is laid with 60 lb. T rails on oak ties. The bonds are No. 0 wire; Wheeler rail joints are used. Much of the special work was furnished by the Paige Iron Works. The country is level and grades are few, the heaviest being only 5.4 per cent. No. 0 trolley wire is suspended from 30 ft. cedar poles. Four feeders distribute the current; the longest extends 5 miles from the power house.

Thirty-two cars make up the rolling stock; seven of these are open. All are mounted on Brill trucks and equipped with two G. E. 20 h. p. motors. The closed cars are 35 ft. long with vestibuled ends, and are heated with stoves and electric heaters, the latter having been made in the company's repair shops. The rolling stock and track have been in use nearly seven years and are still in good condition.

There are two frame car houses each 150 ft. × 40 ft., one of which has a 40 ft. × 40 ft. wing, where the repair shops are located.

The new power station which the company has just built was designed by the Buckeye Engine Company. It stands at the central point of distribution, reducing the copper loss to a minimum. The engine room is handsome in finish and appearance; it has polished hardwood floors, is well lighted, well ventilated and of sufficient size to permit the present installation to be duplicated. There are now installed two Siemens & Halske generators of 300 k. w. capacity and direct connected to Buckeye engines.



INTERIOR OF POWER STATION—MARION CITY RAILWAY CO

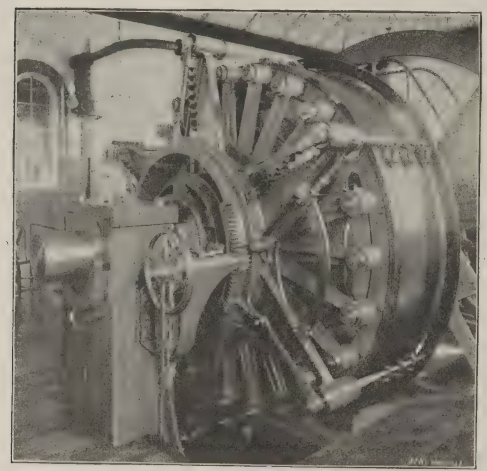
The engines are now condensing tandem compounds 16½ ins. and 29½ ins. × 33 ins., running at 125 r. p. m., and under a pressure of 125 lbs. are rated at 500 h. p. each. The valves of the high pressure cylinders are round, while those of the low pressure are flat, of the original Buckeye type; constant length of travel on their seats is secured by means of the Buckeye compound rocker arm. Both generators and engines are of the most substantial character, suited to the severe requirements of electric railway service.

The switchboard is white marble equipped with Siemens & Halske switches, Weston volt and ammeters and I T E circuit breakers.

The boiler room contains two Edgemoor water tube boilers; the capacity of each is 375 h. p.; they have down draft and are now running at 110 lbs. pressure. The piping is short and at present is not cased. All valves were furnished by the Crane Company.

The plant being located in the heart of the gas belt uses gas for fuel. The stack is 7 ft. inside diameter and

at present is 50 ft. high, so built that the height may be increased if other boilers are added. The power station, on the whole, presents an exceptionally neat appearance.



GENERATOR—MARION, IND

The population served is in the neighborhood of 30,000; the company gives excellent service and enjoys good patronage.

Reduction in Cost of Steam Power From 1870 to 1897 *

By. F. W. Dean

In the year 1870 the most economical steam engine in use in mills was the Corliss simple condensing engine, which used 19 or 20 lbs. of steam per horse power per hour. Previous to that time compound engines had been used in England in mill practice, and simple engines had in many cases been changed to compound. In this country compound pumping engines had been used to a very limited extent. The Pawtucket pumping engine, built by George H. Corliss, and started on June 30, 1878, was probably the most economical steam engine which had been built up to that time, having used less than 14 lbs. of dry steam per indicated horse power per hour. While these engines are not mill engines, they influenced the practice of builders of mill engines, and can properly be considered with them. Pumping engines have heretofore been the leaders in economy, but at present the best pumping and mill engines are of practical equal economy. Of course, the greatest single step in economy was the introduction of the compound engine.

In 1873 the most economical compound engine used about 16½ lbs. of steam per indicated horse power per hour. Improvements in methods of using steam were made until it is now as easy to design an engine to use less than 13 lbs. of feedwater per horse power per hour as it was to use as little as 16 lbs. in 1875. At this date steam jackets were common and were used in all engines which gave the most economical performances. The steps, however, that lowered the steam consumption of compound engines from 16 lbs. to 14 lbs. per indicated horse power per hour were largely the introduction of a cutoff on the low pressure cylinder and a reheating receiver between the cylinders.

These features appear to have been the principal means of lowering economy to 14 lbs. of steam; but to what are we to attribute the step to 13 lbs.? Clearance is well known to be an important factor, and its reduction, especially in the last cylinder of a series, is important for economy. It is receiving constant attention from careful designers, and its reduction is a constant source of gain. The 13 lb. mark has also been reached by an increase in steam pressure with resulting increase in the number of expansions. In some cases a reduction in the size of the high pressure cylinder has doubtless contributed toward economy, by means of which smaller surfaces are exposed to the boiler steam than would otherwise be the case. This carries with it a proportional reduction of initial condensation in the cylinder which is most prolific in this cause of waste.

Still further, the 13-lb. mark has, in general, been attained by engines which have a low pressure cylinder larger for the work to be done than is commonly the case, so that the mean effective pressure referred to the low pressure cylinder is in the vicinity of 21 lbs. There are occasional exceptions, as in the case of the Louisville engine, which worked with a mean effective pressure referred to the low pressure cylinder of 25 lbs. Such cases are exceptional, and their economy can be attributed to great perfection of detail.

It will in general be observed, however, whatever may be said of other causes, that most of the extreme cases of economy are those in which a good vacuum has been maintained. This leads me to say that the importance of good vacuums is often not appreciated, and that air pumps and condensers are as often too small.

There is a strong tendency nowadays to underrate steam jackets, but I believe that in every case where they have been wasteful, or where their economy is indifferent, at all events with ordinary speeds, an examination would show that the jackets are air-bound, water-logged, blowing through traps, or that the jacket piping is bare, and thus steam for heating the building is charged to the engine. Such an arrangement of pipes can furnish but indifferent material for giving up latent heat to the working fluid within the cylinders, and is, in fact, absurd.

The effect of reheaters in drying out steam which issues from a preceding cylinder and in superheating it to 60 deg. or 90 deg., as is often the case, for use in the next cylinder, cannot be otherwise than advantageous, for, as Professor Thurston shows in his paper of 1894 before this society, heat so added to the working fluid saves much more steam than was condensed to liberate this heat. While these considerations are very general, they are necessarily so, for nobody can attribute to any one of the features named its proper effect. Moreover, their combinations are very varied.

Whatever may be said pro and con on this subject, it cannot be denied that the best results have been obtained from engines equipped with jackets and reheaters.

Considering economies effected, it is safe to say that, without including triple-expansion engines, steam economy has steadily decreased from 20 lbs. to 12½ lbs. per indicated horse power between 1870 and 1897. This corresponds to a saving of 37½ per cent.

Within this period of twenty-seven years the use of exhaust steam has extended in various mills, such as cotton, woolen, and paper mills, so that in some mills the cost of steam power is next to nothing. Economies of this kind are not confined to the use of the exhaust of non-condensing engines, for since 1895 the writer's firm has had installed at Lawrence, Mass., a large surface-condensing vertical compound engine, the rejected heat of which is utilized.

What is there to be said concerning boilers within the period that we are considering?

The horizontal return tubular boiler is still the standard of the country, and will probably so remain. It is cheap, and, if properly built, it is safe. As its tube-heating surface can be effectively blown with steam with the certainty that the jet will strike every part thereof, and as, furthermore, its tubes can be effectively scraped at any time without taking the boiler out of service, it must necessarily be more economical than any of the numerous water-tube boilers which are now being introduced. The fire surfaces of the latter can only be indifferently blown, and they cannot be scraped at all unless the boiler is cooled down, and in general it cannot then be done with anything approaching thoroughness. There is scarcely any improvement to be noted in the horizontal return tubular boiler during the last twenty-seven years as far as economy is concerned, but I believe that grates have been improved to a measurable extent, resulting in an economy of perhaps 2 per cent.

My own experience teaches me that the internally fired boiler, either of the locomotive or vertical type, will save under equal conditions some 7 per cent of coal compared with the horizontal return tubular boiler, besides causing an important economy in doing away with brickwork.

Within twenty-seven years economizers for heating feedwater in smoke flues have become common. Although subject to a rather large depreciation, in the general case they will save about 7 or 8 per cent of coal.

There are economies to be obtained from the use of vertical engines. These come from reduction of friction, reduction of repairs to cylinders and pistons, and diminished cylinder oil consumption. It would not surprise me if there were a net saving of 5 per cent by reduced friction of a vertical compound compared with a horizontal engine.

Summing up the various items that have been mentioned, the following may be presented as the economies of the period from 1870 to 1897:

Saving due to compounding, jacket reheaters, higher pressures, and greater expansions	37 per cent.
Due to vertical engines	5 " "
Due to vertical internally fired boilers	7 " "
Due to economizers	7 " "
Due to improved grates	2 " "

With these important economies having been brought about during twenty-seven years, the question arises, Are there any compensating disadvantages?

It is easy to show that there are not, for—

First. The first cost of a cross compound condensing engine is no greater than that of a pair of simple condensing engines twenty-seven years ago, on account of improved tools and processes and reduced prices of materials.

Second. Interest charges are less than they were twenty-seven years ago.

Third. The depreciation of engines is less than it was twenty-seven years ago, on account of better materials, better workmanship, better oil and better means of applying oil. Vertical engines

* Abstract of paper presented at the meeting of the American Society of Mechanical Engineers, Dec. 1.

will render the depreciation of cylinders, pistons, piston rods, piston rod packing, and crossheads less than similar parts in horizontal engines.

Fourth. The reduction in the number of boilers required by some 33 per cent for a given power within twenty-seven years carries with it many reduced charges, such as first cost, interest, repairs, depreciation, insurance, taxes, cost of boiler houses, cost of attendance, and various lesser items.

Fifth. Present boiler building practice is superior to the old, so that high pressures are now as safely and comfortably carried as the lower pressures of 1870. Better materials, longer plates and fewer joints, butt joints of high efficiency and maintaining the circular form with changes in pressure, drilled holes, hydraulic riveting, and round tool caulking render it as safe to carry 200 lbs. or more as any lower pressure.

Sixth. I might include reductions in cost due to handling coal by conveyers for large plants and by mechanical stokers. Conveyors are in some cases very economical, but mechanical stokers are of doubtful value, speaking generally. The greatest efficiency of the conveyer is to be found in connection with the mechanical stoker.

So far the only steam engine considered is the compound engine. This engine has recently been found capable of utilizing the higher pressures much more economically than was formerly suspected. It has therefore diminished the advantage of the triple-expansion engine to such an extent that the latter has met with something of a setback. I believe, however, that the triple engine is still to be common when pressures begin to exceed 160 lbs. of steam. It seems probable that the relative economies of the compound engine, using 160 lbs. and the triple using 185 lbs. of steam, are to-day represented in the very best practice by 12¼ lbs. of steam and 11¼ lbs. of steam respectively per indicated horse power per hour. This corresponds to a saving of 8.16 per cent, which is a paying saving.

Very careful attention should be paid to the kind of steam valves used in engine cylinders. It is the writer's experience that the gridiron valve, properly designed with ample lap, and originally made strictly tight by scraping, will remain so far longer than any other kind.

The future, so far as we can now see, offers us highly superheated steam for further means of economy. The technical papers have frequent accounts of the use of such steam in Germany, and published tests show that a small Schmidt "motor" has used 10.17 lbs. of steam per indicated horse power per hour. It would seem that we have a right to anticipate in the early future a steam rate of 10 lbs. by means of superheated steam in the best designed engines. We have also in anticipation the use of very high steam pressure and quadruple expansion engines as built experimentally at Cornell University and described by Professor Thurston last year before this society. If, however, steam can be so highly superheated that expansion in one cylinder will not cause condensation, nor even the saturated condition until the time of exhaust, as was the case in the Schmidt motor, extreme economy may be obtained without resort to the multiple expansion engine.

The economies thus far mentioned relate to improvements in engines and boilers; but one of the greatest economies results from the low cost of coal at present in Lowell, Lawrence and similarly located towns. The prices of coal in these places show a saving from 1870 to 1895 by themselves of from $7.10 to $3.83 a ton, or about 46 per cent.

I shall now consider the actual figures making up the cost of a mill steam plant, and its cost of operating, say, 1000 h. p. in most mill towns in the State of Massachusetts away from tidewater. The very best steam plant of this power twenty-seven years ago, including a pair of simple condensing engines using 20 lbs. of steam, boilers evaporating 8 lbs of water on total coal used, buildings, chimney and all accessories, cost $70 an indicated horse power. The fixed charges on such a plant were interest at 6 per cent, depreciation at 4 per cent, repairs at 2 per cent, insurance at 1 per cent, or a total of 13 per cent. Attendance and coal is estimated for 308 days.

13 per cent of $70 is	$ 9.10
Coal at 2.50 lbs. per indicated horse power per hour at $7.10 a ton	24.40
Attendance, boilers { 3 day men at $1.50 / 1 night man at $1.50 } =	1.85
Attendance, engine { 1 engineer at $3.00 / 1 assistant at $2.00 } =	1.54
Oil, waste, and supplies	1.25
Total per horse power	$38.14

The very best plant of 1000 h. p. can be installed to-day complete, including buildings, chimney, compound engine using 12.5 lbs. of steam, boilers evaporating 9 lbs. of water on total coal used, economizers, and all accessories, for $57 per indicated horse power. Such a plant can run on 1.4 lbs. of coal per indicated horse power per hour for total coal consumed. The fixed charges are interest at 5 per cent, average depreciation 3½ per cent, repairs 2 per cent., insurance and tax per cent, or a total of 11½ per cent.

11½ per cent of $57 is	$ 6.55
Coal at 1.4 lbs. per indicated horse power per hour at $3.85 a ton	7.41
Attendance, boilers { 2 day men at $1.50 / 1 night man at $1.50 } =	1.39
Attendance, engine { 1 engineer at $3.50 / 1 assistant at $2.00 } =	1.69
Oil, waste and supplies	.80
Total per horse power	$17.84
Saving in first cost	18.6 per cent.
Saving in operation	53 "

Comparative Test of Direct Connected and Belt Driven Railway Generators

Jas. D. Rostron, chief engineer of the Chester Traction Company, of Chester, Pa., contributes in the last issue of *Power* the details of an interesting test recently conducted by him at the Chester Traction Company's power house on Mar. 29 and 30, 1897. This was a comparative test made between two methods of generating electric energy, viz.: One tandem compound condensing engine, built by Robert Wetherill & Company, 20 in. and 36 in. × 48 in. at 100 r. p. m. boiler pressure, 100 lbs. direct connected to one 8 pole, 400 k. w., 100 r. p. m. multipolar General Electric railway generator. Engine was supplied with steam from four horizontal return tubular boilers, burning Lykens Valley buckwheat of fair quality, and free from moisture, with following results:

Hours run—17 hours 30 minutes.

Coal, pounds, weighed and used	14,225
Kilowatt hours work as per wattmeter reading	4,735
Coal, in pounds, per kilowatt hour	3.004
" " " " engine horse power	2.242
Feedwater per temperature	201°
Boiler house "	68°

On Mar. 30 he tested two engines 22 ins. × 48 ins., at 80 r. p. m. single cylinder, condensing, built by Robert Wetherill & Company. These engines were supplied with steam from the same source as the compound engine, same coal in every respect; boiler pressure 100 lbs. To each engine was belted one Westinghouse compound railway generator of 225 k. w., and showed the following results:

Hours run—17 hours 45 minutes.

Coal, in pounds, weighed and used	16,685
Kilowatt hours work as per wattmeter reading	4,365
Coal, in pounds, per kilowatt hour	3.882
" " " " engine horse power	2.901
Feedwater per temperature	202°
Boiler house "	65°

A comparison between the two results shows a saving in coal of 22.7 per cent in favor of the tandem compound engine.

It must be noted in connection with this test that the driven generators were in two units. Mr. Rostron states that had they been as one engine and generator, no doubt the economy would have been greater; but still the difference is so great as to preclude the possibility of the single condensing belt driven being as economical as the direct connected machine, which has been very ably argued to the contrary by some eminent engineers.

The question of cost of installment will no doubt enter into some consideration. While he does not give the amount of any builder's contract, he states that the interest on the difference of cost amounts will reduce the above by 7.5 per cent.

He also remarks that the test was made under regular running and working conditions, without any previous arrangement to take advantage of every little point, but is every day practice at this station. Wattmeter readings were taken as a guide to mark the energy put upon the line, and eliminated many errors due to reading volt and ampere meters during a varying load.

The Proper Construction and Uses of Economizers*

BY HENRY G. BRINCKERHOFF

The principle of heating the feedwater in a separate vessel, quite apart from the boiler, and thereby utilizing the heat in the waste gases, is the function of flue heaters, more commonly called "economizers," leaving the boiler to supply chiefly the heat units necessary for the latent heat of steam. Taking the important steam users throughout the world, this is a recognized and universally adopted practice. Economizers are not only considered a necessary part of the equipment of every steam plant in Great Britain, but are in operation all over the continent and as well known in the spinning mills of Russia and India; equally noted among the gold mines of South Africa and the textile factories of China and Japan; while throughout the large manufacturing districts of the United States they are already extensively adopted.

The great loss of fuel as noted between the heat value of coal and the heat taken by the water, has been observed for many years, and numerous have been the appliances to recover it, the simplest and best method appearing to be to pass the waste gases on their way to the chimney through pipes containing water, and thousands of such pipe heaters have been constructed by nearly as many makers, yet with the exception of one or two they have all failed. Disappointment has attended the result of so many economizers or flue heaters, that we find that some people have become skeptical and condemn them all, and state it to be impossible to build one which will last and give satisfactory results.

The failure of so many flue heaters is attributed to three causes:

First. Not being made of *cast iron*, the only practical metal to withstand the corrosive action of sulphurous gases.

Second. Lack of capacity. It takes *time* to absorb enough heat to make them of practical value, hence the water should be from thirty to fifty minutes surrounded by waste heat.

Third. Lack of *automatic cleaning of pipes*. Soot being a non-conductor of heat, a slight coating on a limited capacity econ-

*Paper read before the meeting of the New England Cotton Manufacturers Association, Oct. 27-28.

omizer would end its usefulness in a few hours after it had been thoroughly cleaned.

The late Edward Green was the first to develop a flue heater embodying these essential features, and a word as to this well known inventor and the business he established will be of interest. Mr. Green was born in 1799, in Wakefield, Yorkshire, and died in the year 1865, and was succeeded in the business he founded by his son, Sir Edward Green, the present head of the firm, who, in 1883, was joined by his second son, Frank Green.

Before the late Mr. Green began to devote his whole time and energy to the apparatus that bears his name, he was engaged in general mechanical work and in the construction of large pumping engines for the deep coal mines of Yorkshire, as well as others for draining the fens in Lincolnshire and Norfolk.

Though the patent for his fuel economizer was taken out in 1845, it was not until after the great Exhibition of 1851 that steam users seriously recognized the great opportunity for saving that was, by its means, placed within their reach. From that date, however, its success was assured, and the large amounts of coal economized by those steam users who gave it a trial, forced it upon the attention of the remainder of the manufacturing community, with the result that the advantages of the economizer became more and more widely known, and at length almost universally recognized, so in the present day the invention is used by boiler owners all over the globe.

Briefly stated, the first and most important detail for a well designed economizer should be the absence of all "made" or packed joints inside of the brick work.

Second. Easy accessibility to every square inch of internal surface.

Third. The vertical pipes should be forced into the top and bottom headers by powerful hydraulic pressure, making the joints metal to metal, which is a far superior piece of workmanship than fitting the pipes in loosely into the boxes or headers and then rusting in by the use of iron filings and sal-ammoniac.

Finally, apply a rigid test to each section of 350 lbs. to the square inch.

A well constructed economizer built under the specifications described should last twenty years under ordinary care and attention. After it has reached that age it can be easily repaired and parts renewed so as to last indefinitely, as an umbrella retains its original individuality which has been fitted with new stick, spokes and re-covered.

The care required consists in blowing off daily at the same time as the boilers. Every three months the soot should be cleaned out of the chamber below, which at such an interval is about an hour's job. Once a year, at least, the caps should be taken off and the interior of the pipes inspected. If the water is bad this should be done oftener. There is no reason why the scraper mechanism should not run smoothly for years. This used to be a troublesome point with some of the early makes of economizers.

The general use of compound condensing engines in modern steam plants has enlarged the field and extended the use of economizers, as the exhaust steam is not available for heating feedwater except to a limited degree. A common practice some years ago, was to take a portion of the exhaust steam for heating feedwater, obtaining thereby a temperature of about 210 degs., while with the compound condensing engine it is not generally feasible to get much over 130 degs., thus making a direct loss in economy for the compound plant as compared with the older ones, to the extent of 7 to 10 per cent of all the coal consumed, offsetting by that amount the gain obtained by compounding, whereas the higher temperature of the steam demands a higher temperature of feedwater, instead of lower, for the proper efficiency and durability of the boiler.

The advantages of the economizer may be summarized as follows:

First.—It is a genuine saving of fuel expenditure by recovery of heat otherwise totally lost.

Second.—It increases the capacity of the boiler plant.

Third.—It saves repairs to the boilers by relieving them of much of the strain of expansion and contraction caused by colder water entering the boilers and mingling with the hotter contents.

Fourth.—It prolongs the life of the boilers for the same reason.

Fifth.—It saves much cleaning of the boilers, thereby increasing their efficiency because of the precipitation of feedwater impurities in the economizer, many impurities not being freed from the water until a high temperature is reached. This fact, and the slow movement of water in the economizer, is the reason that this apparatus removes so much more foreign matter from the feed than the other types of heaters.

Sixth.—The economizer is especially desirable where the work fluctuates. A large amount of power suddenly withdrawn drops the boiler pressure, while fresh coal in the furnace and cold feedwater entering the boilers make matters worse, a condition frequently observed in bleacheries and electric plants. Gage pressure is seldom observed to drop when an ususually large amount of feedwater is being forced into the boiler, where it has been previously heated in an economizer.

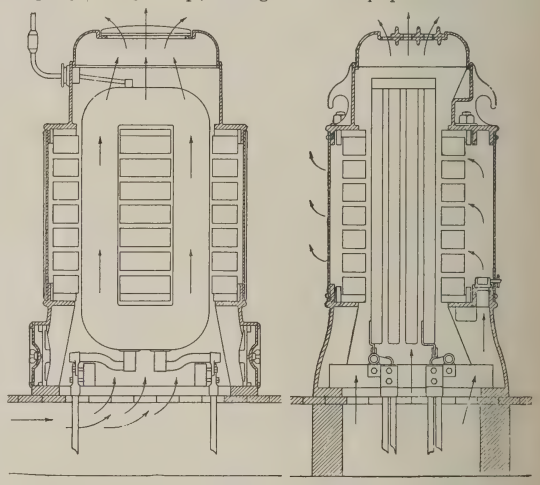
Seventh.—Any use hot water can be put to in processes of manufacture can be obtained free of cost by drawing the pure hot water from the economizer; particularly bleachers and dyers take advantage of this opportunity for their kiers and dye tubs. Where mills are heated during the winter by hot water, a part of the economizer can be included in the circulating system, supplying the heat necessary entirely by the waste gases. This has been done by some large mills, the Grosvenor Dale Company, a good representative of our New England textile mills, being one of them.

In conclusion I may say, it is the general opinion of those owning economizers, and others having them in their charge, that it makes easy working conditions in the boiler room.

Changes in the Buffalo-Niagara Falls Power Transmission Line

The power transmission line from the Niagara Falls power house to Buffalo is now undergoing a considerable increase, the demand for power from Buffalo having within the past few months grown beyond the capacity of the line first put up. The three wires strung on the poles will have shortly three companions, and the white insulators on each pole will be increased to six.

A new order for cable as well as for transformers has been placed with the General Electric Company. The cable is of special manufacture, is insulated to stand the ultimate pressure of the line, which will be 22,000 volts, and is tested under a considerable higher pressure before leaving the works. Twenty-four thousand feet of this cable will be used at first for that part of the transmission line within the city of Buffalo. The order for increasing transformers covers seven of similar size and design to the three already installed in the transformer house of the Niagara Falls Power Company. These ten transformers are the largest ever built. Each has a capacity of 1250 h. p., making a total step-up transformer



SECTIONS OF TRANSFORMERS, SHOWING METHOD OF COOLING BY AIR BLAST

capacity of 10,000 h. p. They are of the air-blast type, and will stand in rows of four upon the air-tight chamber, whence the air is forced through the ventilating spaces in the transformers. It will be remembered that the two-phase current at 2200 volts passes from the 5000 h. p. generators in the power house to the transformers. In these it is not only increased in pressure but changed in phase, the current issuing from the transformer's three-phase current at 11,000 volts. This pressure will be adopted until it becomes necessary to increase it, when it will be doubled and be delivered to the transmission lines at 22,000 volts. On its arrival in Buffalo it will be delivered to the step-down transformers of the Cataract Power & Conduit Company, which controls its distribution there. The electricity will be transformed down to different pressures for distribution over a city network to different points for a variety of purposes, being used directly in induction motors, a number of which will probably be installed in grain elevators, etc.

Several step down transformers will also be placed in the station of the Buffalo General Electric Company, and from these, three phase current, converted into direct current in rotary converters, will be utilized for lighting purposes and for small power units.

The Buffalo Railway Company is also increasing its step-down transformer and rotary converter capacity in its Niagara Street Power House. In addition to the two 500 h. p. converters already in operation, the General Electric Company has built two others of similar capacity and construction. These will bring the total converter capacity in the station up to 2000 h. p. To supply these necessitates the installation of three additional step-down transformers in the transformer house between the station and the canal. These will be of about the same capacity as the three already there —each of 275 k. w.—reducing three-phase current from about 10500 volts to 375 volts for delivery to the alternating current side of the rotary converters in order that it may issue direct current at 550 volts, at which pressure it is delivered up to the bus bars of the station switchboard.

SCIENCE · ENGINEERING · INVENTION ·

A Complete Line of Electric Car Trucks

Among the systems of electric trucks at the recent Niagara Falls convention, one that attracted much interest, not only from the extent, but also from the character of the exhibit, was that of the Taylor Electric Truck Company. This company has established a long and high reputation in the trade.and the following particulars of its system will be of interest to those who did not attend the convention or whose time there was so limited as to prevent a careful

FIG. 1.—STANDARD SINGLE TRUCK

examination of the different features of the trucks. During the past year the company has made several improvements in its trucks, which have been the result of careful study and experience.

One of the notable improvements in the single truck, shown in Fig. 1, is the introduction of the half-elliptic spring over the journal boxes with swinging shackles at each end. This it is claimed entirely overcomes the hammering and pounding of rail joints, crossings, switches, etc., causing the truck to ride smoothly over even a rough track. As may be seen from cut, the car body rides entirely on four full elliptic springs, placed one at each corner, the truck being connected to the car by two simple king bolts, which greatly facilitate the removal of the car body or a change of trucks. One special feature claimed for this construction is that the truck does not strain or twist the car body in service, as the side frame of the truck is not bolted to the side of the car. As will be seen the truck is built with an entire frame surrounding the wheels; the end bar

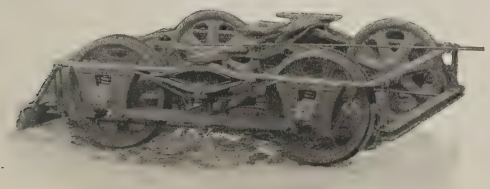


FIG. 3.—EMPIRE STATE RADIAL TRUCK

holds the truck absolutely square and the axles parallel, consequently the flanges of the wheels wear true and even. It is claimed that old wheels from Taylor trucks show excellent distribution of wear on flanges and treads for this reason. The disagreeable teetering of the car body is avoided by supporting it on elliptic springs. This would naturally have an important effect on reducing the wear of the trolley on the overhead wire and on the motors. It may be interesting to know why a teetering car seriously effects the motors. When a car begins to teeter, the end that first sags down causes an increase of weight on the pair of wheels on that end, then when it pitches the opposite way the weight is immediately relieved and transmitted to the other end, consequently there is a continual jerking of the motor, causing serious back-lash of the gears, which is the most destructive element known in gear construction. The wear of the wheels is also increased on account of the continual slipping when the weight is relieved on the end of the car that first pitches up. This feature is a serious factor in the life of motors, and the claim that it is overcome by the use of Taylor trucks is an important one.

The truck is equipped with a compound lever brake and equalizing lever, applying equal pressure on all four wheels at the same instant, thus each wheel is held steadily down a grade, and with a little extra force applied the car can be quickly stopped. A soft, tough iron shoe, about 15 ins. long, is used, which accurately fits the tread and flange of the wheel. Between the shoe and brake-head is an open space to allow circulation of air, to assist in keep the brake shoe cool on long grades. All brake rods are made extra heavy, and provided with a quick acting turn buckle, securely locked, to adjust the brakes. All the pins are steel, securely cottered, and made proportionately heavy for strength. The brake release spring is adjustable, so the shoes slightly clear the wheels when the brakes are idle. A worn out

FIG. 2.—SINGLE TRUCK WITH TRUSS EXTENSIONS FOR LONG CARS

brake shoe weighing about 2½ lbs. was exhibited, and attracted a great deal of attention, from point of economy.

Another notable feature is the simple extension truss for long open cars, as shown in Fig. 2. This extension truss has numerous advantages. The wheels can be taken out of the truck without removing it; the brake shoes can be changed from the outside of the truck without the necessity of running the car over a pit; it does not prevent easy riding of the car. One feature as will be seen is that the extension rods are connected to the truck frame and not to a lower truss rod; the former gives a most substantial support with no possible retarding action of the car body on the springs.

Fig. 3 shows the Taylor double truck, known as the Empire State Radial Truck, for use on long cars requiring double trucks. This style of truck has been in use about four years on large number of railways in this country and Canada, and has established a reputation in service for simplicity, strength and easy riding qualities. A car mounted on these trucks rides as smoothly and easily as a first class passenger coach, and is safe to run at high rates of speed; in fact, there has never been a complaint of these trucks derailing. Manufacturers of electric motors say they have the least trouble reported from their various makes of motors that are mounted on the Taylor double truck of any that are in service. This feature alone should attract the attention of electric railway managers. The car body is mounted as low as the motors will admit, using only one step on either open or closed cars. They are constructed to receive

one motor on each truck, two to a car, or two motors on each truck, four to a car. A notable feature of these trucks is the excellence of the brakes. The point of pull being located very close to the king bolt, there is no tendency of the shoes closing against the wheels

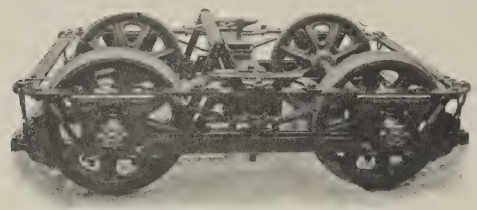


FIG. 4.—ELECTRIC LOCOMOTIVE TRUCK

when the truck is on curves. This feature will be appreciated by those using long cars on double trucks.

In Fig. 4 is shown the company's recent locomotive truck, designed to haul ten or more loaded freight cars. The main frame of this truck is of a very heavy steel, all the cast parts being of malleable steel with heavy bolts accurately fitted. There are two heavy thrust bars extending from the inside leg of each jaw. This feature will be recognized by all who are familiar with modern locomotive construction. The main frame of the truck is constructed to entirely overcome the twisting strains due to the uneven slipping of wheels, which is sometimes caused by one rail being wet. The truck is constructed to bring the center line of the axles directly against the above mentioned thrust bars. Many electric railway men who have had experience in hauling freight with an electric locomotive, find serious difficulty with the twisting of the truck bolsters, caused by the bumping and jerking of the car couplings. This feature is entirely overcome in this truck by a heavy steel arc, accurately fitted and shrunk when hot on the top of the bolster, and is firmly bolted to the side frame of the truck as shown. The brakes are extra heavy in all parts, with proper leverage so the motorneer may have full control of his train, and is arranged that an air brake can be attached if desired.

Special attention is directed by the manufacturers to the fact that the wheels and axles, brake-heads, brake shoes, journal boxes and bearings in both the Taylor single and double trucks are made interchangeable. All manufacturing details of these trucks are carried on under the direct supervision of the manager, John Taylor, who is a thoroughly practical railway man, and well posted on the needs of street railway managers so far as trucks are concerned.

Recent Tests of Plastic Rail Bonds

Reference has already been made in the STREET RAILWAY JOURNAL to the adoption of the Brown plastic rail bond by the government engineers of New South Wales for the return connections on the electric railway system now being installed in Sydney. This bond was only adopted after a careful test of its ability to withstand corrosion and deterioration, and some particulars of the tests employed to determine these qualities are of interest.

They were of two kinds, one to determine the action of acidulated water upon the plastic material, the other the effect upon it of salt water. In the first test a small area on a piece of polished steel was covered with amalgam and on this amalgamated portion a piece of the plastic material was placed. The steel was then immersed in a solution of sulphuric acid and water and allowed to remain there for three months. Upon its removal the steel was quite badly corroded except on the portion covered by the amalgam, while the plastic material remained intact and unchanged. The second test consisted in bolting up a simple joint composed of short sections girder rails with the usual angle plates, connected and bonded with the plastic bond. After the electric conductivity of this joint was measured it was attached to a chain and immersed in Sydney Harbor for a period of three months. At the end of that time it was removed and while the steel portions were badly rusted an electrical conductivity test showed the resistance of the joint had not only not increased but was actually lower than before.

Electricity and Compressed Air in a Modern Car Shop

A good example of modern methods in the distribution of power for small machines and multifarious uses is given in the works of the Barney & Smith Car Company, at Dayton, O. The cars of this company are well known among street railway managers, but the latter are less acquainted with the fact that this company's factory presents a most interesting example of the modern scientific methods of the distribution of power all through the works by compressed air and electricity.

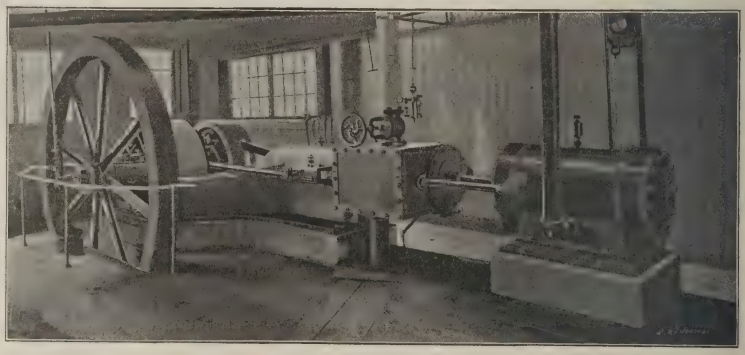


FIG. 1.—ENGINE AND AIR COMPRESSOR

The power house of the company contains a specially built General Electric direct current multipolar 207 k. w. generator, wound for 230 volts, and belted to a 20 x 40 ins. Buckeye engine running at 100 revolutions per minute. Cables of 800,000 c.m. run from the switchboard of this generator to a center of electric power distribution, which is on the peak of the power house. From this point the current is distributed by three cables, two of 500,000 c. m., and

FIG. 2.—TRANSFER TABLE

one of 400,000 c, m., to different points about the extensive works in which the power is used. The present motor equipment comprises two 5 h. p. motors; six 10 h. p. motors, one 15 h. p. motor; two 20 h. p. motors; five 30 h. p. motors, and one 50 h. p. motor, all of the slow speed mulipolar type, and one G. E. 800 railway motor.

These motors are distributed throughout ten different buildings and require for their installation over 1½ miles of weatherproof cable from 00 to 800,000 c. m. The motors are used to drive machine tools of every description, fans, etc. The G. E. 800 motor is employed on a transfer table. It not only propels the table along its track, but is also geared to a winding drum by means of which the cars are pulled on and off the table. This installation of electric

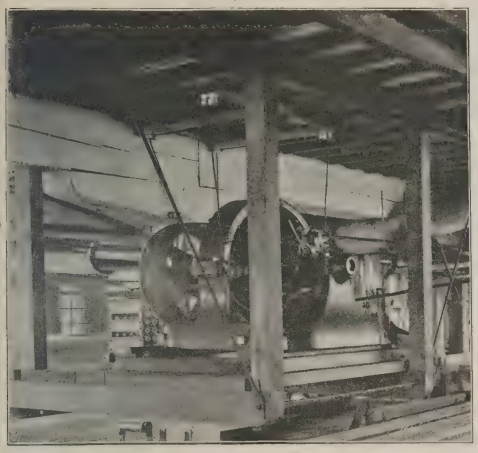


FIG. 3.—OVERHEAD HUNG MOTOR OPERATING WOOD-WORKING MACHINERY

machinery enables two men to do the work that formerly required from fifteen to twenty men.

The distribution of power is not only extremely efficient, but has been found to be much more satisfactory than former methods. One of the most noticeable benefits derived has been in the steady blast supplied by the motor-driven fans which are used in the foundry. At present only a small portion of the works is lighted by electricity. There are in use 600 16 c. p. incandescent lamps, and two 2000 c. p. enclosed arc lamps.

The possession of this electric plant enables the employes of the company to test the street cars which they wire; thus they can guarantee each car to be in proper running order when it leaves the works. It is the intention of the company to add to this plant from time to time, so that the entire works will be eventually equipped with electric light and power.

Fig. 1 shows the compressor of the compressed air system with which the works are equipped. The compressor is of the Brownell type and has a capacity of 500 cu. ft. of air per minute, which is compressed to a pressure of 80 lbs. per square inch. The compressed air is used for operating air hoists in the foundry for handling the ladles of molten iron, in the machine shop at the axle lathe, and in the yards for unloading cars of iron, lumber and various other heavy materials. The air is also employed to advantage for driving portable drills, rivetters, and clipping machines, and for operating freight elevators. The major portion of the compressed air system was built in the company's shops. The electrical equipment was purchased from the General Electric Company, but was installed by the Barney & Smith Car Company.

THE Columbus Street Railway Company, on Nov. 24, announced to its employes that they would present to men who had been in its employ ten years two uniform suits, and to those who had been five years one suit. To the former was allowed the privilege of wearing two gold stripes on their sleeves and to the latter one. In future a gold stripe will be accorded to each employe for each five years of service.

A Modern Gear Plant

The astonishing growth during recent years of the electric street railway industry, has led to an equally rapid development in the manufacture of gears for use with railway motors. The railway motor and motor gear and pinion are coeval, but during the life of the motor many sets of gears and pinions are necessary. To-day when the number of motors in use reaches well toward the hundred thousand, the demand for gears and pinions is enormous, and at no time in the past has it reached its present proportions. A mild estimate places the number of electric railway motor gears in daily use, in the United States alone, at 50,000 at least, and as the average life of the gear is about two years, a yearly output of from 20,000 to 30,000 is necessary for renewals alone, exclusive of those required for new motors.

In the pioneer days of the electric street railway, the cast iron gear and pinion of gun-metal were used exclusively. Experience and time necessarily brought about improvements and changes. To-day the standard motor gears are of cast steel and the pinions of hammered steel, while the teeth are accurately cut from the solid stock by machines as perfect in their adjustment and performance for their work as those which cut the more delicate gears of higher class machinery. The change from cast iron to steel has resulted in a reduction of some 60 lbs. to 70 lbs. in the weight of the gears, while their life has been very materially increased. A steel gear will usually wear more than twice as long as a cast iron gear, and while with the latter type breakage was a common occurrence, with the steel gear breakage is practically unknown.

To supply gears which would carry in themselves a guarantee of perfection, the General Electric Company established some time ago, at its River Works, Lynn, Mass., a plant for the manufacture of gears and pinions. This plant is a model of its kind. The cutting machinery is of the most modern character, and the entire plant is laid out on a comprehensive scale. The building contains an extensive foundry for the gear blanks, as well as the gear cutting shop. The former is equipped with overhead traveling cranes, driven by electric motors, furnaces for the molten metal, core ovens, and modern appliances of all kinds for the manufacture of steel castings of the highest grade. The great difficulty encountered in making steel castings—the tendency to blow-holes, draws and cracks—has been overcome in this foundry. After a long series of experiments, the General Electric Company perfected a process which now enables the foundry man to produce steel castings which are as practically perfect as if of hammered steel.

Fig. 1 shows an interior view of the shop, that side devoted to the milling machines, gear cutters, key seating machines, special

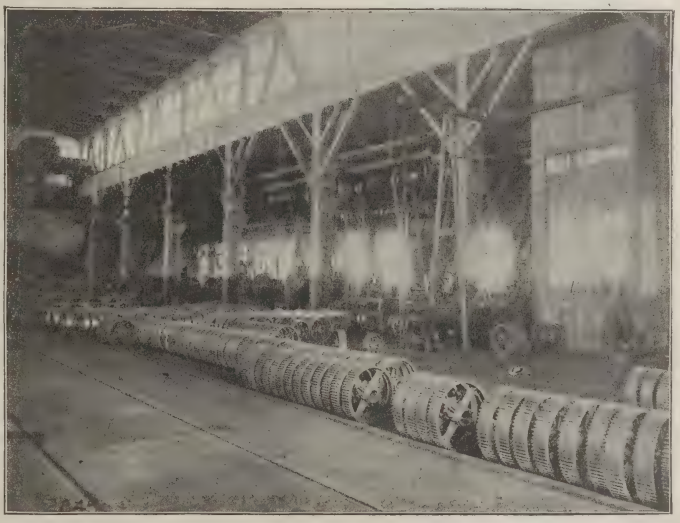


FIG. 1.—MACHINE SHOP—GEAR DEPARTMENT—LYNN

drill presses for drilling the bolt-holes in the gears and others. Some idea of the extent of the industry may be gathered from the number of gears in the foreground standing ready for shipment on order or removal to the stock room. Fig. 3 is a nearer view of some of the special drill presses, milling machines, etc., with a lot of gears in course of preparation for the teeth cutting machines. Fig. 2 shows a steel gear, bolted together and machined, with part of the teeth cut. These teeth are cut from the solid stock by specially made cutters, themselves designed after exhaustive, experiment. The machines used are both elaborate and expensive and are of un-

usually heavy design and accurate workmanship. They are all fitted with ingenious devices for producing uniform teeth. The pinions are cut from the best hammered steel forgings, and the teeth are cut with the same care as is taken in the cutting of the gears. All, that is both pinions and gears, undergo a rigid inspection before shipment.

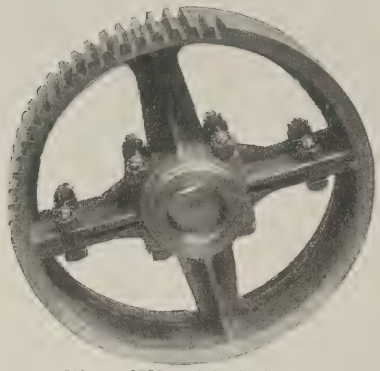
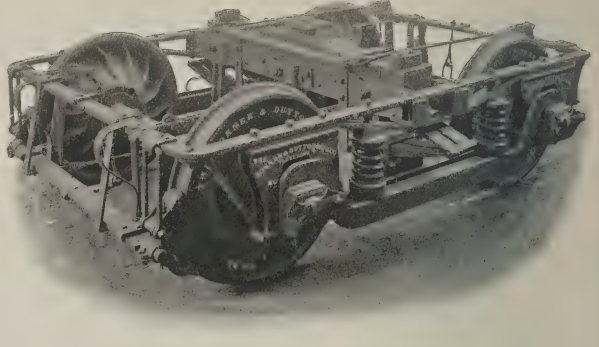


FIG. 3.—STEEL GEAR PARTLY CUT



HEAVY ELECTRIC TRUCK

The question of age of gears has not, perhaps, received from street railway managers the attention it deserves. In the life of gears there is a distinct difference between the extreme life and the proper economical life. There is a point in the age of gear and

FIG. 3.—VIEW DOWN CENTER OF GEAR SHOP

pinion at which it becomes more economical to consign them to the scrap heap, and to use a new gear and pinion, than to retain them in service. The question is a nice one and a series of efficiency tests have recently been carried out. While the results are not yet collated, it may be said that a worn gear and pinion require some 400 watts more energy than a new gear and pinion. This is a statement made authoritively, and one which will give food for profitable thought to managers of electric railways.

Truck for Heavy Electric Service

The accompanying engraving illustrates the No. 30 double truck built by the Dorner & Dutton Company, for heavy electric railway service under double truck cars. The truck was exhibited at the Niagara Falls Convention in the space occupied by the Walker Company, by whom it was equipped with motors, and attracted a great deal of interest and attention.

As will be seen, the truck follows very closely the lines adopted by the master car builders as standard on steam roads, and the principal claims made for it are easy riding and the ease with which it takes curves on account of the swinging bolster. The equalizing bars are forgings, and are designed to allow the truck to come down low enough to make the step from the ground into the car an easy one. The pedestals are of cast iron. The center part of the bolsters is of oak. Oak, in preference to iron or steel, as it deadens the sound and stops any metallic ring. The wheel base is 6 ft. 9 ins., giving ample room for the largest size motors made at the present time. The brake rigging is of the latest style, a change having been made in the equalizing bars to give a greater leverage than previously. The truck can be operated without air or friction brakes. The weight of the truck is 5000 lbs.

The manufacturers use an extra heavy top frame, giving additional strength to the truck, and also provide braces at each end on which to hang guards, providing against any possible accident in case any of the hangers were to break. In such an event these guards would prevent the brake rigging falling to the ground and probably prevent a wreck. There are also extra hanger guards on each side of the bolster which are utilized to provide against any accident that may occur to the motor or the motor supports. This is a feature, it is claimed, that is not used on any other truck, except possibly on trucks that are under the Pullman palace cars.

The manufacturers use their heavy pattern 450 lb. double plate wheel with a tread of 2⅝ ins. and a flange of 1 in. This is amply strong enough for running at high speed on interurban roads. With these wheels are employed malleable iron brake heads with a cast iron slipper, which are easily replaced with a key when worn out. The boxes are self oiling and do not need any attention for six months.

Recent Contracts for the Cast Welded Joint

The cast welded joint as supplied by the Falk Manufacturing Company seems to be adding to the number of its admirers, judging from the contracts that the company is receiving and the unsolicited testimonials expressed in the superiority of the joint and faith in the company's patents. Among the recent companies who adopted the joint is the Capital Traction Company, of Washington, which, as is well known, is making important changes in its road bed preparatory to the introduction of electric power. The company will employ the joint upon the entire length of its Pennsylvania Avenue and Fourteenth Street West lines; work will be commenced at once and finished this winter. The Union Depot Railway Company, of St. Louis, has also closed a contract with the Falk Manufacturing Company for between five and seven thousand cast welded joints for installation on the Guyer and California Avenue lines. Four thousand of these joints will be upon old 6 in. rail. The Citizens' Traction Company, Oshkosh, Wis., has also placed a contract with the Falk Company to build and equip 7 miles of their road with both track and overhead fixtures. The special work has been received from the Falk shops and everything is being put in place for quick operation.

The little booklet "A Joint Affair," distributed by the Falk Manufacturing Company at the Convention, is fully in keeping with this company's method of doing business—very satisfactory indeed. The quotation on the cover, "that is a good book that is opened with expectation and closed with profit," will be appreciated by every street railway manager.

A syndicate headed by John E. Searles, of Baltimore, Md., has bought the $3,000,000 first mortgage of the recently reorganized Columbia & Maryland Railway Company. This will give it complete control of the electric railway between Baltimore and Washington, on which over $2,800,000 has been spent. It is reported that the Southern Railway Company wishes to secure the line in order to get an outlet to Baltimore.

Opening of an Electric Railway at Bamberg, Germany

A successful trial was made on Oct. 22 of the new electric railway at Bamberg, Germany. The trial was made before a royal commission of experts from Munich, Nurenberg and Bayreuth, and the performance of the cars under difficult conditions up steep grades and around sharp curves evoked the hearty approval of the judges. A particular feature of the trial was the application of the electric brake, which is very popular abroad. In speaking of the occasion the local newspaper, the *Bamberger Neueste Nachrichten*, says "through these trials the electrical equipment of our railway has proved the fine workmanship and technical knowledge of its builders."

The cars are equipped throughout by the Walker Company, whose apparatus has achieved popularity abroad as well as at home.

Street Car Lamps

The important feature in lamps intended for use on railway circuits is long life without decrease in brilliancy. To secure this both mechanical strength and uniformity of product are essential. Railway lamps should be uniform not only in size, shape and appearance, but absolutely so in current consumption. Both length of life and sustained candle power depend upon such uniformity, and while the former is the most desirable characteristic, it should not be forgotten that lamps are primarily made to give light. Practically any length of life can be secured in lamps of low efficiency—lamps consuming a large amount of power; but power is not had for nothing, and while one lamp may last longer than another, it may consume so much current as to make it cost more than a lamp of shorter life consuming less current. Furthermore, a lamp may have a very long life, and yet be so dim as to make it worthless—consuming current without giving a proper return in life. The ideal lamp, therefore, is that in which the average life is combined with average candle power and energy consumed to give the best lighting service for the least cost, including lamp renewals and power consumed.

In the Edison railway incandescent lamp, the results above are

ROUND BULB RAILWAY LAMP

obtained, first, by its mechanical strength, the filament, of cellulose with a hard graphitic carbon coating, being so shaped and anchored as to protect it, as well as the bulb, from injuries likely to occur from the vibration and shock inseparable from street car service. The anchoring of the filament is essential. An unanchored filament must necessarily be so stiff and short as to limit the light to a small area. This reduces both the efficiency and sustained brilliancy of the lamp. The position of the anchor is also of importance. To anchor the lower end of the filament to the inside of the bulb is objected to by some on the ground that the filament is held too rigidly, exposing both it and the anchor to rupture in case of jar or shock. Rigidity can be eliminated by loosely resting the filament in the loop of the anchor, but the friction of the filament in the loop quickly wears it away. In the Edison lamp the anchor is set in the stem, and the vibration of the filament is rather checked than entirely prevented. It is thus not strained nor weakened, as both filament and anchor vibrate together, and no chance exists of the branches interlocking and short circuiting, as might perhaps be the case if one loop of the filament were anchored to the side of the bulb, and the other left free to vibrate and strike against it.

As railway lamps are operated in series, the current capacity should be uniform. Edison railway lamps are, therefore, made in three different classes—for 500 volt circuits, for 550 volt circuits and for 600 volt circuits—in each class the lamp being selected for a given amperage. The standard railway lamps have an efficiency of four watts per candle at full 16 c. p. They are fitted with the standard Edison screw base, or with bases to fit almost any make of socket.

For the decoration of cars or for headlights, or special locations in which a small compact bulb is required, the "round bulb" lamp is manufactured. Its filament is shaped and anchored as is the standard railway lamp, and both are furnished frosted or of almost any desired color—either artificially dipped or in natural glass. The engraving herewith shows the round bulb lamp—exact size and shape.

The best lamp can be so misused as to render it worthless, while by proper use the maximum of life and light is obtained. Proper use demands that the same amperage and make in lamps be used on the same car or series; that they be ordered to suit the total voltage of the circuit, and that the lamps which have become dim from age be at once replaced by new ones. And this last requirement is necessary if light is to be economically produced.

A New Controller

The Walker Company has brought out a new controller, which is named the Type S, and which comprises several notable features. The chief specialty of this controller is the device for blowing out the arcs, and it is claimed that it is superior to anything heretofore designed for such a purpose. The arcs are extinguished by a force generated in spiral solenoids of flat copper ribbon, which are imbedded in the partition separating the rings of the controller cylinder. By their influence the arc is driven outwards at right angles with the controller spindle, and is not forced against the insulating bridges, thus burning them. As there is no iron in the solenoid, there is no danger of grounding the controller rings by means of the arc jumping to such exposed pieces of metal.

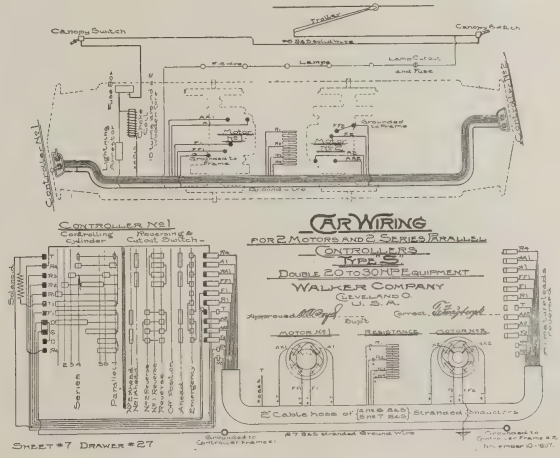


DIAGRAM OF WIRING FOR "S" CONTROLLER

The low self induction of the solenoids enables them to be cut out of circuit at all times, except at the instant that they are needed; thus power is saved. An iron magnet requires to be continuously in circuit, for should it be cut out in the manner above described it would not have time when cut in to magnetize sufficiently to blow out the arc before the latter had done its destructive work. The arrangement in the Walker Type S controller is such that the cylinders are as easily accessible as those in which no blow out devices are employed. The controller is not in the slightest degree complicated by the addition of the solenoidal blow out, and the life of its contacts is greatly enhanced.

The connections of the new controller are shown in the engraving. The reverse lever has seven notches. Two are for forward and backward operation of both motors. Four more enable either motor to be operated forward or backward singly. The

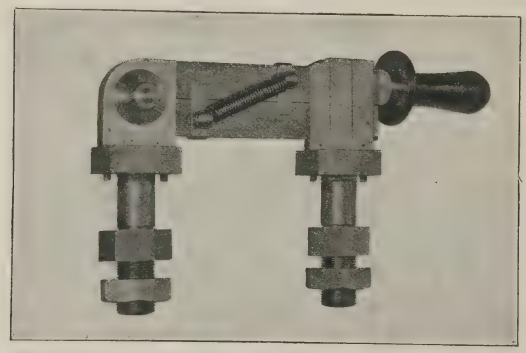
seventh notch consists of an emergency stop, and short circuits the motors through a portion of the controlling resistance. The back drag dynamo action of the motors quickly brings the car to rest, and this arrangement does not in any way strain the construction of the motors.

"S" CONTROLLER

The interlocking of the handles is electro magnetic. The reverse lever is locked whenever current passes through the controller by means of an electro magnetic device, which was described in the October number of the Journal. Obviously, the controller handle must be turned to "off," before the reverse lever can be released, and yet at such times when the controller is not controlling the handles can be manipulated in any way desired; thus the exact idea of an interlocking system is attained.

Quick Break Switches for Railway Service

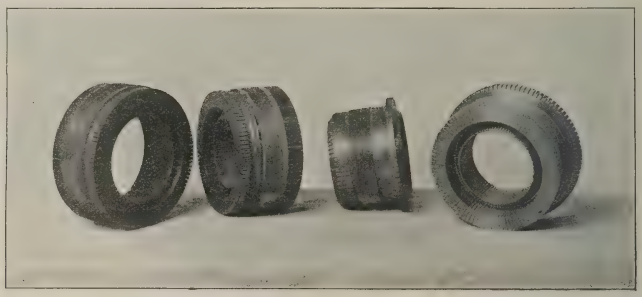
Quick break switches for use on circuits of nominal 500 volts demand a high degree of accuracy of contact and positiveness of action to enable them to properly fulfil their duties. Those manufactured by the General Electric Company are constructed with these ends in view. The switch blade contact consists of two pieces laid edge to edge and connected to a common hinge. They are also connected by a pair of spiral springs, one on each side. Both sections of the blade make connection with the contact clip. In opening the switch, the outer section of the blade, to which the insulated handle is attached, is withdrawn to an angle of 30 degs. before the inner section moves. The inner half of the blade then begins to move, forced from the clip by positive action. As it leaves the clip it is drawn smartly up to the outer half of the blade by the action of the tension springs. The result is an extremely quick break and a wide gap, over which an arc cannot hold. Switches of this type are made in various capacities for both single and double throw, with or without bases, with either front or back connections, except with the 1800, 3600 and 500 ampere switches, which are not furnished with bases except on special order. Single pole switches, three point, four point, etc., are also manufactured by the General Electric Company and are of great convenience in many cases. They swivel at the hinge connection and may control any reasonable number of circuits. Like the standard switches, they are built with bases or back connections for switchboards as desired. The base of the 50 amp. switch is of porcelain; of the larger sizes slate.



QUICK BREAK SWITCH

Repair of Motor Commutators

The standardizing of railway motors has brought about a demand for a cheaper, quicker and better method of supplying repair parts. This is especially true in regard to the renewal of commutators. J. C. Dolph & Company are now making a specialty of supplying parts of commutators as well as completed commutators of all the standard types. In this way this company has aided materially in overcoming the vexatious delays incident to and attendant upon the sending away of parts of electrical machinery for repairs. The railway manager can anticipate his wants in this respect, and by keeping a few assembled commutators in stock, avoid any continued interruption of car service.



SET OF MOTOR COMMUTATORS

In the accompanying illustrations are shown four of the principal types of assembled commutators which are carried in stock by J. C. Dolph & Company. The first commutator is a G. E. 800, the second a G. E. 1000, the third a W. P. 50 and the fourth a Westinghouse No. 3. The best material obtainable is used in the construction of these commutators, and particular attention is paid to securing superior finish and workmanship.

Register Contract in Washington

Messrs. Mayer & Englund, Philadelphia, representatives of the International Register Company, Chicago, have secured the large and much coveted register contract from the Capital Traction Company, Washington, D. C. The Capital Company has adopted the plan of ringing the tickets and cash fares with two single type machines, one in each end of the car. Through an oversight the credit for securing this order for the International Register Company was not given to Messrs. Mayer & Englund in the last issue of the STREET RAILWAY JOURNAL, but to another gentleman. Both Messrs. Mayer & Englund and the International Register Company are to be congratulated upon securing this contract, as the adoption of the International "Iron Clad" register by such a large and important traction company, after a thorough investigation into the merits of the different fare registers, is a high testimonial to the substantial construction of the International machine.

Transfer of Gearless Motor Patents

The British Thomson-Houston Company has secured from Sidney H. Short the right to use his gearless motor inventions, which were patented in this country about six years ago and in Great Britain and Ireland on Jan. 22, 1892. Mr. Short's early and original work in the designing of gearless motors is well known to all street railway managers in this country, and the latest types developed by him before the control of the Short Electric Company was secured by the General Electric Company, are sure to find a large field in heavy electric railroad work abroad as well as in this country. It will be remembered that the Baltimore & Ohio electric locomotives were equipped with motors manufactured under Mr. Short's United States patents (controlled by the General Electric Company), and it is understood that one of the chief reasons for the acquisition of these patents by the British Thomson-Houston Company is the desire to use gearless motors in the equipment of the Central London Underground Railway now under contract.

Tests of Brake Shoes

The following abstract of laboratory tests made to determine the friction of "Diamond S" brake shoes will be of interest. These shoes are manufactured by The Sargent Company, and were illustrated in the October number of the STREET RAILWAY JOURNAL. The tests were made at the testing plant of the Master Car Builders' Association, at Wilmerding, on both steel-tired wheels and chilled wheels.

The apparatus used in making the tests is shown in the accompanying engraving, and was designed to reproduce the conditions of service so far as it is possible to do in laboratory work. A horizontal shaft, 7 ins. in diameter, supported in fixed bearings, has keyed on one end a 33-in. car wheel, and on the other end a clutch by means of which it may be connected to a jack shaft driven by a Westinghouse Standard engine. Secured to the shaft carrying the car wheel is a fly-wheel 48 ins. in diameter and 30 ins. across the face, built up of cast iron discs and steel-tired to make it secure against bursting. The total weight of the shaft, fly-wheel, car wheel and other revolving parts is 12,600 lbs., and the mass is so distributed that it has kinetic energy of 11,995 lbs. moving in a straight line with the same velocity as a point on the periphery of the car wheel. Twelve thousand pounds is taken to be the maximum load upon one journal of either a freight or passenger car, and hence the fly-wheel when in motion has the stored energy that in practice is overcome by braking a single car wheel.

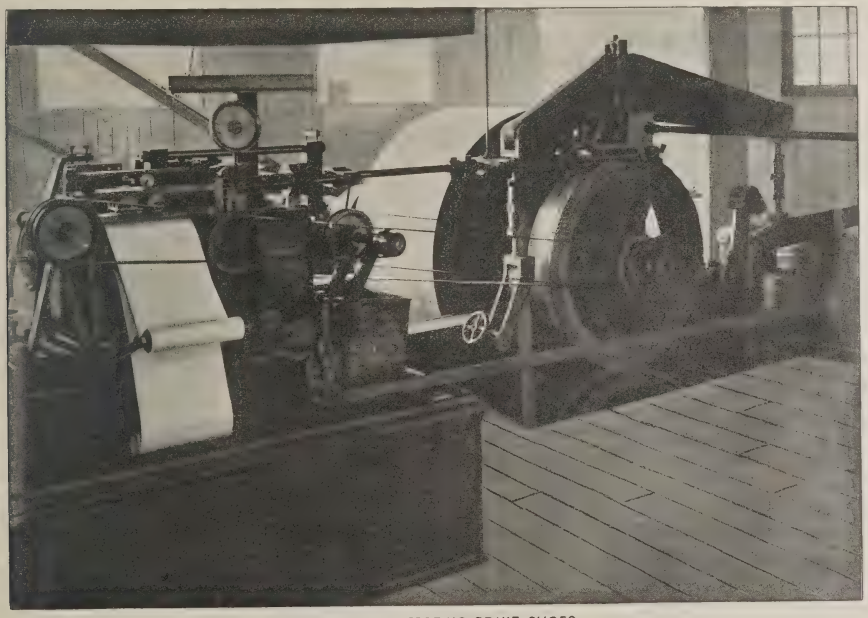
The brake shoe is applied to the wheel by means of a combination of two levers, to the first one of which the brakehead is attached in such manner that any wear of either wheel or shoe can be readily taken up by vertical adjustment. The desired braking pressure is obtained by suspending weights from the free end of the second lever. The dimensions of the levers make the ratio of braking pressure to the weight used as 24 to 1, and the levers alone are equivalent to 1233 lbs. weight at the free end. The shoe is keyed to the brake-head as in ordinary practice, and the latter is connected by rods and yokes with a dynamometer for measuring the friction between the shoe and wheel. Until the application is made the shoe is kept clear of the wheel, the levers being so supported by a pawl and rocking shaft that they may be easily tripped and the full braking pressure applied instantaneously.

In making a test the shoe is clear of the wheel, the clutch is thrown in and the engine started. When the fly-wheel has attained the desired velocity, as indicated by the gage of a Boyer speed recorder, the clutch is thrown out, the braking levers are tripped and the revolving mass is brought to rest by the action of the brake shoe upon the car wheel. In all tests the braking pressure remains constant after it is once applied.

The dynamometer is of the Emory type and will accurately measure any pull up to 3000 lbs. The pull on the brake shoe is transmitted to the dynamometer and the magnitude of the retarding force is measured by the deflection of a calibrated spring. The motion of the spring is transmitted by suitable levers to a small carriage on which a marking pencil is mounted, and this carriage rides between guides on a track, parallel to the axis of a revolving drum carrying the paper upon which the pencil registers. The drum is driven from the wheel shaft by means of belts and gearing, and hence a diagram is obtained, the length of which is proportional to the distance run and the height of which is proportional to the friction of the shoe on the wheel. A second pencil carried on the armature of an electriomagnet in circuit with a clock traces a time record from which the intial speed of the shaft is determined. A third pencil connected with the Boyer speed recorder traces a diagram the height of which is proportional to the velocity of the wheel.

The tests were made with a number of different speeds, and with several different braking pressures. Both soft and hard "Diamond S" brake shoes were tested. The principal results of these tests can be summarized into the following general statement:

The mean co-efficients of friction obtained from hard and soft "Diamond S" brake shoes appear to be in the majority of tests slightly greater for chilled than for steel-tired wheels, but the differences are so small that the friction of these shoes can be regarded as practically the same for both kinds of wheels. In general the soft "Diamond S" brake shoes tested give higher mean co-efficients of friction than "Diamond S" shoes of hard cast iron. The mean co-efficients of friction of the hard "Diamond S" brake shoes tried were higher than those of the plain shoes cast from the same metal. In the case of the soft "Diomond S" brake shoes the addition of the expanded metal does not appear to materially effect the friction, the results not showing a uniform tendency either to raise or to lower the mean co-efficient.



MACHINE FOR TESTING BRAKE SHOES

Tie Plates

Tie plates have been employed for some fifteen years, and to reduce the wear of the rails on the ties they seem to be as popular now as ever in their history. The Q. & C. Company has been an important factor in the development of the tie plate, and its Servis Tie Plate has had a wide adoption and is based upon theoretical principles. One of the most interesting pamphlets on the subject of rails and their appliances is one published by the Q. & C. Company entitled "Tie Plates: Answers to Questions often asked." The pamphlet is written in the form of questions and answers and goes carefully into the advantages claimed for the Servis plate and the principal features of its construction, why the form of its lower flanges are as they are, why the plate is set with its flanges in the direction of the grain of the tie instead of transversely to it, why the upper surface is flat instead of corrugated, and other important points. The pamphlet will afford interesting reading to those who are engaged in track construction.

STREET RAILWAY NEWS

The Walker Company—A Change in Ownership

Late last month it was announced that ex-Governor Roswell P. Flower, of New York; Anthony N. Brady, of Albany; J. W. Hinkley of Poughkeepsie, and Perry Belmont, of the firm of August Belmont & Company, who have all been for some two years past large owners of the stock and bonds of the Walker Company, had purchased the entire stock of the remaining owners, J. B. Perkins, Frank Billings, Sidney H. Short and others, and are to henceforth assume entire control of the company's development. It is understood that the other business interests of Mr. Perkins and Mr. Billings, are so large that they have been able to give but little time to the company's affairs of late, and that Mr. Short, who is now vice-president, and one of the most valuable "assets" of the company, through his long electric railway experience and great ability as an inventor and designer of electrical apparatus, will enter into even more intimate connection with the company's management than has been the case in the past.

The four gentlemen who are now to compose the Walker Company represent street railway interests aggregating in value $100,000,000. Ex-Governor Flower is the chief financial power in the Brooklyn Rapid Transit System, and Mr. Brady is the chairman of its board of directors. Mr. Brady is also interested in street railway systems in Albany, Troy, Providence, Syracuse and other cities. The firm of August Belmont & Company are the bankers for, and are interested in an even larger number of street railway properties. Major Hinkley is president of the Poughkeepsie City & Wappingers Falls Electric Railway Company. It would seem as if the market offered by these properties alone would be a very large one, and the influence exerted upon contracts for the equipment of other lines will also be great.

It is understood that the foreign business of the Walker Company will be developed very rapidly under the new ownership. The present staff of agents in the foreign department is doing most excellent work, and at the present time a large portion of the output of the Walker Company's factory is shipped to the other side of the water. In the United States also, the company's business is understood to be rapidly increasing, and its competition with the older companies is a decided factor in the placing of every contract. In its lighting department it is taking high rank, among its larger contracts being one for the complete electric lighting plant of the Waldorf-Astoria Hotel in New York.

House Warming of the American Society of Civil Engineers

The American Society of Civil Engineers formally opened the doors of its new building at No. 220 West Fifty-seventh Street, on Nov 24, and it was thronged with guests. Late in the afternoon there was a social gathering in the auditorium of the new house, where addresses were delivered by Benjamin M. Harrod, president of the society; General Greene, United States Army; General William P. Craighill, late chief of engineers, United States Army; president J. G. Schurman, of Cornell University, and Joseph H. Choate. Bishop Potter made a prayer. There was a large number of out-of-town members present at the opening, and some of them were accompanied by their wives or daughters. After the addresses there was a house warming, a reception and dancing.

No Smoking on Brooklyn Cars

The Brooklyn Heights Railroad Company has published a notice prohibiting smoking upon any portion of its cars.

THE elevated railway lines in Chicago are holding their increased traffic which was occasioned by the opening of the Union Loop. This line will undoubtedly grow more and more popular as the colder weather comes on.

A Comparison of Wages

Robert P. Porter in a recent article in a New York daily contributes some interesting data upon the different conditions of operating street railway systems in America and England. Among other points touched upon is that of wages, and he gives the following comparison of the wages paid by the Glasgow Corporation Tramways, of Glasgow, Scotland, and the Metropolitan Street Railway Company, of New York City.

GLASGOW.	Per Day.
Point boys	$0.28
Horse turners	34
Trace boys—First six months	40
Second six months	44
Thereafter	48
Horse keepers—First six months	80
Second six months	82
Thereafter	84
(And 24 cents for Sunday morning duty.)	
Sick horse keepers—First six months	84
Second six months	88
Thereafter	92
Car washers—First six months	84
Second six months	88
Second year	92
Thereafter	96
Drivers and conductors—First six months	92
Second six months	96
Second year	1.00
Third year	1.04
Thereafter	1.08

NEW YORK.	Per Day.
Point boys or switch boys	$1.00 to $1.25
Horse turners or changers	None.
Trace boys or tow boys	$1.00
Horse keepers or hostlers	1.75
Sick keepers or hospital men	1.75
Car washers	1.50
Horse car drivers	2 00
Horse car conductors	2 00
Cable gripmen, first year	2.25
Thereafter	2 40
Cable conductors, first year	2.00
Thereafter	2.25
Motormen, electric, first year	2.25
Thereafter	2.40
Electric car conductor, first year	2.00
Thereafter	2.25

The rates given for Glasgow apply equally to Sundays and week days.

Notes From England

(*By our London Correspondent*)

Some of the directors and shareholders of the Glasgow District Subway Company seemed at the half yearly meeting held in the end of October to be not particularly well pleased with the financial results of the past half year's working of their railway. But in this, I think, they were a little unreasonable. The profits, after paying interest on loans, permitted a dividend at the rate of 3 per cent on the 4 per cent preference shares, while the ordinary shares had to go without a dividend. But this is quite a usual state of matters in the early days of an expensive underground city railway. It is worth while to direct attention to the results of the working, for the subway is the only underground passenger railway in Britain employing cable traction. Up till now single cars, weighing about 9 tons each, have been used, and the total working expenses for the half year were about twelve cents per car mile—surely a pretty good showing. They will probably come lower as the traffic increases and when trains of two cars each begin running, which will soon be the case.

The receipts were twenty-five cents per car mile, so that the ratio of expenses to receipts was only about 48 per cent. There is nothing to grumble at there, especially when comparison is made with the two English city electric railways which have their own right of way. At present the percentage of expenses to receipts on the Liverpool Electric Railway, which is an elevated line, is about 63½, and in the first half year of its existence the line showed a ratio of expenses to receipts of no less than 74.87 per cent. Similarly, the percentage on the City & South London Electric Railway (which is an underground line) is at present about 56, and in the first half year it was 79. Both these railways are now regularly paying small dividends on ordinary stock. The Glasgow Subway is more heavily capitalized than the Liverpool line, but much less so than the London one. Accordingly there is no question of the working expenses in Glasgow being exceptionally high; quite the reverse. What Glasgow wants—and what it will probably get—is more traffic. The fares are very low, so that a very large business will have to be done. Glasgow is already carrying more passengers per mile of track than Liverpool, but not nearly so many as London. No doubt

the Glasgow expenses per ton mile will decrease as the business increases, seeing that cable haulage is employed, and especially seeing that the power house machinery and cables are designed to deal with a much heavier service than that with which they have at present to cope.

When speaking of the city of Glasgow, it should be mentioned that the project for consolidating the electric lighting and the tramway departments of the Town Council, to which reference was recently made in these notes, has fallen through, having been defeated by a narrow majority. Possibly it would have been cheaper to have conjoined the generating of electricity for lighting and traction purposes, but at all events by keeping them separate the public will know more exactly how each of two departments is paying.

All over the country one hears of municipalities determining that tramways shall be worked on the trolley wire system. The most important recent case is that of Manchester, where the Town Council have not only decided to use electricity but also—like Glasgow and some other cities—to work the lines themselves. Concurrently the fixing of contracts is going on briskly, and American manufacturers seem to be getting the lion's share of these, so far at least as the electrical equipment is concerned. There is no tendency at present manifested to follow the example of Edinburgh in adopting cable traction for street lines, but if and when a movement can be made in London the method of haulage would have much to recommend it, as the County Council are tooth and nail opposed to overhead wires, and the great straight tramway thoroughfares carrying an enormous traffic are eminently suited for cable working. The work of cable installation in Edinburgh is proceeding apace, and will be finished next summer. The scheme now embraces 32 miles of track on 16 miles of streets. It should suit such an excessively hilly city as Edinburgh, and besides that the Town Council would never tolerate overhead wires. Edinburgh, in fact, in more respects than one is another Washington.

News Notes

Amherst, Mass.—The Amherst & Sunderland Railway Company has made application for a franchise in Hadley.

Ann Arbor, Mich.—The Detroit, Ann Arbor & Ypsilanti Electric Railway Company is negotiating with the Detroit Citizens' Street Railway Company for the purchase of the old Fort Wayne & Belle Isle Railway power house, which it is expected will be removed to Wayne to furnish power for the new line.

Ashland, Pa.—The Ashland & Centralia Railway Company has been granted permission to build a street railway from Ashland to Centralia, a distance of 2 miles. Thomas M. Righter is president of the company.

Atlanta, Ga.—The Atlanta Railway Company has made application for permission to extend its lines.

Baltimore, Md.—The Garrison Avenue Railroad Company has been incorporated with a capital stock of $100,000 to build an electric railway along what is known as Garrison Avenue, in the city and suburbs. The incorporators include M. W. Offutt, W. A. House, Nelson Perin and others.

Boston, Mass.—The State Board of Railroad Commissioners on Nov. 23 refused to ratify the lease of the West End Street Railway to the Boston Elevated Railroad Company, on the ground that the transaction would be detrimental to the public welfare.

Carbondale, Pa.—The Carbondale & Forest City Electric Railway Company has made application for permission to extend its lines through Forest City.

Catskill, N. Y.—Franchises have been granted to the Catskill Electric Railway Company from Catskill to Cairo, a distance of twelve miles. It is expected that the road will be opened in the early spring. Louis E. Robert, 290 Halsey Street, Brooklyn, N. Y., is president.

Chatham, Ont.—The Chatham City & Suburban Street Railway Company is seeking an amendment to its charter so as to enable it to extend its line northwest of the city through the township of Dover, to Mitchell's Bay, Wallaceburg and Petrolea.

Chicago, Ill.—The Chicago, Milwaukee & St. Paul Railroad Company proposes to change the motive power of its line between Llewellyn Park and Sherman Park station to electricity.

THE Chicago City Council has passed an ordinance requiring vestibules to be placed on all the cars in the city.

Columbus, O.—The result of the meeting at Cleveland of the Reorganization Committee of the Columbus Central Street Railway Company will be the reorganization of the property by the bondholders after the entire system has been offered for sale by the receiver. The offer of the Columbus Street Railway Company to purchase the road was rejected.

Conshohocken, Pa.—The State Department has issued a charter to the Stoke-Pogis Railroad Company, to construct an electric railway from Rosemont to West Conshohocken, a distance of 3½ miles. The capital is $50,000. Frederick Phillips is the president of the company. The directors are Clinton Gage, J. M. Whitlan, William M. Kerr, George C. Shoff, Henry C. Landis and J. N. Trainor, of Philadelphia.

Doylestown, Pa.—A charter has been issued to the Doylestown & Willow Grove Traction Company to build electric railways in Bucks, Montgomery and Philadelphia counties. Capital $10,000. The incorporators are W. N. Walmsley, Carroll R. Williams and Joseph Jones, of Philadelphia; Samuel Steckel and George P. Brock, of Doylestown.

East St. Louis, Ill.—The St. Louis, Belleville & Suburban Railway Company has been incorporated with a capital stock of $350,000, and has elected the following board of directors: George Townsend, W. S. Reed and W. N. Horner, of Chicago; A. S. Wilderman, of Belleville, and John Niemes, of East St. Louis. The company intends to build a double track electric railway from East St. Louis to Belleville over the St. Clair County Turnpike, a distance of 14 miles. The work of grading the road has already been started.

Elgin, Ill.—The Elgin City Railway Company has filed for record a trust deed for $200,000, given to David S. Wegg, of Chicago, as trustee, to provide for the payment of an issue of $200,000 bonds running for ten years and bearing 5 per cent interest. The security given is the entire plant of the company.

Flint, Mich.—A franchise has been granted to Samuel W. Smith and Joseph E. Sawyer, of Pontiac, and George E. Taylor, of Flint, for the proposed electric railway from Pontiac to Flint. The route has been surveyed and work on the road will be begun by May 1, 1898.

Fort Scott, Kan.—The Citizens' Railway Company has been incorporated with a capital stock of $60,000, to construct an electric railway in Fort Scott. The directors of the company are W. B. Hurst, W. H. Frost, H. C. Pest, C. B. McDonald, W. D. Lowry, D. P. Thomas, Grant Hornaday, W. C. Perry and John H. Crain, all of Fort Scott.

Greenbush, N. Y.—The Greenbush & Nassau Electric Railway & Power Company has filed a mortgage to the State Trust Company, of New York, for $325,000. The mortgage is given as security for an issue of bonds to build the road.

Jackson, Miss.—It is stated that the city has closed a contract with E. C. Howard, of Chattanooga, Tenn., to build an electric railway and to supply the city with electric lights. Work is to be commenced immediately.

Kansas City, Mo.—The North East Electric Railway Company is considering an extension of its line in the suburbs, a distance of about 6 miles.

Kenton, O.—It is stated that Calvin Brice is at the head of a stock company, which proposes to build an electric railway to connect Kenton, Foraker, Alger and Roundhead.

Leominster, Mass.—The Fitchburg & Suburban Street Railway Company has been granted a franchise in Leominster.

Lexington, Mass.—The selectmen have granted a franchise to the Lexington Street Railway Company to build a line which will begin at Read Street, North Lexington, and run to a connection with the West End Street Railway at Arlington.

Lykens, Pa.—S. Ritter Ickes, of Harrisburg, the leading promotor of the Lykens & Williams Valley Electric Passenger Railway, is endeavoring to buy 4 miles of good second-hand girder and T rail for use in the construction of the line.

Mullica Hill, N. J.—The Gloucester County Board of Agriculture will hold a meeting Dec. 6, at which the subject of building an electric railway will be discussed. In all probability some decided action will be taken.

New Britain, Conn.—It is reported on good authority that the Meriden & Compounce Tramway Company wishes the Central Railway & Electric Company to extend its line from Plainville to connect with its proposed lines from Meriden. If the Central Railway & Electric Company will not extend its Plainville line, the Meriden Company hopes to secure by purchase the franchise of the Central Railway & Electric Company for the line between its terminus and Plainville. Surveyers are already at work on the line, staking it out from Meriden toward Southington.

New Orleans, La.—It is stated that the New Orleans & Carrollton Railroad Company has negotiated a loan of $250,000 for the construction of an extension of its lines to Southport.

Newark, N. J.—The committee appointed by the Third Ward Improvement Society, of East Orange, to see President Scheerer, of the Newark & South Orange Railway Company, in regard to building an electric railway in East Orange, states that Mr. Scheerer has promised to go over the ground and determine at an early date what can be done and to bring the matter to the attention of the directors of the road.

Newport, R. I.—The incorporators of the Middletown & Portsmouth Street Railway Company, which proposes to build an electric railway from Newport to Fall River, at a recent meeting elected Melville Bull, president; Edward A. Brown, vice-president; Philip L. Saltonstall, treasurer; Albert C. Landers, secretary.

Norfolk, Va.—R. Lancaster Williams, who conducted the transaction for the syndicate which purchased the property and franchises of the Norfolk Street Railway, states that a meeting o the syndicate is to be held in Baltimore at which the reorganization of the consolidated Norfolk street railways will be effected and the directorate for the ensuing year chosen. The syndicate virtually owns the Norfolk & Ocean View Railway, also having bought up the bonds and assumed the obligations of that road.

Oakland, Cal.—The Realty Syndicate Company has secured control of the Piedmont & Mountain View Railway. This syndicate already controls the California Improvement Company the California Railway Company and the Alameda, Oakland & Pied

mont Electric Railroad Company. S. P. Taylor is secretary of the Company.

Obion, Tenn.—The Obion & Tiptonville Rapid Transit Company has been incorporated by G. B. Morris, W. M. Wilson, R. S. Lyons, T. J. Ogilvie, J. H. McDowell and T. C. Wilson, to build an electric railway from Obion to Tiptonville.

Palmer, Mass.—The Palmer & Monson Street Railway Company has let the contract for the construction of its lines to Ley & Moulton, of Springfield, who propose to begin work at once.

Pasadena, Cal.—It is stated that the Pasadena & Los Angeles Electric Railway Company proposes to extend its lines from its present terminus at Lake Avenue to the foot of the trail leading up Mount Wilson.

Philadelphia, Pa.—A deal has been closed by which a prominent banking firm disposed of over twenty-five thousand shares (a controlling interest) of Hestonville, Mantua & Fairmount Passenger Railway Company stock, to persons who are known to be closely identified with the management of the Union Traction Company. As a result, it is said that the two companies will henceforth be operated jointly, and that the Hestonville line will actually pass into the control of the Union Traction Company.

Pittsburgh, Pa.—It is announced that the banking firm of Alexander Brown & Sons, of Baltimore, has closed a deal by which the capital stock of $20,000,000 of the United Traction Company, embracing 120 miles of street railways, has been transferred to a syndicate of capitalists in London, New York, Baltimore and Philadelphia.

Pontiac, Mich.—A preliminary survey of the proposed electric railway from Pontiac to Flint has been completed. S. W. Smith and Joseph E. Sawyer, of Pontiac, are interested.

Quincy, Mass.—The Quincy & Boston Street Railway Company has purchased a tract of land at Dorchester, on which a car shed will be erected.

St. Paul, Minn.—A movement is being made to have the St. Paul & Suburban Railway Company extend its lines to South St. Paul.

St. Thomas, Ont.—The City Council has decided to submit a by-law to the ratepayers to guarantee the bonds of the St. Thomas Street Railroad in consideration of the road being converted into an electric system.

Salisbury, N. C.—D. L. Risley, of Philadelphia, John S. Henderson and L. S. Overman are interested in the proposed electric railway to be built in Salisbury.

Vernon, B. C.—A franchise has been granted the Cascade Water Power & Light Company to build an electric railway through the lower country and furnish electric light and power.

Washington, D. C.—The Chesapeake Bay Railroad Company has purchased from the Maryland Southern Railway Company right of way for a railroad from Deanewood, D. C., to the Chesapeake Bay, and it is reported may build and equip it for electric traction. The Chesapeake Company is now building a line from a point on the Bay, about 25 miles south of Bay Ridge, to the District of Columbia.

Personals

Mr. H. J. Dressell has been appointed superintendent of the New Orleans Traction Company.

Mr. E. P. Millett has been elected president of the Henderson (Ky.) Street Railway Company.

Mr. R. T. Ives has secured a controlling interest in the Southington (Conn.) & Plantsville Tramway Company.

Mr. C. R. Vincent, of the Ball & Wood Company, was married last month to Miss M. E. Richardson, of Brooklyn.

Mr. Louis S. Wright has resigned as general manager of the Schuylkill Electric Railway Company of Pottsville, Pa.

Mr. Stephen Greene has been elected vice-president of the Bridgeton (N. J.) & Millville Traction Company, *vice* R. W. Clay.

Mr. Nelson W. Perry has resigned his position as editor of *Electricity* to engage in engineering work with Westinghouse, Church, Kerr & Com pany.

Mr. Justus Eck, engineer for Laing, Wharton & Down, electrical and contracting engineers, of London, is visiting this country. He expects to return to England about Dec. 15.

Mr. W. C. Weaver has been appointed general manager, superintendent and purchasing agent of the Northeast Electric Railway Company, of Kansas City, Mo., *vice* Mr. W. O. Hands, resigned.

Mr. Walter G. Whitmore, of the General Electric Company, was married October 12. Mr. Whitmore has been connected with the General Electric Company and its predecessors since 1889, and is the engineer of the New York office of the company.

Mr. P. A. B. Widener, of Philadelphia, who is well-known in street railway circles, tendered a dinner to a number of prominent Philadelphians at his residence, on November 24. Mr. Widener then made known that he intends to bestow upon the city of Philadelphia the fine residence he now occupies, together with his large collection of rare art treasures, as a memorial to his wife who recently died.

Mr. Auguste Boissonas, who is one of the engineers of the Metropolitan Railway of Paris, spe t a short time in New York last month. Mr. Boissonas stated that construction upon the Metropolitan Railway, which is a proposed underground system upon somewhat the same lines as the proposed rapid transit system in New York, would probably be commenced next spring. A company to build the line has already been formed with a capital of 25,000,000 fr.

Obituary

WILLIAM HOLLEY COTHREN died at Phœnix, Ariz., Nov. 11. He was graduated with high honors from Bowdoin College in 1884, and he was instructor for the succeeding two years in chemistry and physics. In the fall of 1888 he entered the service of the United Edison Manufacturing Company as traveling expert. This position he resigned to accept the position of Superintendent of Construction for the Edison Electric Illuminating Company, of New York, in which capacity he served for about a year and a half, resigning in the summer of 1890 to accept the position of Assistant District Manager for the Central District of the Edison General Electric Company, having its headquarters at Chicago. His duties in this position were of the most exacting nature and were always discharged with marked ability. In the summer of 1892, Mr. Cothren resigned his position, and shortly after accepted the position of Assistant General Manager of the Edison Electric Illuminating Company, of Cincinnati, which position he held until the spring of 1894, when he was obliged to give up his work on account of an illness which finally developed into consumption. From the spring of 1894 until the time of his death, Mr. Cothren resided successively in New York, Virginia, Florida, at his early home in Farmington, Me., and finally in Phœnix, Ariz., in the vain endeavor to check the inroads of the disease. At the time of his death he was but thirty-four years of age, and on the very threshold of a career which his education, training and ability fitted him to make a brilliant one.

AMONG THE MANUFACTURERS

The Corning Brake Shoe Company, of Buffalo, N. Y., has opened an Eastern office for the sale of the Corning brake shoe at 35 Nassau Street, New York City.

The International Register Company, of Chicago, reports a large amount of business and that its factory is turning out a larger number of registers than ever before.

The General Electric Company, during the months of June, July and August, received orders for 278 generators, aggregating nearly 14,000 k. w. for lighting purposes alone.

The Dorner & Dutton Company, of Cleveland, O., has now got nicely started in its new building and is running full on orders. This company has so equipped its factory that it will be able to reduce the cost of everything it manufactures.

The Consolidated Car Heating Company, of Albany, N. Y., through W. E. Cosper, its Chicago agent, has received a contract for the equipment with electric heaters of 100 cars for the Citizen's Street Railway Company of Indianapolis.

The Peckham Motor Truck & Wheel Company, of Kingston, N. Y., states that its works are busier this fall than they have been for three years past, being obliged to run overtime to take care of orders. More than half this company's business is on account of foreign orders received during the last month.

Jos. A. Hurd & Company, Wholesale Lumber Merchants, of Boston, Mass., are doing an excellent business in the supply of all kinds of ties for steam and electric railroads, in cedar, hackmetack, oak and pine both northern and southern; also squared, octagoned, and tapered telephone and electric railway poles, in cedar, hard pine, and chestnut.

The Aultman & Taylor Machinery Company, of Mansfield, O., received on Nov. 19, 13,000 h. p. in orders for boilers; 7000 h. p. of these orders were for the Cahall vertical type and 6000 h. p. for the Cahall-Babcock & Wilcox type. This is claimed to be the biggest single day's business that has ever been done by any boiler manufacturing concern since water tube boilers were invented.

The Pearson Jack Company has established its head office at 64 Federal Street, Boston, Mass. The company will maintain an office in New York at 245 Broadway. This office will be in charge of G. M. Brown, who is well known in connection with the Pearson jack, and will be known as the New York office of the Pearson Jack Company. Mr. Brown will be glad to see all his friends at this office.

Frank Samuel, of Philadelphia, who makes a specialty of the purchase and sale of scrap material of street railways, has purchased from the Capital Traction Company, of Washington, the power house of the company which was recenty destroyed by fire. There are in these ruins about 1500 tons of iron, composed of boilers, engines and various supplies, which Mr. Samuel will have for disposal.

The Link Belt Engineering Company, of Philadelphia, has recently published a very tasteful and attractively illustrated catalogue descriptive of its fuel and ash carriers and entitled, "The Link Belt Carrier." The catalogue contains detail engravings and descrip-

tions of the various parts of the carrier and diagramatic engravings of some of the installations made by the company. The catalogue is beautifully bound in dark green leather covers.

The Springfield Manufacturing Company, of Bridgeport, Conn., has sold one of its car wheel grinders to the Consolidated Traction Company, of Jersey City, N. J. The machine sold was the one which was on exhibition at the Niagara Falls Convention and which attracted much interest there. The company has also recently installed one of its grinders in the car house of the Metropolitan Street Railway Company, of Washington, D. C.

The Oriel Glass Company, of St. Louis, Mo., is sending the following letter to the trade: "If you have vestibuled cars or contemplate putting on vestibules, it will be of interest to you to know that we can now furnish you direct the bent glass used in the curved frames which enclose your cars. We have so reduced the cost of bent glass that all the manufacturers are now using it for the vestibules, etc. Write to us for prices and full information."

Harrington, Robinson & Company, of Boston, will, on Jan. 1, remove to their new offices No. 272-276 Franklin Street, where they will have more commodious quarters, having been compelled to take this step on account of the increase in their business. This firm has recently added to its business an engineering department, and is now in position to handle street railway engineering in all its branches, as well as structural work on buildings of all descriptions requiring steel.

The Gold Street Car Heating Company, of New York, is using for a conductor in its electric heaters a wire of special composition, and not of German silver. This wire has been employed in the heaters of the company for a long time, is of high resistance. and has been found to be proof against deterioration under all conditions met of moisture and temperature. The improved form of Gold heater, in which the wire is wound spirally on an enameled helix, was described in the last issue of the STREET RAILWAY JOURNAL.

The Gold Street Car Heating Company, of New York and Chicago, has published a new catalogue for 1897-98, of its different types of heaters. In the construction of these heaters this company has aimed to utilize all of the electrical energy consumed to the best advantage; that is, to secure the greatest possible amount of heat delivered into the car, for the least amount of current possible. The company believes the best way to accomplish this is to separate the air into very small portions, and to bring these portions in contact with the heated surfaces simultaneously.

Warren Webster & Company, of Camden, N. J., has recently received the following contracts in which the Webster system of steam heating is to be installed, covering old and new steam heating plants. The growth of the Webster system is apparent from the number of plants from whom orders have been received: Carry Apartment House, Washington, D. C.; Babbitt & White Apartment House, Washington, D. C.; Garmon Theological Seminary, Atlanta, Ga.; Eutaw House, Baltimore, Md.; Narragansett Hotel, Providence, R. I.; Cupples Station Buildings, St. Louis, Mo.; Missouri Medical College, St. Louis, Mo.

The Ball Engine Company, of Erie, Pa., is in receipt of the following letter from Julian Kennedy, the eminent steel works engineer, of Pittsburg, which refers to a 400 h. p. vertical engine direct connected to a Siemens-Halske generator: "I am in receipt of a letter from Mr. H. S. Loud, general manager of the Nicopol-Maripol Mining & Metallurgical Company's works in South Russia, in which among other things he says: 'The electric light plant is working beautifully. You would be doing an almost obligatory service in thanking both the Siemens-Halske and the Ball Engine people for me, for the very great satisfaction which their machinery has given this Company. The Ball Engine people were especially gracious in the prints, etc., sent, and their workmanship is magnificent.'"

Eugene Munsell & Company, and the Mica Insulator Company, New York and Chicago, announce that they carry at all times a large stock of their three great lines of insulation, "mica," "micanite," and M. I. C. compound, ready for prompt delivery; and are in a position to supply at short notice special forms of insulation for any system of electrical apparatus. They make a specialty of the prompt filling or orders, both from their stocks at New York and Chicago, as well as at their local agencies in the following cities: Cuyahoga Supply Company, Cleveland, O.; Arther S. Partridge, St. Louis, Mo.; Sinclair Randall, Cincinnati, O.; Brooks-Follis Electric Company, San Francisco, Cal. M. I. C. compound is their latest production, and is commanding considerable attention among the electrical trade.

The Central Electric Company, of Chicago, has received a large number of testimonials to the satisfaction given to users by its apparatus. Among the highly prized compliments held in its files is a letter from W. E. Brice, president and general manager of the Mason City & Clear Lake Traction Company, of Mason City, Ia. Mr. Brice writes to the Central Electric Company under date of July 9, 1897, as follows: "We have just completed 18 miles of electric railway, using your material for the entire overhead construction. We have found everything to be first-class, and can recommend your materials for the purposes for which we use them. The shipments have all been made very promptly." The fact that this road has proved of such interest to railway projectors in general, is the best kind of proof of the high standard reached by the railway department of the Central Electric Company.

The Berlin Iron Bridge Company, of East Berlin, Conn., states that the J. & E. Stevens Company, of Cromwell, Conn., manufacturers of toys of all descriptions, has awarded the contract for furnishing and erecting a complete set of buildings. The main foundry portion is 40 ft. wide and about 200 ft. long. The trusses have a clear span. The sides of this building have been designed so that it is well lighted by large mullion windows. On the roof are placed at suitable intervals, ventilators arranged with shutters so that they can be readily opened and closed for the purpose of ventilation. The cupola platform and floor is built of steel framework and covered with steel plates. Besides the foundry building proper, there are two small brick building having a steel roof. All the buildings are lined with Berlin patent lining. The Berlin Company is also erecting for the Newport News Ship Building & Dry Dock Company, of Newport News, Va., the steel foundations for a 140 ton crane: This crane is to be used for the placing of engines, boilers and other machinery in the large war vessels which they are constructing for the government, and will be also used for placing on the sides of these vessels their armor plates, some single pieces of which weigh from 40 to 50 tons. This crane revolves in a circle on a turn-table which is supported on a steel foundation about 25 ft. high. This steel foundation is to carry, besides its own weight, the weight of the crane, its machinery, and whatever load may be lifted, which altogether will aggregate 900 tons.

The McGuire Manufacturing Company, of Chicago, has nothing but the most encouraging re orts to offer, and advises that its sales the past month have exceeded the highwater mark of 1892. The company's works are running to their fullest capacity, and a night shift has again been put on, this being necessitated by the large number of orders for sweepers and stoves received from railways which have deferred ordering these articles until the last moment. The company was, however, prepared, and is fulfilling its promised deliveries in every case. That the company's combination snow plow and sweeper is popular in the East, which was formerly the home of the snow sweeper industry, is evidenced by the fact that 75 per cent of orders for sweepers this year have been from Eastern roads. The McGuire Company is in a position to deliver a few sweepers from stock immediately. The company's stove business is excellent, and as the cold weather approaches the orders increase daily. The success of the "New Columbia" stove is manifested by the hundreds of letters on file from users of this popular heater, and the willingness of the McGuire Company to send this stove anywhere in the United States on approval is indicative of the great confidence had in it. The company's truck department has been running nights and Sundays for the past month, and presents a busy scene, as the company is working on several large orders and is making large daily shipments. In the steam specialties the company reports an exceedingly large demand and states the year will close as the most prosperous on ine five years.

The Western Electric Company, of New York and Chicago, is placing upon the market an ornamental enclosed arc lamp similar in style to its standard enclosed arc lamp but finished in polished brass. The features of this enclosed arc lamp, have placed it in the front rank. The company is also having a large sale of its non-sparking brush, which is manufactured under Letters Patent No. 419,660. granted to Ludwig Gutmann, and is composed of a composition of high and low resistance metals. Although speaking tube is not an electrical article, it is closely associated with the electrical business, and the Western Electric Company is one of the largest manufacturers of speaking tubes in the world. The company is mailing to its customers a very handsome picture of a lion which is a reproduction from nature. This picture is a half tone printed upon a cardboard 11 ins. × 14 ins.,with a silk cord at the top for hanging. The company has furnished a room 18 ft. × 18 ft. in the rear of its Chicago store as a show room for fixtures. Numerous chandeliers and brackets have been placed in this room, and these have been wired up with 2-point, 3-point, 4-point and combination switches in order to show the methods by which lights in private houses may be controlled. A large variety of beautiful shades is shown on the fixtures. Five of the Western Electric enclosed arc lamps are also exhibited. The company issued under date of November, 1897, a handsome pamphlet devoted to line construction material and car and motor supplies, which will be promptly mailed to any address upon application. Many of the leading railways in the country have adopted "W. E." insulation in its various forms as a standard, and it has now stood the test of time in actual service and has proved to have high wearing and insulating qualities. The company calls special attention to its "W. E." sleet wheel. This wheel will remove the sleet from the trolley wire without damaging any part of it, having never been known to catch in an ear, frog or crossing. In anticipation of a large sale of these wheels during the present season a good sized stock has been made up from which prompt shipment will be made on all orders.

The Walker Company has two busy shops these days at Cleveland and New Haven, and a glance through the various departments, from draughting room to assembling shop would show many machines of many types in process of construction, to fill contracts on hand. The largest work in hand in this, or perhaps in any other shop at present, consists in building the two 1600 k. w. direct connected generators for the Brooklyn Heights Railroad, but this undertaking does not prevent active work on some of the smaller machines. Two 225 k. w. direct connected generators are being built for the Meadville Traction Company, of Meadville, Pa., and in addition to the generators and the station switchboard this railway company will use eight donble street car equipments of the Walker 4 A, 25 h. p. type. Five other railway generators are in process of con-

struction for the Paris tramways, three 200 k. w. of the belted type and two 300 k. w. direct connected. In addition to these railway generators, Walker Company is engaged in manufacturing three electrical locomotives for western copper mines. One of these is for a standard gage track, and the other two for a narrow 3 ft. gage. In designing and building narrow gage motor units of whatever nature the success of Walker Company is shown conclusively by the immense number of American and foreign orders for machines of this class filled during the past year. Among the isolated plants by the Walker Company now under way may be mentioned one at the St. Lawrence State Hospital, near Ogdensburg, N. Y., where the plant will consist of six direct connected generators, two each of 25, 50 and 75 k. w. capacity, respectively, besides a very complete switchboard. The R. G. Dunn Building, now being erected at the northeast corner of Broadway and Reade Streets, New York, will be lighted by three 100 k. w. direct connected Walker generators, and plants are to be placed in the Girard Building, Philadelphia (200 k. w. direct connected Walker generator), and in the new Wellington Hotel, Milwaukee, where two 150 k. w. machines will supply the light. Orders for over 125 equipments for European street railways are being filled, among them being one for the Ghent tramway in Belgium. The Bellaire Steel Company, of Bellaire, O., whose power plant consists of two 100 direct connected Walker generators, is about to more than double its capacity by the addition of a direct connected 250 k. w. machine. It will be seen from these facts that Walker apparatus enjoys the widest popularity, nor is the company backward in the design and manufacture of the more recent types of alternating machines, including generators of multiphase currents and rotary transformers.

New Publications

THE ADAMS CABLE CODEX. F. O. Houghton Company, Boston, Mass. 198 pages. Paper, 25 cents; cloth, 50 cents.

The messages seem to be well selected for a brief code of this character, and include personal as well as business communications.

ON THE RIGHT TO PLEDGE SECURITIES CARRIED ON A MARGIN. By Elliott Norton. Seven pages.

This is a review of the legal liability of a stockholder for conversion of a customer's securities carried on a margin. This can only be done legally in New York State, according to Mr. Norton, when the broker has securities of the same kind on hand or under his control, and does not have to purchase them in the market.

SLIDE VALVES. By C. W. McCord, Jr., M. E. Published by John Wiley & Sons, New York. 168 pages. Illustrated. Price, $2.

This is based upon a series of articles by the author recently published in *Power*, but revised and enlarged. The general principles of valve design are discussed and various well known types carefully illustrated and described. The author is an authority on the subject he treats.

THE MONEY QUESTION. By H. V. Poor. Published by H. V. & H. W. Poor, New York. 202 pages.

Mr. Poor has devoted a great deal of time and attention to financial subjects and believes that the solution of the money question lies in the establishment of a national bank. He presents a strong array of arguments in support of this position. The pamphlet is brought up to date, and contains references to and comments upon financial and political happenings of the present year.

THE STORY OF AMERICAN COALS. By W. J. Nicholls. Published by J. B. Lippincott Company, Philadelphia, Pa. 405 pages. Illustrated. Price, $3.50.

This work is not a comparison of the fuel value of the different kinds of American coal, as might be expected from its title, but a description of the American coal mining districts, the methods of mining and storing the coal and of shipping it to its destination. The book is gotten up in fine style, on good paper, and is of much interest. It contains an index.

THE RAILWAY BUILDER. Fifth edition. By W. J. Nicholls. Published by J. B. Lippincott Company, Philadelphia, Pa. 283 pages. Illustrated. Price, $2.

This is an excellent treatise on roadbed construction, written in rather a popular way, and describes the methods of making preliminary surveys for steam railroads, estimating the cost of construction and installing the track. Some particulars are also given of the cost of steam railroad equipment and of the different types of locomotives and cars used on the prominent lines. The book is well illustrated and has an index.

AMERICAN AND OTHER MACHINERY ABROAD. By F. J. Miller. Published by the American Machinist. Ninety pages. Price, fifty cents.

This gives in a very interesting way the results of a tour made during the past summer among the machine shops of Great Britain, Belgium, Prussia and St. Petersburg and throws much light upon the practices and opinions of machine tool builders and users abroad. Mr. Miller reports an extensive use abroad of American tools, and his comment upon European commercial methods and customs will be of value to all manufacturers seeking trade in the countries visited by him.

THE POWER CATECHISM. The Power Publishing Company, of New York. 226 pages. Illustrated. Price, $2.

This catechism is based upon a series of articles which have been recently published in *Power*, and takes up the general subject of boilers and their settings, combustion, firing, heating of feedwater, chimneys, piping, engines, pulleys, belting and shafting. The style is very clear, the illustrations, which are in outline, are good, and the volume contains a number of important tables useful to the steam engineer. As a whole, the book is exceedingly interesting and valuable, and the style in which it is written, that of questions and answers, is an excellent one for students and learners, as it helps to make clear to them points which might be abstruse to the beginner. The book contains a very complete index.

ELECTRIC POWER TRANSMISSION. A Practical Treatise for Practical Men. By Louis Bell, Ph. D., New York. The W. J. Johnston Company, 491 pages, 229 illustrations. Price, $2.50.

Written from the point of view of the man, engineer or not, who desires to know what can be accomplished by electrical power transmission, and by what processes the work is planned and carried out, this volume will be welcomed as a well conceived treatise on a timely subject. Discussion of theories and the derivation of formulas are happily omitted, the design being to set forth in the simplest possible manner the fundamental facts concerning present practice. When necessary to introduce theoretical considerations for the full understanding of principles, they are explained in the most direct way possible and always with a view to their practical bearing. Aside from its technical features the pages of this volume, like the other writings of Dr. Bell, are marked by a literary grace rare indeed among technical writers, and which adds a zest to their perusal. As one of the most important considerations to be dealt with in electric railway engineering is the distribution of power problem, there are few chapters in this book that will not directly appeal to those of that profession.

The opening chapter is on elementary principles, and deals in a masterly and original manner with the subject from a practical standpoint, and with reference to effects, divorced from any considerations as to the nature of electricity. Chapter II is on the conditions of power transmission, in which the sources of power are discussed and methods of transmission compared. Chapter III treats of power transmission by continuous currents, both by constant current and at constant potential. The following chapter is on some of the properties of alternating currents, and gives a most lucid and common sense explanation of the more important properties, such as inductance, reactance, lag, impedance, power factor, etc.

Power transmission by alternating currents forms the subject of Chapter V and is principally devoted to apparatus, the various types of generating machinery and motors, both single and polyphase, being described in principle and construction. The following chapter deals with current reorganizers or transformers, the rotary transformer being thoroughly considered. After a chapter on prime movers, mostly devoted to water power apparatus, comes an important chapter on hydraulic development. Chapter IX is on the organization of the power house, and Chapter X and XI on the line and line construction, both of which subjects are treated in thorough detail. Chapter XII treats of the important question of centres of distribution, which is here for the first time dealt with in a manner at once practical and thorough.

The final chapter is on "The Commercial Problem," which points out how to proceed in order to estimate whether or not in a given case electrical power can be furnished at a price below that of the prevailing cost of competing power. With the method and data here employed, any intelligent man at all conversant with the factors entering should be able to quickly settle this all important point.

Trade Catalogues

GOLD'S ELECTRIC HEATERS. Published by Gold Street Car Heating Company. Sixteen pages. Illustrated.

THE LINK BELT CARRIER, published by the Link Belt Engineering Company, of Philadelphia and New York. Forty-four pages. Illustrated.

List of Street Railway Patents

U. S. PATENTS ISSUED OCT. 19, TO NOV. 16, 1897, INCLUSIVE

OCT. 19.

SWITCH MECHANISM.—John Cudlip, Nesquehonnig, Pa. No. 591,821.

BRAKE MECHANISM.—Henry S. Goughnour, Johnstown, Pa. No. 591,836.

RAILWAY SWITCH.—Hans C. Lansen, Newman, Cal.—No. 591,852.

RAILWAY SWITCH MECHANISM.—M. T. Koch, Hub City, Wis. No. 592,009.

AUTOMATIC SWITCH.—George Bansall, Lilly, Pa. No. 592,043.

ELECTRIC CAR TRUCK.—Emil Lundquist, Pittsburg, Pa. No. 592,151.

In a truck for electric locomotives, the combination of two wheel-axles; a driving-motor solely mounted on the truck-frame between the axles, a motor shaft, having a pinion on either end

thereof; a motor-casing; said pinions each engaging a gear rotatively mounted in bearings in the extensions of the motor-casing and loosely surrounding the axles, said gears connected to the axles through flexible joints, consisting of sleeves loosely surrounding the axles, one end of each sleeve flexibly coupled to the axles and the other end similarly coupled to the gears.

ELECTRICAL RAILWAY.—Rudolph M. Hunter, Philadelphia, Pa. No. 592,225.

OCT. 26.

FENDER OR GUARD FOR TRAMWAY CARS.—David Dotson, Brooklyn, N. Y. No. 592,241.

RAIL HOLDER.—Jared I. Irwin and Andrew J. Irwin, Sandersville, Ga. No. 592,291.

In a holder of the class described, the combination with a series of clamp-sections, of a series of locking-blocks adapted to be applied to said sections, and springs for locking the blocks in their applied positions upon the sections, substantially as described.

RAILROAD SWITCH.—Charles Richey, Atlanta, Ga. No. 592,448.

CAR FENDER.—Jennie P. Duval, Kansas City, Mo. No. 592,516.

ELECTRIC RAILWAY.—Eben C. Crocker, Bridgeport, Conn. No. 592,528.

CAR FENDER.—Ernest Tortoiseshell, Paterson, N. J. No. 592,555.

JOINT FOR THIRD RAILS FOR ELECTRIC RAILWAYS.—Patrick Haley and Paul P. Thomson, Chicago, Ill. No. 592,565.

In a rail joint the combination with the adjacent end of two rails, of plates adapted to close the bottom and sides of the joint, and a good conductor filled in between the ends of the rails and held therein by said plates.

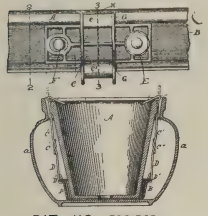
CAR BRAKE.—Cornelius Bresnahan, Detroit, Mich. No. 592,604.

This invention relates to that class of car brakes in which the brake shoes act upon the rails.

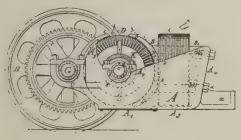
AUTOMATIC SWITCH.—Charles Partington, Newport, Ky No. 592,662.

CONDUIT-RAILWAY TROLLEY.—Wm. Luer, Chicago, Ill. No. 592,711

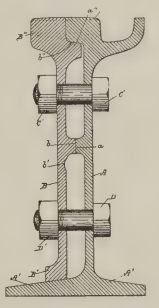
STREET CAR.—George F. Brown, Chicago, Ill. No. 592,749.



PAT. NO. 592,565



PAT. NO. 592,965



PAT. NO. 592,829

NOV. 2

RAILWAY RAIL.—John P. Richardson, Cambridge, Mass. No. 592,829.

In a duplex rail, a pair of rails, one of said rails having a base or foot inclined on its upper side and having a head at its upper end and an inclined surface below said head, and the other rail having a head at its upper end an inclined rib adapted to fit against the inclined surface of the opposite rail and having an inclined surface at its lower end adapted to fit against the inclined portion of the foot or base, means for fastening said rails together, and abutment ribs on the interior surfaces of said rails.

SWITCH OPERATING ATTACHMENT FOR STREET RAILWAY CARS.—Edmund L. Bullock, Hartford, Conn. No. 592,862.

SINGLE-RAIL RAILWAY CAR.—Frederick W. Dunton, Hollis, N. Y. No. 592,866.

HAND STRAP FOR CARS.—James S. Savage, Jr., and George R. Taylor, Buffalo, N. Y. No. 592,919.

TROLLEY WIRE HANGER.—Napoleon J. St. Hilaire, Gardner, Mass. No. 592,923.

TROLLEY FOR ELECTRIC CARS.—Elwood C. Davis, New York, N. Y. No. 592,928.

CAR FENDER.—Thomas H. Campbell, Beaver, Pa. No. 592,950.

ELECTRIC MOTOR FOR STREET CARS.—Charles E. Emery, Brooklyn, N. Y. No. 592,965.

An electric motor frame in the general form of a cup or cradle, capable of being made fluid tight, with the ends raised above the center to receive pole pieces and with the sides forming the field yokes cut down at the armature shaft bearings.

CAR FENDER.—William R. Forbes, Pittsburgh, Pa. No. 593,014.

ELECTRIC RAILWAY.—Rudolph M. Hunter, Philadelphia, Pa. No. 593,051.

MOTOR VEHICLE FOR SINGLE RAIL ELEVATED RAILWAYS.—Fritz B. Behr, London, England. No. 593,076.

CAR FENDER.—Ronald A. Stuart, New York, N. Y. No. 593,137.

CAR FENDER.—Henry W. Weiss, Quakertown, Pa. No. 593,142.

CURRENT COLLECTOR FOR ELECTRIC RAILWAYS.—Frederick A. Anderson, Washington, D. C. No. 593,154.

In a current-collector, a standard comprising a plurality of frame bars, conducting bars arranged between the frame bars and insulated therefrom, terminals arranged at the top of the standard, fuse blocks arranged in the upper portion of the standrrd, and fuses arranged exteriorly of the sides of the fuse-blocks.

NOV. 9.

PUSH BAR FOR TROLLEY CARS.—Wm. H. Thomas, Lahaska, Pa. No. 593,340.

RETURN WIRE CONNECTION FOR ELECTRIC RAILWAYS.—John H. Bickford, Salem, Mass. No. 593,369.

ELECTRICALLY ACTUATED SWITCH MECHANISM.—Walram S. Brown, Brooklyn, N. Y. No. 593,389.

TROLLEY POLE AND STAND.—F. A. Seaver, Hartford, Conn. No. 593,424.

RE-ISSUE—BRAKE SHOE CONNECTION.—John J. Kinzie, Jr., Pittsburg, Pa. No. 11,636.

RE-ISSUE—CAR FENDER.—Chas. F. Maisch, Philadelphia, Pa. No. 11,637.

NOV. 16.

AUTOMATIC RAILROAD SWITCH.—Adolphe Grossman, New Orleans, La. No. 593,650.

TROLLEY.—Oswald L. Kirsh, West View, Pa. No. 593,847.

STREET AND STATION INDICATOR.—S. E. Bisbee, South Pasadena, Cal. No. 593,956.

We will send copies of specifications and drawings complete of any of the above patents to any address upon receipt of fifteen cents. Give date and number of patent desired. THE STREET RAILWAY PUBLISHING COMPANY, HAVEMEYER BUILDING, NEW YORK.

A Few Press Comments on the October Issue of the Street Railway Journal

It is a splendid number.—*Niagara Falls Cataract.*

In character of contents and typographical appearance it is well worth attention.—*Commercial and Financial Chronicle.*

The October number of the STREET RAILWAY JOURNAL is one of the most creditable publications of its kind that has ever appeared.—*New Haven Leader.*

The STREET RAILWAY JOURNAL has published one of the best convention numbers any trade paper ever produced. It is interesting to anyone and must be especially so to street railway men.—*Niagara Falls Gazette.*

Those desiring to have a copy of the handsomest trade publication ever issued, should send their address to the office of the STREET RAILWAY JOURNAL. This is a banner number, and the interests it represents should feel proud of so worthy and able an exponent.—*Boston Herald.*

The STREET RAILWAY JOURNAL for October is a mammoth number, superbly printed and illustrated and contains a full report of the meeting of the New York State Association at Niagara Falls, while much space is given to full and beautifully pictured descriptions of the electric railways of the Niagara River region.—*Detroit Free Press.*

The October issue of the STREET RAILWAY JOURNAL, being the Niagara Falls convention number, is before us, and we do not hesitate to say that it about reaches the climax of the art of printing and special journalism. If we stayed up a few nights we might possibly find half a flaw in it somewhere, but we'd be too mean for anything to do that in view of such a splendid piece of work. If this journal continues to grow, a big truck will have to accompany each number. Every man, woman and kid interested in street railways should take this journal.—*American Investments and Financial Opinions.*

Abstract of the Tenth Annual Report of the West End Street Railway Company

BOSTON, Nov. 10, 1897.

To the Stockholders:

Your directors submit the following statement and report, covering the operations of your railway for the year ending Sept. 30, 1897.

Gross earnings	(Increase	$377,073.49)	$8,719,031.78
Operating expenses	(Decrease	120,910.58)	6,213,708.56
Net earnings	(Increase	$497,984.07)	$2,505,323.22
Taxes		$372,460.18	
Interest and rentals of leased roads and subway		507,915.38	
Total fixed charges			880,375.56
Balance			$1,624,947.66
Against which the dividend charges were as follows:			
8 per cent. dividend on preferred stock		$512,000.00	
3½ per cent. dividend on common stock, paid April 1		317,975.00	
4 per cent. dividend on common stock, to be paid Oct. 1		363,400.00	1,193,375.00
Balance			$431,572.66
Against which are charged value of tracks taken up, and bad debts, etc, written off		$449,258.49	
Less credit for transfer of insurance.			
Sinking fund		79,478.59	369,779.90
Surplus			$61,792.76

Notwithstanding the weather during the spring and summer months was quite unfavorable for the usual pleasure riding during the day and evening, the gross receipts of the road show quite a gain over the previous year. The same conditions have existed during the past year as was stated in the previous report. The running of the cars has been very much interrupted by the construction of the subway, the laying of pipes by the Metropolitan Water Board, and several large sewers which have been constructed by the city. While these interruptions are unavoidable, they entail quite an expense upon the road.

The past fiscal year has been marked by two events in connection with the company of more importance than any that have preceded them—the leasing and opening of the subway, and the leasing of the road to the Boston Elevated Railroad Company. On Dec. 15, 1896, a contract for a lease of the subway having been signed by the City of Boston and by the Transit Commission, and by your president, duly authorized by the board of directors, a special meeting of the stockholders was held and the contract was ratified by them. Subsequently the contract was approved by the Board of Railroad Commissioners, and became binding upon your company for twenty years, as provided in the contract.

The portions of the subway from the Public Garden, and from Tremont Street to Park Street station, were completed during the past season. The completed portions are believed to be constructed in the most permanent and substantial manner. The engineering skill which has been shown in the construction of this—the most extensive work of the kind in the country, when it is remembered that for a large part of its route it is under the most congested streets of the city—and the success of the engineers in overcoming the difficult problems which arose in the progress of the work, have been most favorably commented on by engineering experts from this country as well as from many foreign countries, who have professed great pleasure in the examination of the work.

The portion of the subway from the Public Garden to Park Street was opened for travel Sept. 1, 1897, that from Tremont Street and Shawmut Avenue to Park Street, Oct. 1, 1897. It is expected that during the coming year the portion from Park Street to the Union Station will be completed and opened for travel.

The portion of the subway in use at the prsent time is open for travel from six o'clock A. M. to twelve, midnight, during each day of the week. There are at present 1362 trips per day being run through the subway. In the immediate future three additional lines of cars will be added, making a total of 1790 regular trips per day, with extra trips as the travel demands. This, in the busy hours of the day, when the largest number of trips per hour is being run, will give from two to three cars a minute leaving Park Street, which is quite a tax upon the capacity of that station. Our returns show that nearly one-fifth of the passengers taking the cars in the subway during the day do so between the hours of five and six o'clock P.M., and that 90 per cent of these take cars at Park Street.

Our returns show that 7 per cent of the total number of passengers carried over the entire system are carried through the subway.

The number of total round trips made daily by cars north of Boylston, on Tremont Street to Union Station, Charlestown, Chelsea Ferry and Somerville, is 1757.

The cost to the company of equipping the portion of the subway already in use has been large, and when the remaining portion is completed a large outlay for equipment will be required. The contract for the use of the subway and the cost of the care of same, and the quite considerable force of men employed when the whole shall have been completed, will entail a large expense upon the company. As the charge for rental is based upon the cost, and as it can only be estimated at this time what part of the $7,000,000 authorized will be spent on construction, the charge to the company for rental can only be estimated; but the work has so far proceeded that it can be safely stated that the cost to the company for rental and expenses will be at least $350,000 per annum, and this with no account made of the expense of equipping the subway. With only a portion of the subway open for travel, and that having been in use but a short time, it is too early to expect any judgment of the effect of the subway when completed and in use, upon the travel of the road.

At the last session of the Legislature, an amendment to the charter of the Boston Elevated Railway Company authorized a lease of this company to be made to the Elevated Company. The terms of a lease having been agreed upon by the directors of both companies, on Sept. 9 of this year, a special meeting of the stockholders was held to take action upon the lease, a copy of which was presented to the meeting. By an almost unanimous vote the lease was approved and the president authorized to execute the same on behalf of this company; this has been done and the lease has also been executed by the president of the Boston Elevated Company, duly authorized. Before the lease should take effect, the act of the legislature authorizing it required the approval of the Board of Railroad Commissioners. The lease has been presented to the Board and awaits the action of the commissioners, which it is presumed will be given at an early day.

There have been purchased during the year one hundred and seventy-five nine-bench open cars. At the date of the annual report, September 30, 1897, the road was under contract for sixty 25 ft. box cars, which have since that date been received, but are not incliuded in the report.

Maintenance and repairs of track are a large item in the expenses of the Company. There has been expended during the year for this purpose $831,411.51. There has been used on new construction and on repairs of track 5,985 tons of rails. There has been expended for girder special work $116,372; for tram cast special work, $13,447. These items do not include the cost of laying the same.

The passenger car mileage for the year has been 29,786,936 miles, an increase over the previous year of 3,945,029 miles. The number of revenue passengers carried has been 172,554,513, an increase over the preceding year of 5,692,225. The number of free transfer passengers carried during the year has been 23,777,726, an increase over the previous year of 6,211,365. This makes the total number of passengers carried in the cars 196,332,239.

The number of employes in all departments is 5,095.

Respectfully submitted,

SAMUEL LITTLE, Pres.
For the Board of Directors.

Report of Earnings of the Montreal Street Railway Company

The business of the Montreal Street Railway Company for the year ending Sept. 30, as shown by the annual report just issued, is as follows:

	1892.	1896.	1897.
Gross receipts	$564,407	$1,265,898	$1,342,368
Operating expenses	466,648	710,865	736,429
Net earnings	97,762	555,034	605,939
" " per cent. on capital		11.55	12.41
Passengers carried	11,631,386	29,896,471	32,047,317

The immense increase in net earnings from $97,762 in 1892, to $605,939 in 1897, and of passengers carried from 11,600,000 to 32,000,000, is a striking commentary on the influence of electricity upon the financial characteristics of street railways and the service rendered to a community.

DIGEST OF CONTENTS.—DECEMBER, 1897

Abkürzung des Inhalts—November 1897

Bau der Unterirdischen Strassenbahn der Metropolitan Street Railway Company, New York . . . . . [Seite 825.]

Diese Strassenbahngesellschaft ist im Begriff ein 94 km. langes Netz von elektrischen Linien mit unterirdischen Leitung in der Stadt New York herzustellen. Der Kanal befindet sich in der Mitte des Pflasters und beträgt eine Tiefe von 775 mm. von dem Niveau des Pflasters bis zum Boden des Betons. Die Durchschnitt kosten stellen sich auf $100,000 pro eingleisige Meile (M. 240,000 pro km.) Der Bau wurde sehr beschleunigt, und um den Verkehr in dem belebtesten Theile der Stadt nicht zu beeinträchtigen, wurde eine Strecke von 2 km. in 24 Werktage vollendet. Für die Erzeugung des Stromes baut die Gesellschaft entlangs des Wasserufers eine Kraftstation von einer Fähigkeit von 70,000 Pferdestärke und der Strom wird mittels dem mehrphasischen System in den verschiedenen Theilen der Stadt vertheilt.

Die Kraftstation wird aus 11 Vertikalmaschinen von dem cross compound System mit Condensation von je 4000 P. S. bestehen; jede ist mit einem dreiphasigen Alternator von derselben Fähigkeit direkt verbunden. Es sollen von 8 bis 10 Hilfestationen errichtet werden.

Die elektrische Strassenbahn von Alexandrien, Egypten [Seite 834.]

Ausführlicher Bericht über die Eröffnung, letzten September, der neuen elektrischen Strassenbahn dieser Stadt. Die Feierlichkeit wurde durch den Khedive beigewohnt.

Betrieb.

Motoren für Elektrischen Bahnen. IV.—Motoren-Verschluss, von G. T. Hanchett . . . . . [Seite 835.]

In diesem Artikel beschreibt der Verfasser die Form und Umhüllung von allen Motoren welche in Amerika allgemein verwendet werden, unter welchen etliche der früheren Typen einbegriffen sind, und beweist wie und warum verschiedene Formen vorgezogen worden sind. Die moderne Praxis richtet sich nach dem vollständigen Verschluss der Motoren, obschon dies in einiger Weise die Luftziehung beeinträchtigt. Für den Hochbahn- oder ähnlichen Dienst der es ermöglicht, werden die Umhüllungen offen gelassen. Die grössere Ventilation welche durch dieses Verfahren verursacht wird, ist von grossem Vortheil für Motoren von besonderem Umfang, in welchen bedeutende Kraft in schmalem Raume gehaust werden soll. Die Fortschritte in der Zugänglichkeit der Motoren und in der Schmierung der Theilen werden ebenfalls ausführlich beschrieben.

Pleasure Bay, der Vergnügungsort der Atlantic Coast Line elektrischen Bahn . . . . . [Seite 840.]

Beschreibung eines neuen Vergnügungsorts welcher durch eine elektrische Bahn der New Jersey Seeküste zum Zweck einer vermehrnung des Verkehrs eingerichtet wurde. Die Gebaüde besitzen verschieden novellen Baueigenheiten, und unter den Attractionen befinden sich ein flössendes Theater, elektriche-Boote, u. s. w.

Finanzielle Erörterungen und Betriebsorganisation des Brooklyner Schnellverkehrsystems . . . . . [Seite 842.]

Beschreibung der Verwaltungsorganisation eines der grössten Strassenbahnensystemen in den Vereinigten-Staaten, welches über 80,000,000 Passagiere jährlich befördert, und dessen Brutto-Einnahmen während dem letzten Jahre sich nahezu auf $4,500,000 belief. Der Artikel ist durch ein eTafel illustrirt, welche die Verwaltungs- und Abtheilungschefs angiebt, und es wird erwiesen dass deren Gehalte sich auf 1½ pro-zent der Brutto-Einnahmen belaufen. In einer anderen Tafel wird ein Verzeichniss des Gesammt-Personnels jeder Abtheilung der Gesellschaft gegeben. Der Artikel illustrirt in einer vortrefflichen Weise die Verwaltungsmethode einer der bedeutendsten Amerikanischen Corporationen.

Briefe und Mittheilungen von Fachmännern.

Recension des Artikels von Dr. Emery über "Maschinen für den elektrischen Betrieb . . . . . [Seite 845.]

Dies ist eine Beantwortung durch Charles E. Emery auf einen in der Londoner "Electrical Review" erschienenen Brief welcher den in der Oktobernummer des STREET RAIWAY JOURNALS veröffentlichten Artikel über "Machinen für den elektrischen Betrieb" recensirt. Der durch ihn hauptsächlich erwähnte Punkt ist dass direkt verbundene Maschinen für elektrische Strassenbahnen nicht besonders stark gebaut zu sein brauchen um die in dem elektrischen Betrieb befindichen Stösse zu widerstehn, da die vorkommende Abweichungen Maximal-Kraftreduktionen sind, und infolge dessem sind die Windung auf dem Cylinder und die Abnützung der Theile minder mit einer veränderlichen Ladung als mit der Maximalladung. Dr. Emery erwidert dass eine plötzliche Zunahme in der Ladung ein Hemmung der Geschwindigkeit hervorruft. Das Schwungrad windet natürlich den Cylinder der Muschine, und alle beweglichen Theile der letzteren sind durch den Stoss zusammengebracht. Weiter erörtert er dass wenn die Ladung plötzlich vermindert wird, die Elasticität der Ladung und das Gewicht der beweglichen Theilene benfalls Stösse verursachen, da jedes Stück Metall gewissermassen als Feder wirkt. Auch sind die Seitanstrengungen mit schweren Ladungen verschiedener als mit leichten Ladungen.

Das Civildienst-Disciplinsystem, von George H. Davis. [Seite 846.]

Der Verfasser erwähnt die Thatsache dass das disciplinarische System der Canal & Claiborne Railway Co., wie es in seinem vor dem Amerikanischen Strassenbahnverein gelesenen Bericht beschrieben war, nicht das "Brown" System, wie es auf den Dampfbahnen angewendet wird, sondern ein der Bahn eigenes System ist, welches Mitbewerbung unter den Angestellten als Antrieb verwendet.

Ersparnisse in Kraftstationen . . . . . [Seite 846.]

Der Verfasser erörtert die durch N. H. Heft in der letzten Nummer des STREET RAILWAY JOURNALS veröffentlichte Angabe, dass er bei 4 mills pro Kilowattstunde Kraft vermittelst Lokomotivfunken, 70 cents pro Tonne kostend, erzeugen konnte, und bezieht sich ebenfalls auf zwei andere Kraftstationen, von denen die eine Kilowattstunde für 2 8 mills, mittels Kohle $2·40 pro Tonne kostend, und die andere eine Kilowattstunde für 3 mills, mittels Kohle $2.55 pro Tonne kostend, erzeugen konnte.

Arbeitsverlust in Reparaturwerkstätten . . . [Seite 846.]

Mittheilung über die Arbeitsverlustfrage in Strassenbahnen-Reparaturwerkstätten.

Rechtswesen . . . . . [Seite 847.]

Leitartikeln.

Der Anschlag der elektrischen Kraftstationen auf dei Heizungs einheit . . . . . [Seite 850.]

Das STREET RAILWAY JOURNAL *für 1898* . [Seite 850]

Der Postverkehr auf elektrischen und Kabelbahnen . [Seite 851.]

Die neuliche Construktion der Strassenbahn mit unterirdischer Leitung in New York . . . . . [Seite 851.]

Maschinen für den elektrischen Betrieb . .]Seite 852.]

Die Vertheidigung des Städtlichen Besitzes von Strassenbahnen. [Seite 853.]

Oberbau.

Schaltungsapparate der Schalttafeln in Zentralstationen, von George Moffat . . . . . [Seite 854.]

In diesem Artikel erörtert der Verfasser die verschiedene Gattungen von Umschalter, Rheostaten, Stromunterbrecher, Blitzableitern, u. s. w., welche in Zentralstationen für elektrische Bahnen benutzt werden, sowie die Grundsätze von denen sie abhängig sind, und die besten Verfahren für deren Bau, Einrichtung und Besorgung.

Harvard Kraftstation in Boston. . . . . [Seite 856.]

Beschreibung einer städtischen Kraftstation, welche in solcher Weise gebaut wurde, das sie später eine Fähigkeit von 7200 kw. leisten soll. Die Maschinen sind von der Kreuzverbund Type, mit Condensation. Die Generatoren besitzen eine Fähigkeit von je 1200 kw. und werden direkt betrieben. Die Centrale besitzt einen Versuchsraum.

Die Anlage der Marion City Railway Company . [Seite 857.]

Beschreibung einer Strassenbahn welche durch die Gasgegend fährt, und natürlichen Gas als Heizungsmaterial verwendet. Die Maschinen sind von der Compound Type, ohne Condensation, und zwei Generatoren von 200 kw. Fähigkeit werden benutzt.

Kostenverminderung der Dampfkraft von 1870 bis 1897, von F. W. Dean . . . . . [Seite 858.]

Die während dieser Zeit eingeführten Verbesserungen, welche den Dampfverbrauch per Pferdekraftstunde von 9 kg. auf 6 kg. erniedrigt haben, sind nach der Angabe des Verfassers besonders den folgenden Ursachen zuzuschreiben: der Einführung von Verbundmaschinen, der Verwendung eines Unterbrechers auf dem Niederdruckcylinder, des Ueberheizers und den höheren Drücken. Fernere Ersparnisse erweisen sich in der Richtung von Vertikalmaschinen, inwendig geheizten Vertikalkesseln, Economiseurs, verbesserten Rösten und übergeheizten Dampf.

Vergleichender Versuch von direkt verbundenen und durch Riemen getriebenen Eisenbahn Generatoren . . [Seite 859.]

Bericht über einen in Chester, Penn., stattgefundenen Versuch in einer Kraftstation. Die direkt verbundene Einheit bestand aus einer 20 und 36 zoll per 48 zoll Doppelverbund- Condensationsmaschine, welche durch einen 800 kw. Generator getrieben, und mittels 3 Pfund Kohle pro Kilowattstunde gewirkt wurde. Die durch Riemen gewirkte Einheit bestand aus einer 22 per 42 zoll eincylindrischen Machine welche einen 225 kw. Generator trieb, und 3 Pf. 882 Kohle pro Kilowatt verbrauchte. Die Verzinsung des Unterschieds zwischen den Kosten der beiden Anlagen vermindert den Unterschied der Ersparniss um 7½ prozent.

Die richtige Construktion und Benutzung von Economiseurs, von H. G. Brinckerhoff . . . . . [Seite 859.]

Der Economiseur soll ohne Gelenken in dem Mauerwerk bestehen; seine innere Oberflächen sollen zugänglich sein; die Verbindungen sollen durch Wasserdruck geschehen.

Aenderungen in der Bufalo-Niagara Falls Kraftübertragungs linie . . . . . [Seite 860.]

Die Zahl der Drähten wurde gedoppelt. Die Zahl der hinaufgehenden Umgestaltern in Niagara Falls wurde auf zehn gebracht, je von einer Fähigkeit von 1250 P. S. Die hinuntergehende Umgestalter welche sich in der Buffalo Strassenbahn-Kraftstation befinden, besitzen eine Fähigkeit von je 275 kw. und derer Zahl wnrde zu sechs vermehrt.

Wissenschaft. — Baukunst. — Erfindungen.

Vollständige Gattung von Untergestellen für elektrischen Strassenbahnenwagen . . . . . [Seite 861.]

Beschreibung von zwei einfachen und zwei doppelten Untergestellen für elektrischen Strassenbahnenwagen.

Neuliche Versuche von plastischen Schienenverbindungen. [Seite 862.]

Diese Versuche wurden durch die Staatsingenieuren der Regierung Neu-Süd-Wales unternommen, behufs Feststellung der Danerhaftigkeit der leitenden Eigenschaften von plastischen Schienenverbindungen.

Eine moderne Zahnradfabrik . . . . . [Seite 863.]

Beschreibung bedeutender Werke in Lynn, Mass., für den Guss und dass Schneiden von Stahlzahnräder und Triebeln.

Untergestell für schweren elektrischen Betrieb . [Seite 864.]

Beschreibung eines Untergestells welches nach dem für Dampfbahnen verwendeten gebaut ist, jedoch mit gewissen Aenderungen um es dem elektrischen Betriebe anwendbar zu machen. Das Untergestell wiegt 2268 kg. und wird auf 200 kg. schweren Rädern getragen.

Neuliche Verträge für Gussschweissverbindungen . [Seite 864.]

Betriebseröffnung einer elektrischen Strassenbahn in Bamberg, Deutschland . . . . . [Seite 865.]

Ein neuer Controler . . . . . [Seite 865.]

Beschreibung eines Controlers mit einer magnetischen Einrichtung versehen, für die Auslöschung der durch die Unterbrechung des Stromes verursachten elektrischen Bogen.

Strassenbahnlampen . . . . . [Seite 865.]

Dieser Artikel beschreibt das durch eine gewisse Bahn verwendete Verfahren, mittels welchem die Lampenfaser in solcher Weise geankert wird, dass die Schwingungen des Wagens sie nicht brechen, während die Ankerung die Faser nicht beeinträchtigt.

Schnellwirkender Umschalter für den Eisenbahndienst. [Seite 866.]

Beschreibung einer Reihe von Schaltbrettumschalter mit Doppelklinge für 500 Volt Ströme.

Reparaturen von Motortransformatoren . . . [Seite 866.]

Versuche von Bremsenschuhen . . . . . [Seite 867.]

Beschreibung eines Verfahrens für Versuche, und der während einer neulichen Untersuchung erzielten Erfolgen.

Mittheilungen über Strassenbahnen.

Mittheilungen von England . . . . . [Seite 868.]

Finanzieller Bericht der West End Street Railway Co. in Boston. [Seite 874.]

Die Gesammtzahl der während dem letzten Jahre durch diese Strassenbahn geführten Passagieren belief sich auf 196,332,239.

Table des Matières—Decembre 1897.

La construction du chemin de fer à caniveau de la Metropolitan Street Railway Company, New York . . [Page 825.]

Cette compagnie installe un réseau de tramway électrique à conducteur souterrain d'une longueur de 94 km. dans la ville de New York. L'article décrit le système d'une façon complète, à l'aide de nombreuses illustrations. Le canniveau est logé dans le milieu de la voie et a une profondeur de 775 mm. depuis le sol jusqu'à la base du béton. Le prix de revient de l'installation s'élève à une moyenne de $100,000 par mille de voie simple (310,000 frs. par kilomètre.) Le travail a été poussé d'une manière très rapide, et de façon à éviter toute interruption inutile du traffic sur la section la plus importante, un longueur de voie de 2 km. avant été complétée en 24 jours ouvriers. La compagnie construit pour la génération du courant une station de force motrice de 70,000 chevaux-vapeur au bord de la rivière, et le courant sera distribué d'après le système polyphasé à des convertisseurs rotatoires aux différentes parties de la ville.

La station consistera en 11 machines verticales du type cross compound à condensation, de 4000 chevaux-vapeur chaque, directement couplées à un alternateur triphasique de la même capacité. Les stations transformatrices seront au nombre de 8 ou 10.

Le tramway électrique d'Alexandrie, Egypte . [Page 834.]

Compte-rendu de l'inauguration, en Septembre dernier, du nouveau tramway dans cette ville. Le Kédive assistait à la cérémonie.

Service.

Moteurs de chemins de fer électriques. IV.—Enveloppes de moteurs, par G. T. Hanchett . . . . . [Page 835.]

L'auteur décrit la façon et les contours de tous les moteurs généralement employés aux États-Unis, y compris quelques-uns des types primitifs, et démontre comment et pourquoi certaines formes ont été préférées. La pratique moderne se prononce dans la direction d'une enveloppe hermétique des moteurs, bien qu'à un certain point de vue cet usage a lieu au détriment de la ventilation. Dans l'exploitation des chemins de fer élevés et autres systèmes qui le permettent, les moteurs sont laissés ouverts. L'augmentation de capacité qui résulte de cette addition à la ventilation est de grand avantage pour les moteurs de grande dimension exigeant une énergie considérable dans un espace restreint. L'auteur décrit également les progrès accomplis en rendant le moteur plus accessible et dans le graissage des accessoires.

Pleasure Bay, le lieu d'amusement desservi par le chemin de fer électrique d'Atlantic Coast Line . . . . [Page 840.]

Description d'un nouveau lieu d'amusement créé sur le bord de la mer par une compagnie de tramway électrique de New Jersey afin de stimuler le trafic. Les bâtiments se distinguent par de détails de construction originaux, et parmi les attractions se trouvent un théâtre flottant, des bateaux électriques, etc.

Caractéristiques financières et organisation administrative du système de transport accéléré à Brooklyn . . [Page 842.]

Description de l'organisation administrative de l'un des systèmes les plus étendus de tramways aux Etats Unis, sur lequel plus de 80,000,000 de voyageurs sont transportés par an, et dont les recettes durant le dernier exercice se sont élevées à près de $4,500,000. L'article est illustré par un diagramme indiquant les chefs d'administration et de divisions, dont les salaires s'élèvent à 1½ pour cent des recettes brutas. Il est aussi donné un tableau du personnel complet employé dans chaque division de la compagnie. Cet article présente une excellente illustration de la manière dont l'une des plus grandes administrations américaines est conduite.

Lettres et communications diverses.

Critique du mémoire du Dr. Emery sur "les machines pour la traction électrique" . . . . . [Page 845.]

Réponse faite par Charles E. Emery à une lettre publiée dans "l'Electrical Review" de Londre, faisant la critique de l'article paru dans le numéro d'Octobre du Street Railway Journal sur les machines pour la traction électrique. Le point principal soulevé etait que les machines pour tramways électriques à accouplement direct n'ont pas lieu d'être construites d'une solidité exceptionnelle pour résister à une répétition de chocs, ainsi que cela a lieu dans le service de traction électrique, attendu que les variations sont des réductions d'énergie du maximum, que par conséquent la torsion du cylindre et l'usure des parties sont moindres dans la charge maxima. Le Dr. Emery répond qu'un sucroît de charge subit est de nature à diminuer la vitesse. Le volant a naturellement une tendance à tordre le cylindre de la machine. D'un autre côté lorsque la charge est relâchée subitement, l'élasticité de la charge et le poids des parties mobiles produisent également des chocs, attendu que chaque pièce de métal transmettant la charge est jusqu'à un certain point un ressort. De même, les effort latéraux sont différents dans des charges lourdes de ceux dans les charges légères.

Le système de discipline du service civil, par George H. Davis. [Page 846.]

L'auteur appelle l'attention sur le fait que le système de discipline en usage sur la ligne de tramway de Canal et Claiborne à la Nouvelle-Orléans, décrit dans son mémoire lu devant l'Association Américaine de Tramways le mois dernier, n'est pas le système "Brown" tel qu'il est employé par les lignes à vapeur, mais un système propre à la compagnie, dont la caractéristique principale consiste dans l'émulation parmi les employés, assurant un service efficace.

Economies de stations centrales . . . . [Page 846.]

L'auteur s'occupe de l'assertion fait par N. H. Heft dans le numéro précédent du Street Railway Journal, qu'il pouvait produire de l'énergie à 4 mills par kilowatt-heure au moyen d'étincelles de locomotives, au coût de 70 cents par tonne, et fait mention de deux autres stations l'une produisant un kilowatt-heure au prix de 2.8 mills, avec du charbon coûtant $2.40 par tonne, et l'autre au prix de 3 mills avec du charbon coûtant $2.55 par tonne.

Perte de travail dans les ateliers . . . . . [Page 846.]

Communication envoyée sur la question de la perte de travail qui a lieu dans certains ateliers de réparation de tramways.

Jurisprudence . . . . . [Page 847.]

Articles de Fond.

La proportion d'unités de chaleur dans les stations d'énergie électrique . . . . . [Page 850.]

Machines pour la traction électrique . . . [Page 850.]

Le STREET RAILWAY JOURNAL *en 1898* . . [Page 850]

Le service postal sur les tramways électriques et funiculaires. [Page 851.]

La construction récente d'un tramway à conducteur souterrain à New York . . . . . [Page 851.]

La défense de la propriété municipal de tramways . [Page 853.]

Construction.

Instruments de contrôle dans les tableaux de distribution de centrales, par George Moffat . . . . [Page 854.]

L'auteur passe en revue les différentes formes de commutateurs, de rhéostats, de coupe-circuits, et de parafoudres employés dans les stations centrales de tramways électriques, les principes sur lesquels ils sont basés, et les meilleures méthodes de construction, d'installation et de surveillance.

Station de force motrice de Harvard, à Boston . [Page 856.]

Description d'une station de force motrice urbaine construite de manière à fournir á un moment donné une capacité de 7200 kw. Les machines sont du type cross compound, à condensation; les générateurs ont une capacité de 1200 kw. chaque, et sont actionnés directement. La station est pourvue d'une salle d'essais.

L'installation de la Marion City Railway Company . [Page 857.]

Description d'une ligne de banlieue traversant la région du gaz, et sur laquelle le gaz naturel est employé comme combustible. Les machines sont du type compound sans condenseur, et il y a deux générateurs de la capacité de 200 kw.

Réduction dans le prix de revient de la vapeur comme force motrice de 1870 à 1897, par F. W. Dean . . . . [Page 858.]

Les progrès les plus saillants accomplis dans cet intervale durant lequel la consommation de vapeur à été réduite de 9 kg. à 6 kg. par cheval-heure, sont attribués à l'introduction des machines compound, à l'emploi d'un détendeur sur le cylindre à basse pression, du surchauffer, et à des pressions plus élevées. Les économies à venir tendent dans la direction de l'emploi de machines verticales, de chaudières verticales à chauffage interne, d'économiseurs, de grilles perfectionnées et de vapeur surchauffée.

Essai comparatif de générateurs de chemins de fer accouplés directement ou par transmissions de courroies . [Page 859.]

Rapport d'un essai fait dans une station centrale de Chester, Pa. L'unité à accouplement direct consistait en une machine tendem compound á condensation de 20 et 36 x 48 pouces, actionnant un générateur de 800 kilowatts, et consommant 3 livres de charbon par kilowatt-heure. L'unité à transmission de courroie consistait en une machine monocylindrique de 22 x 42 pouces actionnant un generateur de 225 kilowatts, et consommant 3 libres 882 de charbon par kilowatt-heure. L'interêt résultant de la différence de coût de deux installations réduit la différence en économie de 7½ pour cent.

La propre construction et l'emploi des économiseurs, par H. G. Brinckerhoff . . . . . [Page 859.]

L'économiseur doit être construit de manière à ne posséder de joints dans l'intérieur de la maçonnerie, les surfaces internes doivent être accessibles; les joints doivent être faits par pression hydraulique.

Changements dans la ligne de transmission de Buffalo-Niagara Falls Power Co. . . . . . [Page 860.]

Le nombre de fils de fer a été doublé. Le nombre de transformateurs ascendants à Niagara Falls a été porté à dix, d'une capacité de 1250 chevaux chaque. Les transformateurs descendants dans la station d'énergie pour tramways à Buffalo sont en unités de 275 kw. chaque, et leur nombre a été porté à six.

Science — Génie — Inventions.

Une série complète de trucks pour tramways électriques. [Page 861.]

Description de deux trucks simples et de deux trucks à bogies pour tramways électriques.

Essais récents de joints de rails plastiques . . [Page 862.]

Description d'une série d'essais entrepris par les ingénieurs du gouvernement de la Nouvelle Galles du Sud afin de déterminer la durabilité de qualités conductrices de joints plastiques.

Une fabrique moderne d'engrenages . . . [Page 863.]

Description d'une usine importante de Lynn, Mass., pour la fabrication d'engrenages et de pignons en acier.

Contrats récents pour joints rivés . . . . [Page 864.]

Truck pour trafic électrique de grand transport . [Page 864.]

Description d'un truck construit d'après le modèle usuel de truck pour locomotive, avec quelques légères modifications afin de l'adapter au service de traction électrique. Le truck pèse 2268 kg. et est porté sur des roues du poids de 200 kg.

Ouverture de l'exploitation d'un tramway électrique à Bamberg, Allemagne . . . . ; . . . [Page 865.]

Lampes de tramways . . . . . [Page 865.]

Cet article décrit la méthode employée par une compagnie pour l'ancrage du filament de la lampe de façon à ce que les vibrations de la voiture ne le brisent pas, tout en empêchant que l'ancrage n'exerce aucune usure sur le filament de charbon.

Un nouveau contrôleur . . . . . [Page 865.]

Description d'un contrôleur muni d'un dispositif magnétique pour l'extinction des arcs électriques occasionnés par la rupture du courant.

Réparation de transformateurs de moteurs . . [Page 866.]

Interrupteur instantané pour le service des chemins de fer. [Page 866.]

Description d'une série d'interrupteurs de tableau de distribution à deux branches pour des circuits de 500 volts.

Essais de sabots de freins . . . . . [Page 867.]

Description d'une méthode d'essais et des résultats obtenu au cours d'une récente investigation.

Faits Divers.

Notes d'Angleterre . . . . . [Page 868.]

Rapport financier de la West End Street Railway Co., de Boston, [Page 874.]

Le nombre total de voyageurs transportés sur cette ligne électrique pendant l'année dernière s'est élevé à 196,332,239.

Lista de Materias—Diciembre 1897.

La construcción del tranvía á conductor subterráneo de la Metropolitan Street Railway Company, Nueva York . [Pág. 825.]

Esta compañía emprende la construcción en la ciudad de Nueva York de una red de tranvías eléctricos á conductor subterráneo de una longitud total de 94 km. El sistema está descrito detalladamente con muchas ilustraciones. El conducto está colocado en el centro de la vía, y tiene una hondura de 775 mm. del pavimento al fondo del betón. El coste de construcción es cerca de $100,000 por milla de vía simple (310,000 pesetas por km.) La instalación fué conducida muy rapidamente y para evitar la interrupción del tráfico en la sección más importante, una distancia de 2 km. fué concluida en 24 días de trabajo. Para la generación de la corriente la compañía construye cerca del río una estación de fuerza motriz de 70,000 caballos, y la corriente será distribuida por medio del sistema polifasico á los convertidores giratorios en varias secciones de la ciudad.

La estación constará de 11 máquinas verticales del tipo cross compound á condensación cada una de cuyas está directamente acoplada á un alternador trifasico de misma capacidad. Las estaciones de transformación serán al número de 8 á 10.

El tranvía eléctrico de Alejandria, Egipto . . [Pág. 834.]

Relación de la inauguración, en Setiembre, del nuevo ferrocarril eléctrico de esta ciudad. El Khédive fué presente á la ceremonía.

Operación.

Motores de ferrocarriles eléctricos. IV.—Envolventes de motores, por G. T. Hanchett . . . . . [Pág. 835.]

El autor describe la forma y la envolvente de todos los motores generalmente usados en los Estados Unidos incluyendo unos de los tipos primitivos, y demuestra como y porqué varias formas han sido más deseables. La práctica moderna se dirige hácia el cercamiento completo de los motores, aunque al sacrificio de la ventilación. En la explotación de ferrocarriles aéreos y otros servicios que lo permiten, las envolventes quedan abiertas. El aumento de capacidad asegurado por esa ventilación adicional es de gran ventaja en motores de mayor tamaño necesitando gran energia en un espacio limit do. Los progresos hechos en la construcción de motores y en el engrase de sus partes son descritos cabalmente.

Pleasure Bay, el lugar de diversión de la compañía de ferrocarril eléctrico Atlantic Coast Line . . . . [Pág. 840.]

Descripción de un nuevo lugar de diversión establecido por una compañía de tranvías eléctricos sobre la costa de New Jersey para estimular el tráfico. Los edificios contienen varias novedades de construcción y algunas de las atracciones constan en un teatro flotante, lanchas eléctricas, etc.

Detalles financieros y organización administrativa del sistema de transporte rápido de Brooklyn . . . [Pág. 842.]

Descripción de la organisación administrativa de uno de los más importantes sistemas de tranvías en los Estados Unidos, sobre

cuyo más de 80,000,000 viajeros fueron transportados durante el año pasado, las recetas brutas montando á cerca de $4,500,000. El artículo está ilustrado por un diagrama, indicando los jefes de administración y de departamentos, y mostrando que los salarios de esos oficiales representan 1½ por ciento de las recetas brutas. Es también dado un cuadro de los empleados de cada departamento de la compañía. Ese artículo es una excelente ilustración del modo de administración de una de las más considerables propiedades en los Estados Unidos.

Varias Comunicaciones.

Crítica de la relación del Dr. Emery sobre "máquinas para la tracción eléctrica" . . . . . [Pág. 845.]

Eso es una contestación por Charles E. Emery á una carta publicada en la "Electrical Review" de Londres, critisando el artículo en el número de Octubre del STREET RAILWAY JOURNAL sobre máquinas para estaciones de energía eléctrica. El autor menciona en primer lugar que las máquinas acopladas directamente no necesitan ser construidas de solidez especial para resistir á los choques encuentrados en la tracción eléctrica, pues las variaciones que occurren son reducciones de energía del máximo, y por consecuencia la torsión sobre el cilindro y la usura de las partes son menores con una carga variable que con una carga máxima. En contestación, el Sr. Emery sostiene que un aumento súbito de la carga disminuye la velocidad.

El volante naturalmente tiene una tendencia de torcer el cilindro de la máquina, y todas las partes móviles de ella son llevadas juntamento por el choque. Asimismo, cuando la carga está disminuida súbitamente, la elasticidad de la carga y el peso de las prrtes móviles producen igualmente choques, pues cada pedazo de material transmitado la carga es en un cierto sentido un resorte. Asimismo, los retorcimientos laterales son diferentes con cargas pesadas de los con cargas ligeras.

El sistema de disciplina del servicio civil, por George H. Davis. [Pág. 846.]

El autor llama la atención sobre el facto que el servicio de disciplina de la compañía Canal y Claiborne, descrito en su artículo leido antes la Asociación Americana de Tranvías el mes pasado no es el sistema de "Brown," empleado por ferrocarriles de vapor, sino un sistema especial de suyos, cuya parte principal consta en emulación entre empleados, segurando un servicio eficaz.

Economías en estaciones de fuerza motriz . . [Pág. 846.]

El autor se refiere á la aserción hecha por N. H. Heft en el último número del STREET RAILWAY JOURNAL, á saber, que puede producir energía á 4 mills por kilowatt-hora, por medio de centellas de locomotoras, al coste de 70 centavos por tonelada, y hace mención de dos otras estaciones, de cuyas la primera produce una kilowatt-hora para 2.8 mills, con carbón al coste de $2.40 por tonelada, y otra por 3 mills, con carbón al coste de $2.55 por tonelada.

Desperdicio de tiempo en talleres de reparación . [Pág. 846.]

Informe demonstrando como empleados de talleres de reparación frecuentemente malgastan tiempo.

Jurisprudencia. . . . . . [Pág. 847.]

Artículos de la Redacción.

La proporción de unidades de calor en las estaciones de fuerza eléctrica . . . . . [Pág. 850.]

El STREET RAILWAY JOURNAL *en 1898* . . [Pág. 850.]

El servicio de correos sobre los tranvías eléctricos y de cable. [Pág. 851.]

Sobre la reciente construcción de tranvías á tracción subterránea en Nueva York . . . . . [Pág. 851.]

Máquinas para la tracción eléctrica . . . [Pág. 852.]

La defensa de la propiedad municipal de tranvías . [Pág. 853.]

Construcción.

Aparatos contralores de los cuadros de distribución en estaciones centrales, por George Moffat . . . [Pág. 854.]

El autor trata de los varios modos de llaves, reóstatos, cortacircuitos, y pararrayos usados en estaciones de fuerza de ferrocarriles eléctricos, de los principios de cuyos están dependientes, y de los mejores métodos de construcción, instalación y conservación.

Estación de fuerza motriz de Harvard, á Boston . [Pág. 856.]

Descripción de una estación de fuerza motriz urbana, diseñada para una capacidad final de 7200 kw. Las máquinas son del tipo cross-compound á condensación; los generadores tienen una capacidad de 1200 kw. cada uno, y son accionados directamente. La estación está provista con una sala de ensayo.

Instalación de la Marion City Railway Company . [Pág. 857.]

Descripción de una línea suburbana atravesando la régión del gas, y sobre la cual gas natural está usado como combustible. Las máquinas son del tipo compound sin condensación, y hay dos generadores de la capacidad de 200 kw.

Reducción en el coste de fuerza motriz de vapor desde 1870 hasta 1897, por F. W. Dean . . . . . [Pág. 858.]

Las mayores mejoras efectuadas en este intervalo, durante lo cual el consumo de vapor fué reducido de 9 kg. á 6 kg. por caballo-hora, son consideradas de ser la introducción de máquinas compound, el uso de un interruptor sobre el cilindro de baja presión, él recalentador y más altas presiones. Las economías del porvenir van en la dirección de máquinas verticales, de calderas verticales con quema interna, economisadores, parrillas perfeccionadas, y vapor sobrecalentada.

Ensayo comparativo de generadores de ferrocarriles directamente acoplados y con transmisión de correas . . [Pág. 859.]

Relación de un ensayo hecho en una estación de fuerza motriz á Chester, Pa. La unidad de la instalación de acoplamiento directo constaba de una máquina tandem compound de condensación de 20 y 36 x 48 pulgadas, accionada por un generador de 800 kw., con 3 libras de carbón por kilowatt-hora. La instalación con transmisión de correas constaba de una máquina de un cilindro de 22 x 42 pulgadas, accionando un generador de 225 kw., con 3 libras 882 de carbón por kilowatt-hora. El interés de la diferencia en el coste de ambas instalaciones reducirá la diferencia en economía de 7½ por ciento.

La propia construcción y uso de economisadores, por H. G. Brinckerhoff . . . . . [Pág. 859.]

El economisador no debe tener juntas dentro del enladrillado; sus sobrefases internas deben ser de facil aceso, las juntas deben ser hechas por medio de presión hidráulica.

Cambios en la línea de transporte de fuerza motriz de Buffalo-Niagara Falls . . . . . [Pág. 860.]

El número de alambres ha sido doblado. El número de transformadores ascendentes á Niagora Falls ha sido alzado hasta diez, cada uno de la capacidad de 1250 caballos. Los transformadores descendentes en la estación de fuerza motriz del tranvía de Buffalo son en unidades de 275 kw. cada uno, y su número ha sido aumentado hasta seis.

Ciencia. — Ingenieria. — Invenciones.

Una serie completa de carretones para tranvías eléctricos. [Pág. 861.]

Descripción de dos carretones simples y de dos carretones dobles para tranvías eléctricos.

Ensayos recientes de juntas de carriles plásticas . [Pág. 862.]

Relación de unos ensayos hechos por los ingenieros del gobierno de Nueva Gales del Sur, al fin de determinar la durabilidad de las calidades conductivas de juntas plásticas.

Una maquinista moderna de engranajes . . [Pág. 863.]

Descripción de talleres importantes á Lynn, Mass., para la fundición y cortadura de engranajes y piñiones de acero.

Carretón para servicio eléctrico pesado . . . [Pág. 864.]

Descripción de un carretón construido según el tipo de carretones de locomotoras de vapor, aunque algunos cambios han sido introducidos para adaptarlo al servicio de ferrocarriles eléctricos. El peso del carreton es de 2268 kg., y va colocado sobre ruedas del peso de 200 kg.

Recientes contractos para juntas hechas ascua . . [Pág. 864.]

Lámparas de tranvías . . . . . [Pág. 865.]

Este artículo describe el método empleado por una compañía para ancorar los filaméntes de lámparas de manera que las vibraciones del coche no causan su rotura, mientras que el anclage no puede consumir el filamento de carbón.

Inauguración de un tranvía eléctrico en Bamberg, Alemania. [Pág. 865.]

Un nuevo contralor. . . . . . [Pág. 865.]

Descripción de un contralor provisto con un procedimiento magnetico para extinguir los arcos eléctricos causados por la rotura de la corriente.

Conmutador instantáneo para el servicio de ferrocarriles. [Pág. 866.]

Descripción de una serie de conmutadores de cuadro de distribución, con dos hojas, para circuitos de 500 volts.

Reparación de transformadores de motores . . [Pág. 866.]

Ensayos de zapatas de frenos . . . . . [Pág. 867.]

Descripción de un método de ensayos, y de los resultados obtenidos en una reciente pesquisa.

Novedades.

Notas de Inglaterra . . . . . [Pág. 868.]

Relación financiera de la West End Street Railway Co., de Boston. [Pág. 874.]

El número total de viajeros transportados por esta línea eléctrica durante el año pasado fué de 196,332,239.

Financial Notes.

Akron, O.—It is reported that the Akron Street Railway & Illuminating Company has purchased the Akron & Cuyahoga Falls Rapid Transit Company's line, which extends from Kent to Barberton, a distance of 20 miles, the purchase price being $400,000.

Auburn, Me.—At a joint convention of the city government recently the first step was taken in the proposed electric railway to Turner. This road will be a link in the electric road projected by the syndicate composed of Amos F. Gerald, of Fairfield; I. C. Libby, of Waterville; H. F. Twitchell and Galen C. Moses, of Bath, and Herbert M. Heath, of Augusta. At the meeting an order was introduced authorizing the location and construction of the line from the terminus of the Lewiston & Auburn Electric Railway in Auburn to Turner. Mr. Libby is reported as stating that in the spring the road will be built from Lewiston to Brunswick and Bath, with branches to Small Point and other places, including an extension to Portland.

Baltimore, Md.—The Baltimore & Northern Electric Railway Company has filed a mortgage for $1,250,000 to the Maryland Trust Company, as trustee, to secure an issue of $1,250,000 fifty year 5 per cent gold bonds, dated Nov. 1, 1897. The money is to be used in paying off debts and extending the company's system.

Bloomington, Ill.—The pending application for a receiver for the Bloomington City Railway Company will be withdrawn.

Boston, Mass.—The report of the parties who are appraising the assets of the West End Street Railway, preparatory to the Railroad Commissioners authorizing a lease to the Boston Elevated Railroad and the issuance of elevated railroad securities, will be favorable to the West End. It is stated the committee has found assets more than sufficient to cover all outstanding securities.

Brockton, Mass.—The Brockton, Bridgewater & Taunton Street Railway Company has declared a semi-annual dividend of 3 per cent.

Brooklyn, N. Y.—Arrangements have been made by the managers of the Brooklyn City & Newtown and the Coney Island & Brooklyn Railroad Companies to consolidate the two roads. The plan is to lease the Brooklyn City & Newtown to the Coney Island & Brooklyn, which will be the operating company. The two systems are now practically controlled by the same men. The new lease will have to be ratified by the stockholders.

JUSTICE WILMONT M. SMITH, of the Supreme Court, has appointed J. H. Frothingham permanent receiver of the Kings County Elevated Railway in foreclosure proceedings to succeed James Jourdan, who was made temporary receiver over a year ago.

Charleston, S. C.—At a recent meeting of the stockholders of the Charleston Street Railway Company a proposition to issue fifty-year five per cent gold coupon bonds to the amount of $850,000, and to secure the same by a mortgage of all the property and franchises of the company, was agreed upon.

Chicago, Ill.—The West Chicago Street Railroad Company has declared a quarterly dividend of 1½ per cent. payable November 15.

Dallas, Tex.—Judge Smith has granted an order authorizing a foreclosure of the $350,000 bonds of the Dallas City Street Railway Company, held by the Mercantile Trust & Deposit Company, of Baltimore.

Haverhill, Mass.—The Plum Island Electric Street Railway Company has made application for authority to issue $30,000 of original stock for the purpose of substituting electricity for horse power on its system and extending its lines.

Indianapolis, Ind.—The assets of the Indianapolis, Anderson & Marion Electric Railway Company, with the exception of the power houses at Fairmount and Alexandria and the ties furnished by the Loud Lumber Company, have been sold at receiver's sale to Noah J. Clodfelter, who represents a reorganized company. The amount of the bid was $5000, with arrangements for the settlement of $80,000 worth of claims by the issue of stock in the new company, which is capitalized at $500,000. The directors of the new company are: L. N. Downs, of Battle Creek; C. S. Cleaver and R. H. Davidson, of Chicago; W. R. Pierson, of Fairmount, Ind., and Frank Maus and Judge Bartholomew, of Indianapolis.

JUDGE BROWNLEE has issued an order directing a sale of all the assets of the Indianapolis, Anderson & Marion Railway Company on November 15, with the exception of the power houses at Fairmount and Alexandria, and the ties furnished by the Loud Lumber Company.

Ithaca, Mich.—At a recent meeting of those interested in the construction of the proposed electric railway from Ithaca to Lansing, a committee was appointed, consisting of M. V. Montgomery, F. L. Dodge, C. C. Vaughan and Geo. P. Stone, with instructions to draw up articles of incorporation. As soon as the company is formed the route will be decided upon and the plans for the construction of the road formulated.

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Jersey City, N. J.—It is reported that the Consolidated Traction Company has leased the lines of the Passaic & Newark Electric Traction Company.

Lincoln, Neb.—The Lincoln Street Railway will be sold under foreclosure on Dec. 10, by order of the United States Circuit Court, on complaint of the New York Security & Trust Company.

Mount Vernon, N. Y.—It is announced that John H. Starin, owner of Glen Island, and others, have decided to build an electric railway from Mt. Vernon to the Glen Island dock, and that application for a franchise has been made.

New York, N.Y.—The Fulton, Wall & Cortlandt Street Ferries Railroad Company's property and franchises will be sold at auction on Dec. 2, by L. J. Phillips & Company, at the New York Real Estate Salesroom, 111 Broadway, in foreclosure proceedings on the application of the Central Trust Company.

THE directors of the Third Avenue Railroad Company have declared a quarterly dividend of $2 per share.

Norfolk, Va.—Negotiations are pending for the purchase of the Norfolk Street Railway Company's property and franchises by a syndicate of Baltimore and Richmond capitalists, headed by John L. Williams, of Richmond. The syndicate, it is stated, proposes to purchase in addition the Norfolk & Ocean View Railroad, and the Norfolk, Willoughby & Old Point Railroad and ferry.

Pittsburgh, Pa.—The West End Traction Company has been incorporated with a capital stock of $15,000, by J. C. Reilly, W. J. Burns, Thomas G. Bigelow, J. D. Callery and W. V. Callery, of Pittsburgh.

Pittsfield, Mass.—W. D. Winter, of Springfield, and John C. Hammond, of Northampton, are interested in the proposed electric railway from Pittsfield to Northampton.

Port Jervis, N. Y.—At a recent meeting of the Port Jervis Electric Railroad Company an issue of $70,000 in bonds was authorized.

Quincy, Mass.—The Quincy & Boston Street Railway Company is seeking permission to extend its lines to Braintree.

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See page 85.

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Racine, Wis.—A number of well known Racine capitalists who have been discussing the feasibility of organizing a company for the purpose of constructing an electric railway from Racine to Waterford by way of Union Grove and Burlington, recently held a meeting at which it was decided to take steps to organize a company, secure the right of way during the winter, that all might be in readiness to commence work in the early spring.

A MORTGAGE has been filed by the Belle City Railway Company in favor of the Illinois Trust & Savings Bank, of Chicago, for $250,000, covering all the property of the company. Of this amount $225,000 is to pay the purchase price of the road which was bought by Frank J. Miller at receiver's sale. The other $25,000 will be used for improving the road.

Rockford, Ill.—James S. Ticknor, of Rockford, has disposed of his interest in the franchise and right of way in the proposed Rock River Electric Railway from Rockford to Dixon to the syndicate, which, it is said, will build the line in the early spring. John Farson, of Chicago, and Congressman Aiken, of Flint, Mich., are among its backers. E. M. Hopkins, of Chicago, is to be the president; J. S. Ticknor, of Rockford, secretary, and Mayer Schneider, of Oregon, treasurer of the new company. The company is now completing the right of way.

Sherman, Tex.—A deal has been consummated by which the Sherman City Street Railroad, the Electric Belt Railway and the Denison Street Electric Railway have passed into the hands of J. McGeagh, representing an Eastern syndicate. Mr. McGeagh states that he has in addition to the above property purchased 200 acres of land lying between Sherman and Denison and that his company, which will be known as the Sherman & Denison Twin City Electric Rapid Transit Company, will within thirty days commence the work of re-equipping and extending these lines in the two cities and connecting them with a double track, the whole to be operated by electricity. The company will open a county fair ground, race track and park.

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Sing Sing, N. Y.—Justice J. F. Barnard, at a Special Term of the Supreme Court, held at Poughkeepsie recently, appointed John V. Cockcroft as receiver of the Ossining Electric Railway Company, on motion of Abram S. Underhill, attorney for the complainant, John P. Truesdell. By the terms of the appointment the receiver is to file bonds in the sum of $10,000, and is directed to continue the operation of the road pending further orders of the Court. It is understood that the placing of the road in the hands of a receiver is a preliminary step to the reorganization of the concern on a plan which will include an extension of the line to other villages in the county.

Staten Island, N. Y.—The Princess Bay Railroad Company has been granted a franchise to build an electric railway from the Staten Island Railroad station on Princess Bay to the Princess Bay shore in Richmond County, a distance of 1½ miles. The directors of the company are Seymour Case and G. S. Barnes, of Tottenville; A. W. Browne, G. L. Harrison and W. A. Johnston, of Princess Bay, and A. W. Johnston, of New Brighton.

Electric Turn-Tables

The Baltimore & Southwestern Railway has been experimenting with electric motors on turn-tables. Turning locomotives at divisional points and terminals is a service of much annoyance and no little expense to railroad companies. It generally takes four men to turn a locomotive, and while they are doing so their regular work is abandoned. Experiments were made with an electric motor on the 60-ft. turn-table at Chillicothe with such success that the Park Street turn-table at Cincinnati was similarly equipped. The result has been rather astonishing in the matter of expense. The current was purchased from the power plant and it cost on an average of less than one-half a cent for each time the table was turned. When this same table was operated by hand it cost 12 cents for each engine. The yearly saving is about $709.

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